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2021 EDITION

SIGNIFICANT CHANGES to the International Building Code®

Douglas W. Thornburg, AIA, CBO
Sandra Hyde, P.E.
Jay Woodward



ICC INTERNATIONAL CODE COUNCIL®

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SIGNIFICANT CHANGES TO THE

INTERNATIONAL BUILDING CODE®

2021 EDITION

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2021 EDITION

International Code Council

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Preface

The purpose of *Significant Changes to the International Building Code® 2021 Edition* is to familiarize building officials, fire officials, plans examiners, inspectors, design professionals, contractors and others in the construction industry with many of the important changes in the 2021 *International Building Code®* (IBC®). This publication is designed to assist those code users in identifying the specific code changes that have occurred and, more importantly, understanding the reasons behind the changes. It is also a valuable resource for jurisdictions in their code-adoption process.

Only a portion of the total number of code changes to the IBC are discussed in this book. The changes selected were identified for a number of reasons, including the frequency of application, special significance or change in application. However, the importance of those changes not included is not to be diminished. Further information on all code changes can be found in the *Complete Revision History to the 2021 I-Codes,* available from the International Code Council® (ICC®) online store. The revision history provides the published documentation for each successful code change contained in the 2021 IBC since the 2018 edition.

The IBC discussion in this publication addressing significant code changes is organized into eight general categories, each representing a distinct grouping of code topics. It is arranged to follow the general layout of the IBC, including code sections and section number format. The table of contents, in addition to providing guidance in the use of this publication, allows for the quick identification of the significant code changes that occur in the 2021 IBC.

This edition of *Significant Changes to the International Building Code* includes a ninth part that addresses a limited number of selected code changes that occur in the 2021 edition of the *International Existing Building Code®* (IEBC®). Applicable to all existing buildings, the IEBC is intended to provide flexibility to permit the use of alternative approaches to achieve compliance with minimum requirements to safeguard the public health, safety and welfare. Both structural and nonstructural changes are addressed in Part 9 of this publication.

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Throughout the book, each change is accompanied by a photograph, an application example or an illustration to assist and enhance the reader's understanding of the specific change. A summary and a discussion of the significance of the changes are also provided. Each code change is identified by type, either an addition, modification, clarification or deletion.

The code change itself is presented in a format similar to the style utilized for code-change proposals. Deleted code language is shown with a strike-through, and new code text is indicated by underlining. As a result, the actual 2021 code language is provided as well as a comparison with the 2018 code language, so the user can easily determine changes to the specific code text.

As with any code-change text, *Significant Changes to the International Building Code, 2021 Edition* is best used as a study companion to the 2021 IBC. Because only a limited discussion of each change is provided, the code itself should always be referenced to gain a more comprehensive understanding of the code change and its application.

The commentary and opinions set forth in this text are those of the authors and do not necessarily represent the official position of the ICC. In addition, they may not represent the views of any enforcing agency, as such agencies have the sole authority to render interpretations of the IBC. In many cases, the explanatory material is derived from the reasoning expressed by the code-change proponent.

Comments concerning this publication are encouraged and may be directed to the ICC at significantchanges@iccsafe.org.

About the *International Building Code*

Building officials, design professionals and others involved in the building construction industry recognize the need for a modern, up-to-date building code addressing the design and installation of building systems through requirements emphasizing performance. The *International Building Code* (IBC), in the 2021 edition, is intended to meet these needs through model code regulations that safeguard public health and safety in all communities, large and small. The IBC is kept up to date through the open code-development process of the International Code Council (ICC). The provisions of the 2018 edition, along with those code changes approved in the most recent code development cycle, make up the 2021 edition.

The International Code Council (ICC), publisher of the IBC, was established in 1994 and is a nonprofit association that provides a wide range of building safety solutions including product evaluation, accreditation, certification, codification and training. The ICC develops model codes and standards used worldwide to construct safe, sustainable, affordable and resilient structures. The ICC's mission is to provide the highest-quality codes, standards, products and services for all concerned with the safety and performance of the built environment.

The IBC is one of 15 International Codes® (I-Codes®) published by the ICC. This comprehensive building code establishes minimum regulations for buildings systems through prescriptive and performance-related provisions. It is founded on broad-based principles that make possible

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the use of new materials and new building designs. The IBC is available for adoption and use by jurisdictions internationally. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference, in accordance with proceedings established by the jurisdiction's laws.

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Douglas W. Thornburg is currently Vice President and Technical Director of Products and Services for the International Code Council (ICC), where he provides administrative and technical leadership for the ICC product development activities. Prior to employment with ICC in 2004, he spent 9 years as a code consultant and educator on building codes. Doug also spent 10 years with the International Conference of Building Officials (ICBO), where he served as Vice President/Education. He began his career with the City of Wichita, Kansas where he had inspection, plan review, and building administration responsibilities.

In his current role, Doug also continues to create and present building code seminars nationally and has developed numerous educational texts and resource materials. He was presented with the ICC's inaugural Educator of the Year Award in 2008, recognizing his outstanding contributions in education and training.

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Prior to the ICC, Sandra worked for Weyerhaeuser in the research and development of engineered lumber products. She has a master's degree in Structural Engineering from Portland State University and is a Registered Civil Engineer in Idaho and California. She has authored and reviewed many support publications, including *Significant Changes to the International Residential Code*, *Special Inspection Manual* and, in conjunction with the APA, *A Guide to the 2018 IRC Wood Wall Bracing Provisions.*

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Jay Woodward is a Senior Staff Architect with the ICC's Business and Product Development department. With more than 38 years of experience in building design, construction, code enforcement and instruction, Jay's current position involves developing publications and seminars in support of the *International Building Code*. Jay has previously served as the Secretariat for the ICC A117.1 standard committee, the ICC's *International Energy Conservation Code*, and the *International Building Code* Fire Safety Code Development committees.

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Kevin was a member of the original IFC Drafting Committee that worked to create the first edition of the IFC. He served for 7 years on the IFC Code Development Committee and was the chairperson of the committee from 2001 to 2004. Kevin has actively participated in numerous technical committees to evaluate specific hazards and technologies and to create regulations specific to those hazards.

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Buddy Showalter is a Senior Staff Engineer with the ICC's Product Development group. He develops technical resources in support of the structural provisions of the *International Building Code* and *International Residential Code*. Buddy reviews publications authored by the ICC and engineering groups, while also developing publications and technical seminars on the structural provisions of the I-Codes for building departments, design engineers and special inspectors. He was the project lead in the development of the publication *Mass Timber Buildings and the IBC* as well as associated education programs, jointly developed by the ICC and the American Wood Council (AWC).

A graduate of Virginia Tech, Buddy has been a member of the Editorial Board for *STRUCTURE* magazine for over 15 years. Prior to joining the ICC, he spent 26 years with the AWC where he oversaw its technology transfer program with oversight responsibility for publications, website, helpdesk, education and other technical media. Buddy has more than 34 years of experience in development and support of building codes and standards, publishing over 60 technical articles for industry-related trade journals.

Beth Tubbs, P.E., FSFPE
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Beth Tubbs is a Senior Staff Engineer with the ICC's Codes and Standards Development department. She has 25 years of experience in codes and standards development and the associated support documents such as the IBC and IFC commentary. Beth has also represented the ICC in various national and international activities such as the SFPE Design Fire Standard Development Committee and the ASME A17.1 Code Correlation Committee. She is the staff secretariat for the *International Existing Building Code* and the *International Fire Code*. In addition, Beth is currently the lead staff on the ICC Fire Code Action Committee, which works to develop technically relevant proposals to the I-Codes related to fire and life safety requirements.

Beth has a bachelor's in civil engineering from Worcester Polytechnic Institute (WPI) and a master's degree in Fire Protection Engineering from WPI. She is a Fellow of the Society of Fire Protection Engineers (SFPE) and a member of the Board of Directors for the Society. She holds a professional fire protection engineering license in the Commonwealth of Massachusetts and the State of California.

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About the International Code Council®

The International Code Council is a nonprofit association that provides a wide range of building safety solutions including product evaluation, accreditation, certification, codification and training. It develops model codes and standards used worldwide to construct safe, sustainable, affordable and resilient structures. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance, fostering safe and sustainable design and construction.

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PART 1

Administration

Chapters 1 and 2



- **Chapter 1** Scope and Administration
- **Chapter 2** Definitions

The provisions of Chapter 1 address the application, enforcement and administration of subsequent requirements of the code. In addition to establishing the scope of the *International Building Code*® (IBC®), the chapter identifies which buildings and structures come under its purview. A building code, as with any other code, is intended to be adopted as a legally enforceable document to safeguard health, safety, property and public welfare. A building code cannot be effective without adequate provisions for its administration and enforcement. Chapter 2 provides definitions for terms used throughout the IBC. Codes, by their very nature, are technical documents, and as such, literally every word, term and punctuation mark can add to or change the meaning of the intended result. ■

CHAPTER 1

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Chapter 1

Format of Administrative Provisions

CHANGE TYPE: Clarification

CHANGE SUMMARY: Numerous revisions in format have occurred in *International Building Code* (IBC) Chapter 1 in order to provide for consistent language throughout the administrative provisions found in each of the International Codes® (I-Codes®).

2021 CODE TEXT:

SECTION 103
~~DEPARTMENT OF BUILDING SAFETY~~ CODE COMPLIANCE AGENCY

103.1 Creation of enforcement agency. The ~~Department of Building Safety~~ [INSERT NAME OF DEPARTMENT] is hereby created and the official in charge thereof shall be known as the building official. The function of the agency shall be the implementation, administration and enforcement of the provisions of this code.

103.2 Appointment. The building official shall be appointed by the chief appointing authority of the jurisdiction.

103.3 Deputies. In accordance with the prescribed procedures of this jurisdiction and with the concurrence of the appointing authority, the building official shall have the authority to appoint a deputy building official, ~~the~~ other related technical officers, inspectors~~, plan reviewers~~ and other employees. Such employees shall have powers as delegated by the building official. ~~For the maintenance of existing properties, see the International Property Maintenance Code.~~



Photo courtesy of the City of Folsom, California, Building Services Department

Front counter at building department.

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SECTION 107
~~SUBMITTAL~~ CONSTRUCTION DOCUMENTS

SECTION 113
~~BOARD~~ MEANS OF APPEALS

113.1 General. In order to hear and decide appeals of orders, decisions or determinations made by the building official relative to the application and interpretation of this code, there shall be and is hereby created a board of appeals. The board of appeals shall be appointed by the applicable governing authority and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business and shall render all decisions and findings in writing to the appellant with a duplicate copy to the building official.

113.2 Limitations on authority. An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an ~~equally good~~ equivalent or better form of construction is proposed. The board shall not have authority to waive requirements of this code or interpret the administration of this code.

113.3 Qualifications. The board of appeals shall consist of members who are qualified by experience and training to pass on matters pertaining to building construction and are not employees of the jurisdiction.

113.4 Administration. The building official shall take immediate action in accordance with the decision of the board.

(These are several examples of extensive format and text changes that establish consistent language throughout the administrative provisions of Chapter 1 in each of the I-Codes.)

CHANGE SIGNIFICANCE: Chapter 1 of the IBC, as well as the other I-Codes, provides guidance in both the administration of the code compliance agency and the application of the technical provisions found within the codes. Establishment of departmental duties and responsibilities includes those related to the issuance of permits, the review of submittal documents, the inspection of buildings and other activities that ensure compliance with the code. In addition, the application of the code requirements as related to scope and intent, interpretations and policies, alternate methods and materials, and the relationship of codes and referenced standards is set forth. Numerous revisions in format have occurred in the IBC in order to provide for consistent language throughout the Chapter 1 administrative provisions found in each of the I-Codes.

Although each of the I-Codes has unique provisions established in Chapter 1 to address the administration and application functions specific to the scope of the individual code, many other provisions are consistent throughout the various I-Codes. It is well recognized that the ICC develops and publishes a broad "family of codes" to address the needs of jurisdictions in the regulation of buildings and structures.

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It is therefore appropriate to provide as much consistency as possible in the application of all of the I-Codes, as most administrative and enforcement matters are the same for any code. While those matters unique to a specific code have typically remained unchanged, a number of editorial and organizational changes have been made to the administrative chapter (Chapter 1) in each of the I-Codes.

In an effort to provide consistency in presentation, a template was developed for each of the areas being revised. As an example, in Section 103 the section title "Code Compliance Agency" has replaced various terms that have been used in various I-Codes to identify the jurisdictional agency assigned to enforce the code. In the IBC, this agency was previously described as the Department of Building Safety; in the *International Fire Code* (IFC), it has been the Department of Fire Prevention; in the *International Mechanical Code* (IMC), it was the Department of Mechanical Inspection; and so on. The new terminology is generic in nature to represent the inclusion of all aspects of the code administration function under one agency.

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110.3.5

Type IV Connection Protection

CHANGE TYPE: Addition

CHANGE SUMMARY: A new inspection has been established, applicable only to Type IV-A, IV-B and IV-C construction, that deals with connections where fire-resistance is provided by wood cover.

2021 CODE TEXT: **110.3.5 Type IV-A, IV-B and IV-C connection protection inspection.** In buildings of Type IV-A, IV-B and IV-C construction, where connection fire-resistance ratings are provided by wood cover calculated to meet the requirements of Section 2304.10.1, inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.

CHANGE SIGNIFICANCE: The inspection function is arguably the most critical aspect of building department operations. As the construction process moves forward, specified inspections of the work being done must be completed prior to such work becoming concealed and inaccessible for evaluation. A listing of the required inspections, where applicable, begins with a potential preliminary inspection and continues through various stages of the work, ending with a final inspection. The scope of each inspection is indicated and the extent of work to be available for inspection is provided. A new inspection has been established, applicable only to mass timber construction of Types IV-A, IV-B and IV-C, that deals with connections where fire-resistance is provided by wood cover.

Connections of structural members, and their protection to achieve a fire-resistance rating, represent a significant component of mass timber buildings' structural integrity, and therefore warrant a specific new



Photo courtesy of American Wood Council

Wood cover protection of structural member connections to achieve a fire-resistance rating.

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requirement for building department inspections. Special inspections are not required for this aspect of construction as this field inspection process does not require any special expertise nor special tools for testing that are outside the day-to-day work of building inspectors. These new requirements are parallel to, and generally the same as, the inspection of fire-resistive protection for connections of traditional heavy timber that have been done in the course of building department inspections for more than 100 years. This mandate does not preclude the building official from requiring special inspections in special cases as established in Section 1705.1.1.

It is likely that designers will choose to overlay wood connections using additional wood cover that will protect the underlying wood and steel. This additional thickness of wood can be provided by oversizing the structural element or by adding a collar or other architectural embellishment at the connection. For oversized wood structural elements, the inspector will need to check the approved building plans to determine the required dimensions of the oversized structural element to be used to meet the fire-resistance rating. Where the plans indicate the addition of wood members to protect the connection, the inspector will need to verify that the additional wood members are in place and meet the minimum dimensions set forth in the approved construction documents.

Section 110.3.5, now reformatted as Section 110.3.6, has historically required the inspection of gypsum board when used as a component of fire-resistance-rated assemblies. The connection being protected may be steel-to-mass timber, concrete-to-mass timber, or any other combination of materials. Gypsum board is assigned a fire-resistance-rating time based on board thickness and other performance properties of the product, such as a Type X certification. When the connection protection calls for the addition of gypsum board to add fire-resistance time, the thickness, number of layers and other properties should be inspected.

It is also possible for additional material added at the connection location to be a combination of both gypsum board and wood. Architecturally, the designer may choose to add a $^{5}/_{8}$-inch Type X gypsum board collar, which is equivalent to 40 minutes of protection, and cover it with a layer of wood trim equivalent to 20 minutes of protection, thus providing 1 hour of protection at the connection location.

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110.3.7

Inspection of Weather-Exposed Balconies

CHANGE TYPE: Modification

CHANGE SUMMARY: The inspection currently required for certain weather-exposed balcony and walking surface waterproofing has been modified through the introduction of the defined term "weather-exposed surfaces."

2021 CODE TEXT: ~~**110.3.6**~~ **110.3.7 Weather-exposed balcony and walking surface waterproofing.** Where balconies or other elevated walking surfaces ~~are exposed to water from direct or blowing rain, snow or irrigation~~ have weather-exposed surfaces, and the structural framing is protected by an impervious moisture barrier, all elements of the impervious moisture barrier system shall not be concealed until inspected and approved.

> **Exception:** Where special inspections are provided in accordance with Section 1705.1.1, Item 3.

CHANGE SIGNIFICANCE: For most buildings, there are a number of inspections mandated by the code that are required to be made during the construction process. Starting with the footing/foundation inspection, followed by framing and other applicable inspections, and finishing with the final inspection, the work is evaluated for compliance with the code while visible and accessible. In some cases, additional inspections are required to address unique conditions where compliance is deemed critical. Examples include inspections of fire- and smoke-resistant penetrations, as well as a variety of special inspections set forth in Chapter 17. The scope of the inspection for weather-exposed balcony and walking surface waterproofing, mandated where applicable, has been modified through the introduction of the defined term "weather-exposed surfaces."



Photo courtesy of PPAMPicture

Balconies depicted are considered "weather-exposed".

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The reference to a currently defined term accomplishes two things: 1) it allows for a more consistent application of the code through specified conditions under which exterior surfaces are not considered exposed to the weather, and 2) it deletes the inspection where the only water exposure concern is due to irrigation.

Balconies and similar elevated walking surfaces that are exposed to moisture from rain and snow are subject to potential structural damage where an impervious moisture barrier provides protection of the structural members. It is vitally important that the construction methods used in the protection of the members from such damage due to extended exposure to water be compliant with all applicable code provisions. Therefore, the code specifically mandates an inspection of the waterproofing that is provided for any elevated exterior walking surfaces. The extent of what constitutes an exterior condition that must be inspected has been modified to refer to only those surfaces that are considered by definition to be weather-exposed.

The regulation of weather-exposed surfaces has historically been focused on the use of gypsum construction in exterior applications. In fact, prior to the definition's move to Chapter 2 in the 2012 edition of the IBC, it was located in Chapter 25 dealing with gypsum board and plaster. The definition identifies those exterior locations where the potential exposure to weather is not likely to be an issue, such as ceilings, roof soffits and walls that are protected in some manner. The allowances recognized in the definition are now also applicable in the determination of whether an inspection is required for those exterior balconies and walking surfaces where the structural framing is protected by an impervious moisture barrier.

Per the definition, an exterior surface is considered as weather-exposed unless one of three conditions exist. Since these conditions only reference walls, ceilings and balconies, it will be necessary to provide a degree of equivalency when determining the protection potential of walking surfaces. For example, a wall beneath an unenclosed roof area is not considered as weather-exposed provided the wall is located a horizontal distance from an exterior opening equal to no less than twice the height of the opening. Thus, a balcony floor that is roofed above with a vertical clearance of 8 feet could be considered as weather-exposed unless it is located at least 16 feet inside the leading edge of the roof line.

The use of the definition for scoping purposes also modifies what water sources are subject to regulation. Because the definition specifically refers to surfaces exposed to the weather, the required inspection is no longer mandated where irrigation features, primarily lawn sprinkler systems, are the sole source of water exposure to the elevated surface. Only where rain, snow or a similar weather event impacts an exterior surface is the inspection required.

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202
Definition of Atrium

CHANGE TYPE: Modification

CHANGE SUMMARY: The revised definition of atrium is now limited to addressing only two conditions: 1) an atrium is a vertical space enclosed at the top, and 2) an atrium typically connects three or more stories.

2021 CODE TEXT: **202 ATRIUM.** ~~An opening~~ A vertical space that is closed at the top, connecting two or more stories ~~other than enclosed stairways, elevators, hoistways, escalators, plumbing, electrical, air-conditioning or other equipment, which is closed at the top and not defined as a mall. Stories, as used in this definition, do not include balconies within assembly groups or mezzanines that comply with Section 505~~ in Group I-2 and I-3 occupancies or three or more stories in all other occupancies.

CHANGE SIGNIFICANCE: The recognition of an atrium in the *International Building Code* (IBC) as more than just a design feature is due to the openings between stories that pose a significant hazard under fire conditions. In order to address this unique approach to vertical openness, special provisions were established in the 1980s to provide alternative protection through concepts applicable to open courts and shaft enclosures. Confusion has occurred over the years due to the format, in which Section 712 regulating vertical openings provides the scoping provisions for atriums. In addition, the relationship between the definition and its availability as an optional means to address vertical openings has caused misapplication of the code's intent. An effort has been made to better clarify the application of the atrium provisions by simplifying the definition.

The definition of atrium was significantly simplified through the elimination of some previous language and the relocation of other text to Section 712.1.7. The remaining terminology in Section 202 is limited to



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Atrium.

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top, and 2) an atrium typically connects three or more stories. The listing of those components that are not considered as atriums has been deleted, and the reference to balconies and mezzanines has been moved to Chapter 7. The primary significance of the modification to the definition is the increase in the threshold from two to three stories before an atrium condition is created in all occupancies except Group I-2 and I-3.

Significant confusion has always existed due to the "two-story" atrium condition that was previously expressed in the definition. Many code users assumed that where a floor opening connected only two stories, it was still required to be regulated as an atrium due to the definition's wording. Although it was possible for the designer to consider the two-story opening as an atrium, it was not required to do so as the designation of the vertical opening as an atrium is just one of several fire protection methods allowed by Section 712.1. In most cases where only two stories are open to each other, Section 712.1.9 can be applied provided the six conditions are met. In those instances, Section 712.1.7 addressing the use of an atrium will not be used, and the provisions of Section 404 regulating atriums are not applicable.

It is important to note that there may be limited circumstances where an open two-story condition exists and one or more of the requirements of Section 712.1.9 cannot be met. In such situations, by definition, an atrium condition cannot be considered due to the "three-story" threshold. However, if a complying atrium can be considered as an acceptable approach to addressing a vertical opening of three or more stories, it should also be acceptable where the opening connects only two stories.

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202

Definition of Change of Occupancy

CHANGE TYPE: Modification

CHANGE SUMMARY: The scope of a change of occupancy has been narrowed where no classification change takes place.

2021 CODE TEXT: **202 CHANGE OF OCCUPANCY.** ~~A change in the use of a building or a portion of a building which results in one of the following:~~ Either of the following shall be considered as a change of occupancy where this code requires a greater degree of safety, accessibility, structural strength, fire protection, means of egress, ventilation or sanitation than is existing in the current building or structure:

1. Any change in the occupancy classification of a building or structure.
2. Any change in the purpose of, or a change in the level of activity within, a building or structure.

~~1. A change of occupancy classification.~~
~~2. A change from one group to another group within an occupancy classification.~~
~~3. Any change in use within a group for which there is a change in application of the requirements of this code.~~

CHANGE SIGNIFICANCE: Every building, or portion of a building, must be assigned an occupancy classification with respect to its use by placing it into one of the specific occupancy groups identified in Chapter 3. These groups are used throughout the code to address everything from allowable building size to required fire protection features. The occupancy



Photo courtesy of buzbuzzer

Multiple-tenant building.

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classification process represents identifying a distinct hazard, or more typically a group of hazards, that must be specifically addressed throughout the applicable code requirements. For example, the classification of Group A recognizes those assembly-related concerns associated with theaters, night clubs, places of worship and other facilities where large numbers of people congregate in a concentrated manner. Where there is a change in the use of the building that modifies the type or extent of the hazards created by the new use, a change of occupancy occurs. The scope of a change of occupancy is now more specifically stated in order to identify when such a condition takes place.

Historically, a change of occupancy only occurred where there was a specific change of the building's occupancy category. This included both changes within an occupancy group, as well as changes from one occupancy group to another. This scope of a change of occupancy was modified in the 2015 IBC to include a change in use, and clarified in the 2018 edition to indicate that all such changes in use that result in a change in the code's application are considered as a change of occupancy, even if no change in classification occurs. The 2021 IBC has been further revised to narrow the scope of a change of occupancy where there is no change in classification.

Where no change in occupancy classification occurs, a change of occupancy now exists only in those buildings where 1) there is a change in a building's purpose or level of activity, 2) that functional change is such that the current IBC requires a greater degree of regulation than presently exists in the current building, and 3) the greater degree of regulation required by the current IBC occurs only in the areas of accessibility, structural strength, fire protection, means of egress, ventilation or sanitation. The intent is to limit the application of a change of occupancy where there is no change in classification to only those new uses that present a higher risk to the life safety or welfare of the occupants than was created by the previous use.

Due to the restructured scope of the definition, there is a question as to how to address a building that undergoes a change in occupancy classification where no greater degree of safety, accessibility, structural strength, fire protection, means of egress, ventilation or sanitation is required by the code. An example is the remodeling of a Group A-2 assembly space in a manner where it would be reclassified as Group B. Where the new use poses an equal or lesser hazard level, but such use is classified as a different occupancy, it would seem appropriate to also consider it as a change of occupancy even though no modifications would be required.

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202

Definition of Impact Protective System

CHANGE TYPE: Addition

CHANGE SUMMARY: A definition for impact protective system has been added for assemblies that are designed to withstand windborne debris.

2021 CODE TEXT: **202 IMPACT PROTECTIVE SYSTEM.** Construction that has been shown by testing to withstand the impact of test missiles and that is applied, attached or locked over exterior glazing.

CHANGE SIGNIFICANCE: In windborne debris regions, glazing in buildings must be either impact resistant or be protected with an impact-resistant covering meeting the minimum requirements of the ASTM International standard ASTM E1996, *Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.* These mandatory protection requirements are meant to maintain the integrity of the building envelope and thereby prevent damage to the building due to wind and water and the consequent financial as well as functional losses.

Windborne debris regions are currently defined in the IBC as areas in hurricane-prone regions within one mile of the ocean in Exposure Category D with a basic design wind speed of 130 mph or more, as well as inland areas with a design wind speed of 140 mph or more. Hurricane-prone regions are defined as areas in the United States with shoreline along the Gulf of Mexico or Atlantic Ocean having a design wind speed of more than 115 mph. The state of Hawaii and territories of Puerto Rico, Guam, the Virgin Islands and American Samoa are all designated as hurricane-prone regions.



Photo courtesy of jmsilva

Impact protective system.

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In the windborne debris region, for glazed openings within 30 feet of the grade plane, any impact protection system must pass the minimum requirements of the Large Missile Test described in ASTM E1996. For glazed openings located more than 30 feet above grade, any impact protection system must pass the minimum requirements of the Small Missile Test of ASTM E1996.

This definition is referenced by Section 1709.5.3, which contains provisions for the special inspection of windborne debris protection and uses the term impact protective system.

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202

Definition of Mass Timber

CHANGE TYPE: Addition

CHANGE SUMMARY: Mass timber is now specifically defined as representative of both the large wood building elements historically recognized as Heavy Timber (now Type IV-HT) construction and the three new construction types of IV-A, IV-B and IV-C.

2021 CODE TEXT: **202 MASS TIMBER.** Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross-section dimensions of Type IV construction.

202 NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER). Noncombustible material, in accordance with Section 703.6, designed to increase the fire-resistance rating and delay the combustion of mass timber.

CHANGE SIGNIFICANCE: Heavy timber has never been specifically defined in the IBC; its meaning derived partially from various code provisions addressing its application in regard to the regulation of building design and construction. Heavy timber members have large cross sections to achieve a slow burning characteristic, with minimum dimensions established in Table 2304.11 of the IBC. Although regulated in various forms when heavy timber structural elements are used on a limited basis throughout a building, the primary recognition of such materials is through the type of construction classification of Type IV. This construction type, similar to Type III, is made up of structural members that typically must meet the criteria for heavy timber members (exceptions include exterior and interior walls). A new definition recognizes that



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Mass timber construction with glulam and CLT.

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Mass timber represents both the large wood building elements historically recognized as Heavy Timber (now Type IV-HT) construction and the three new construction types contained in the 2021 IBC (Types IV-A, IV-B and IV-C). A single term now represents the various sawn and engineered wood products referenced in Chapter 23 (Wood) of the IBC and in ANSI/APA PRG 320 *Standard for Performance-rated Cross-laminated Timber*.

Type IV-HT mass timber construction has exterior walls made of noncombustible materials, fire-retardant-treated wood (FRTW), or cross-laminated timber (CLT) protected in accordance with IBC Section 602.4.2. Interior building elements must be of solid or laminated wood. Columns, roof/floor beams, girders, flooring, roof decking and partitions must have minimum nominal dimensions per Table 2304.11. A key feature recognizes that Type IV-HT is deemed to meet an acceptable degree of fire resistance based solely on its required minimum dimensions. In contrast, mass timber used in construction Types IV-A, IV-B and IV-C is required to have a fire-resistance rating. The rating may be determined in accordance with Section 703.2.2 addressing various methods for determining fire-resistance, including calculations performed in accordance with Section 722.

Another new definition addresses the passive fire protection sometimes required for mass timber construction. Depending on the building's type of construction, mass timber is permitted to have its own fire-resistance rating, have a fire-resistance rating through a combination of the inherent mass timber fire-resistance plus protection with noncombustible insulating materials, or use the noncombustible protection to provide the entire fire-resistance rating. The definition of noncombustible protection also recognizes its value in delaying the combustion of mass timber members.

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202

Definition of Nailable Substrate

CHANGE TYPE: Addition

CHANGE SUMMARY: Nailable substrate has been defined to clarify what materials should be expected to provide withdrawal resistance for roof or wall cladding assemblies.

2021 CODE TEXT: **202 NAILABLE SUBSTRATE.** A product or material such as framing, sheathing or furring, composed of wood, wood-based materials or other materials providing equivalent fastener withdrawal resistance.

CHANGE SIGNIFICANCE: The addition of a definition of nailable substrate clarifies what products and materials are to be used for wind resistance in wall assemblies. Some siding materials have sufficient capacity on their own to resist wind loads, including wood panel sheathing and hardboard siding. Many other materials have limited resistance to wind loads; for example, vinyl siding and insulated vinyl siding need another material behind the siding to resist wind loads. Such wind resisting materials are typically wood framing, wood sheathing or cold-formed steel framing. For some siding and roof materials, furring is added specifically to provide an attachment surface. Adding the definition of nailable surface clarifies that these structural elements need to be used when attaching siding to the structure. Fasteners must be attached to wood or cold-formed steel. The definition also offers a performance approach, by referencing an option for calculating nailing equivalency in a material other than wood.

New Section 1404.14.1.1, addressing vinyl siding fasteners and fastener penetration for wood construction, directly references the new term.



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Furring forms a nailable substrate over insulation and beneath vinyl siding.

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202

Definition of Penthouse

CHANGE TYPE: Clarification

CHANGE SUMMARY: The definition of penthouse has been slightly revised to ensure that enclosures extended to the roof in order to house stairways are considered as penthouses.

2021 CODE TEXT: **202 PENTHOUSE.** An enclosed, unoccupied rooftop structure used for sheltering mechanical and electrical equipment, tanks, elevators and related machinery, stairways and vertical shaft openings.

CHANGE SIGNIFICANCE: Penthouses are structures placed on the roofs of buildings to shelter various types of machinery and equipment, as well as provide an enclosure for vertical shaft openings. A key feature of penthouses is that they are enclosed, yet unoccupied, areas of a building. The scope of the portion of a building that would be considered as a penthouse is often critical in the evaluation of allowable building height and area, type of construction, means of egress, fire resistance, structural loading conditions, and other key areas of regulation. The definition of penthouse has been slightly revised to ensure that enclosures extended to the roof in order to house stairways will also be considered as penthouses.

Where applying the provisions of the IBC, penthouses that comply with Section 1511 do not contribute to the building's number of stories and building floor area. In addition, a penthouse is not to be included in the determination of any fire area in the building. Various required fire-resistive ratings may also be reduced for penthouse structures. As such, the scope of what type of structure is considered as a penthouse is critical for proper code application. In conjunction with the use limitations set forth in Section 1511.2.2, the definition of penthouse in Chapter 2 has historically provided the limitations of such rooftop structures. In



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Penthouses.

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use has been limited to only those structures used exclusively to shelter mechanical and electrical equipment, tanks, elevators and associated machinery, and vertical shaft openings. There has previously been some question whether its use to enclose the uppermost portion of a stairway qualifies as acceptable. The definition, as well as Section 1511.2.2, has been expanded to clarify that rooftop structures that enclose stairways may be considered as penthouses when in compliance with Section 1511.

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202

Definition of Puzzle Room

CHANGE TYPE: Addition

CHANGE SUMMARY: The puzzle room, a relatively new type of special amusement area, is now specifically regulated by the code and a related definition provides the necessary scoping to address its unique hazards.

2021 CODE TEXT: **202 PUZZLE ROOM.** A puzzle room is a type of special amusement area in which occupants are encouraged to solve a challenge to escape from a room or series of rooms.

CHANGE SIGNIFICANCE: Special amusement areas, previously described in the code as special amusement buildings, have historically been regulated in a specific manner in order to address a unique type of building, or portion of a building, with unique fire and life safety hazards. Typically limited to haunted houses, amusement park attractions and similar venues, special amusement areas provide for a defined path of travel throughout the facility. Common characteristics include: a device or system that conveys passengers or a walkway that confines the occupants along a directed path; a means of egress that is not readily apparent due to visual and or audio distractions; and the potential for confusion and panic by the building's occupants due to the nature of the attraction or the manner of conveyance. The puzzle room, a relatively new type of special amusement area, is now specifically regulated, and a related definition provides the necessary scoping to address its unique hazards.



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Puzzle rooms, often referred to as "escape rooms," are entertainment facilities where individuals are placed in a room and directed to find a way out of the room, or more typically, to find their way to the next room in the puzzle. Although such a room or rooms would be viewed as assembly in nature, the rooms are typically small and the occupant load relatively low, often resulting in their classification as a Group B occupancy. Each of the rooms is designed in a manner that provides a unique problem-solving experience to the occupants. This unique design often incorporates a number of features intended to disorient the occupants or disguise the means of egress. As such, the design is contrary to the intended function of a code-complying means of egress system.

To better address the hazards that are associated with puzzle rooms, they are now specifically considered as special amusement areas, requiring compliance with Section 411 as well as other applicable IBC provisions. As such, they are subject to specific requirements for smoke detection, automatic sprinkler protection, emergency voice/alarm communication, exit signage and interior finish. In addition, special means of egress provisions have been established to address the specific concerns of puzzle rooms. See the discussion of Section 411 for further information.

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202

Definition of Structural Members

CHANGE TYPE: Clarification

CHANGE SUMMARY: Definitions for primary structural frame and secondary structural members have been revised to better address new technologies, as well as remove archaic concepts and redundant language.

2021 CODE TEXT: **202 PRIMARY STRUCTURAL FRAME.** The primary structural frame shall include all of the following structural members:

1. The columns.
2. Structural members having direct connections to the columns, including girders, beams, trusses and spandrels.
3. Members of the floor construction and roof construction having direct connections to the columns.
4. ~~Bracing~~ Members that are essential to the vertical stability of the primary structural frame under gravity loading ~~shall be considered part of the primary structural frame whether or not the bracing member carries gravity loads~~.

202 SECONDARY STRUCTURAL MEMBERS. The following structural mem-bers shall be considered secondary members and not part of the primary structural frame:

1. Structural members not having direct connections to the columns.
2. Members of the floor construction and roof construction not having direct connections to the columns.
3. Bracing members ~~other than those~~ that are not designated as part of ~~the~~ a primary structural frame or bearing wall.



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Columns and girder trusses form the primary structural frame in a roof; trusses are considered secondary structural members.

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CHANGE SIGNIFICANCE: In the regulation of structural members for the purposes of required fire resistance, as well as for other reasons, such members are considered as either primary or secondary in nature. Provisions regulating primary structural frame members often rise to a higher level than those regulating secondary members due to the increased loading conditions and lack of redundancy involved. Definitions regarding both of these types of structural elements have been revised so as to update the terms to adequately address new technologies; remove parts of the definitions that could be considered archaic; and remove what was considered as redundant language. As such, the revised definitions better identify a component's status as primary or secondary.

The type and level of protection required for various structural elements varies in Table 601 and Section 704 depending on the member and the portion of the structural system where it is placed. Changes were also made to both Table 601 and Section 704.4 to incorporate the revised secondary structural member definition. On the whole this group of revisions may not seem significant, but these definitions are used frequently and have a great impact on determining the proper fire resistance of structural elements and how they are to be protected.

Any member or component that is essential to the vertical stability of the building under gravity loads is now to be classified and protected as part of the primary structural frame, clarifying a long-standing question of whether the definition was intended to apply to bearing walls, which are assemblies rather than single components.

For the primary structural frame, the following components qualify:

1. Columns.
2. Beams and girder trusses – directly supported by columns.
3. Roof and floor panels and slabs – monolithic concrete and timber construction.
4. Braced frames and moment frames – transfer gravity loads to the foundation.
5. Bearing walls – support gravity loads and transfer them to the foundation.

For secondary structural members, components that are built into an assembly that supports a portion of a floor, roof or only their own self-weight qualify:

1. Roof trusses connected to a girder truss.
2. Roof purlins and subpurlins connected to beams.
3. Floor joists and trusses.
4. Nonbearing walls.
5. Bracing in the roof, floor or walls that is specifically designed to resist wind or seismic loads and is redundant for gravity systems.

The revisions in the definitions help to address some of the newer structural systems, such as mass timber constructed only of cross-laminated floor and wall panels with no columns, as well as concrete slab floor systems without beams where the slabs connect directly to the columns.

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PART 2

Building Planning

Chapters 3 through 6

- **Chapter 3** Occupancy Classification and Use
- **Chapter 4** Special Detailed Requirements Based on Occupancy and Use
- **Chapter 5** General Building Heights and Areas
- **Chapter 6** Types of Construction

The application of the *International Building Code* (IBC) to a structure is typically initiated through the provisions of Chapters 3, 5, and 6. Chapter 3 establishes one or more occupancy classifications based upon the anticipated uses of a building. The appropriate classifications are necessary to properly apply many of the code's non-structural provisions. The requirements of Chapter 6 deal with classification as to construction type, based on a building's materials of construction and the level of fire resistance provided by such materials. Limitations on a building's height and area, set forth in Chapter 5, are directly related to the occupancies it houses and its type of construction. Chapter 5 also provides the various methods available to address conditions in which multiple uses or occupancies occur within the same building. Chapter 4 contains special detailed requirements based on unique conditions or uses that are found in some buildings. ■

306.2
Group F-1 Occupancy Classification

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Uses Not Classified as Group H

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Alcoholic Beverage Storage

403.3.2
Water Supply to Required Fire Pumps

404.1
Scope of Atrium Provisions

404.5
Smoke Control in Atriums

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406.2.4
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Group I-2 Corridor Doors

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Group I-2 Care Suites

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414.2.3
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Allowable Height in Feet

TABLE 504.4
Allowable Height in Stories

TABLE 506.2
Allowable Building Area

506.3.2
Allowable Area Frontage Increase

508.4.4
Separated Occupancies

508.4.4.1, 509.4.1.1
Fire Separations of Mass Timber

508.5
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TABLE 509.1
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510.2
Stairway Construction in Podium Buildings

TABLE 601
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602.4
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Type IV-A, IV-B and IV-C Buildings

602.4.4
Type IV-HT Buildings

603.1
Combustible Materials in Types I and II

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306.2

Group F-1 Occupancy Classification

CHANGE TYPE: Modification

CHANGE SUMMARY: Energy storage systems and water/sewer treatment activities have been added to the listing of Group F-1 occupancies.

2021 CODE TEXT: **306.2 Moderate-hazard factory industrial, Group F-1.** Factory industrial uses that are not classified as Factory Industrial F-2 Low Hazard shall be classified as F-1 Moderate Hazard and shall include, but not be limited to, the following:

Energy storage systems (ESS) in dedicated use buildings

Water/sewer treatment facilities

(no changes to other listed uses)

CHANGE SIGNIFICANCE: Although the potential hazard and fire severity of the multiple uses in the Group F occupancy classification is quite varied, these uses share common elements. The occupants are adults who are awake and generally have enough familiarity with the premises to be able to exit the building with reasonable efficiency. Public occupancy is usually quite limited, and most occupants are aware of the potential hazards the use creates. The Group F-1 classification is applied for those factory and industrial uses that pose a moderate degree of hazard, essentially any such use that would not be considered as a low-hazard Group F-2 occupancy. The Group F-1 designation typically recognizes the presence of materials that pose a risk due to their combustibility or flammability potential. Due to these anticipated hazards, two additional types of uses addressing energy storage systems and water/sewer treatment activities have been added to the listing of Group F-1 occupancies.



Photo courtesy of TerryJ

Group F-1 water treatment facility.

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Electrical energy storage systems are regulated by Section 1207 of the *International Fire Code*® (IFC®). The purpose of these systems is to provide standby or emergency power, an uninterruptable power supply, load shedding, load sharing and similar capabilities. The IFC extensively regulates such facilities, including the obtaining of permits, submitting of construction documents and providing for a hazard mitigation analysis. A substantial number of safeguards have been established in the IFC to allow for recognition as a moderate-hazard condition in the determination of occupancy classification.

Where a single-occupancy building is used only for energy storage systems (ESSs), electrical energy generation and other electrical grid operations, the building is now to be considered as a Group F-1 occupancy. Although no other occupancies are permitted in the building, administrative and support areas that do not contain ESSs are allowed provided they do not exceed 10 percent of the building area on the story they are located. In the evaluation of the anticipated fuel load hazard, a moderate-hazard Group F-1 classification was deemed appropriate. For comparison purposes, electric generation plants have been historically classified as Group F-1 occupancies.

If an ESS is installed in a building having an occupancy other than Group F-1, the ESS is to be considered as part of that other occupancy. However, the provisions of IFC Section 1207 addressing an ESS will apply for the space the ESS occupies. The impact of the new Group F-1 classification may be significant for larger ESS installations in dedicated-use indoor locations, as classification as a Group H-2 occupancy will no longer be required.

Although nearly every community has a water/sewer treatment facility, there has been a lack of consistency in how such facilities should be viewed for occupancy classification purposes. Typically considered as a Group F industrial use, it has been unclear as to whether a moderate-hazard Group F-1 or a low-hazard Group F-2 classification is most appropriate. Such facilities are now specifically listed as one of the many Group F-1 occupancies due to the potential hazards that are typically present. There is a concern that some of the materials in use, especially in water treatment activities, are of a hazardous nature that would warrant a Group H classification should the maximum allowable quantities permitted in Section 307 be exceeded. Where the allowable quantities of hazardous materials do not rise to the level of a Group H classification, it was determined that a moderate hazard exists, resulting in an occupancy classification of Group F-1.

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307.1.1

Uses Not Classified as Group H

CHANGE TYPE: Modification

CHANGE SUMMARY: The distilling or brewing of alcohol beverages, as well as the storage of beer, distilled spirits and wine, are now considered as conditions where the quantities of the beverages are not limited in a non-Group H occupancy provided compliance with the IFC is achieved.

2021 CODE TEXT: **307.1.1 Uses other than Group H.** An occupancy that stores, uses or handles hazardous materials as described in one or more of the following items shall not be classified as Group H, but shall be classified as the occupancy that it most nearly resembles.

18. Distilling or brewing of beverages conforming to the requirements of the *International Fire Code.*

19. The storage of beer, distilled spirits and wines in barrels and casks conforming to the requirements of the *International Fire Code.*

(no changes to other listed uses)

CHANGE SIGNIFICANCE: High-hazard Group H occupancies are characterized by an unusually high degree of explosion, fire or health hazard as compared to typical commercial and industrial uses. There is a single common feature about all Group H occupancies: They are designated as Group H based on excessive quantities of hazardous materials in use and/or in storage. A variety of conditions have historically been established under which a Group H classification is not required despite that the quantities of materials exceed the amounts set forth in Table 307.1(1) or 307.1(2). The distilling or brewing of alcohol beverages, as well as the storage of beer, distilled spirits and wine, are now considered as conditions where the quantities of the beverages are not limited in a non-Group H occupancy provided compliance with the IFC is achieved.



Photo courtesy of FocusEye

Whiskey distillery.

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The addition of the two new uses regarding the manufacture and storage of alcoholic beverages is significant due to the elimination of any classification as a Group H occupancy. Distilling, brewing and the storage of alcohol beverages, regardless of alcohol content and the quantity of liquid, are not considered as Group H occupancies where in compliance with the IFC. This allowance in part takes into consideration the new automatic sprinkler requirements for the manufacture of distilled spirits, or the bulk storage of distilled spirits or wine. Where the alcoholic beverages being manufactured or stored exceed 16-percent alcohol content, regardless of the liquid quantity, a sprinkler system shall be provided throughout the fire area containing the Group F-1 or S-1 occupancy. See the discussion of new Sections 903.2.4.2 and 903.2.9.3. Due to the fire protection afforded by an automatic sprinkler system, along with other safeguards established in the IFC, the manufacture and storage of alcoholic beverages in any quantity is not ever to be considered as a Group H occupancy. Manufacturing activities will be classified as Group F-1 or Group F-2 based on the alcohol content, while the newly revised storage occupancy provisions will address the concerns associated with classification as Group S-1 or Group S-2.

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311.2, 311.3

Alcoholic Beverage Storage

CHANGE TYPE: Clarification

CHANGE SUMMARY: The proper occupancy classification for the storage of beverages, specifically alcohol beverages, has been clarified for both the Group S-1 and S-2 categories.

2021 CODE TEXT: **311.2 Moderate-hazard storage, Group S-1.** Storage Group S-1 occupancies are buildings occupied for storage uses that are not classified as Group S-2, including, but not limited to, storage of the following:

Beverages over 16-percent alcohol content

(no changes to other listed uses)

311.3 Low-hazard storage, Group S-2. Storage Group S-2 occupancies include, among others, buildings used for the storage of noncombustible materials such as products on wood pallets or in paper cartons with or without single thickness divisions; or in paper wrappings. Such products are permitted to have a negligible amount of plastic trim, such as knobs, handles or film wrapping. Group S-2 storage uses shall include, but not be limited to, storage of the following:

Beverages up to and including 16-percent alcohol ~~in metal, glass or ceramic containers~~

(no changes to other listed uses)

CHANGE SIGNIFICANCE: In general, the Group S designation includes storage occupancies that are not highly hazardous. Such storage uses are classified into two divisions based on the hazard level involved.



Photo courtesy of John J Miller Photography

Bourbon whiskey warehouse.

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Group S-1 includes those buildings used for moderate-hazard storage purposes, whereas low-hazard uses make up the Group S-2 classification. The proper occupancy classification for the storage of beverages, specifically alcohol beverages, has been clarified for both the Group S-1 and S-2 categories.

The storage of alcoholic beverages having a maximum alcohol content of 16 percent has historically been classified as a Group S-2 low-hazard occupancy provided the containers are composed of noncombustible materials. There has previously been a concern that such beverages stored in wooden barrels and casks pose a higher hazard than typically addressed by the Group S-2 classification. This concern has now been addressed through the inclusion of safeguards set forth in new IFC Chapter 40 relating to ignition sources, mechanical ventilation and spill containment. Therefore, the Group S-2 classification is now appropriate for the storage of alcohol beverages with no more than 16-percent alcohol content regardless of the types of containers in which the beverages are stored.

Where the alcohol content of beverages in a storage condition exceeds 16 percent, the occupancy classification for such storage use is now specifically identified as Group S-1. This classification is applicable for both bulk storage and retail packaging. Previously, there had been no specific entry in the *International Building Code* (IBC) for such a use; however, the Group S-1 classification was typically applied due to the mandate in Section 311.1 that storage uses that are not classified as Group S-2 shall be considered as Group S-1. Additionally, where the maximum allowable quantities of hazardous materials have been exceeded, a classification of Group H was often assigned. Due to an evaluation of the actual hazards involved with the storage of such materials, and the recognition that the IBC has always considered the manufacture of beverages with more than 16-percent alcohol content as a Group F-1 occupancy, the classification of such storage uses as Group S-1 now provides for consistency in application.

It should be noted that these revisions in the IBC were part of a series of changes in the IFC, including new Chapter 40 addressing the storage of alcoholic beverages.

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403.3.2

Water Supply to Required Fire Pumps

CHANGE TYPE: Modification

CHANGE SUMMARY: The mandate for the water supply to required fire pumps by two water mains has been extended to those buildings more than 120 in height where the building's type of construction is either IV-A or IV-B.

2021 CODE TEXT: **403.3.2 Water supply to required fire pumps.** In all buildings that are more than 420 feet (128 m) in building height and buildings of Type IV-A and IV-B construction that are more than 120 feet (36 576 mm) in building height, required fire pumps shall be supplied by connections to not fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

> **Exception:** Two connections to the same main shall be permitted provided that the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through not fewer than one of the connections.

CHANGE SIGNIFICANCE: Fire pumps are installed in sprinkler and standpipe systems to pressurize the water supply for the minimum required sprinkler and standpipe operation. Fire pumps are only "required" to meet the system needs. Therefore, whether a particular high-rise building includes fire pumps will depend on interaction of the height of the building, the local water system and the designs of the sprinkler and



Photo courtesy of naturallywood.com, KK Law

Mass timber construction taller than 120 feet.

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standpipe systems in the building. Historically, where the systems require a fire pump and the building is more than 420 feet in height, fire pumps are to be supplied by two water mains located in separate streets. Having two connections will greatly reduce the possibility of the loss of water due to a main break, given the valving of a public water system. The mandate for supply by two water mains has been extended to those buildings more than 120 feet in height where the building's type of construction is either IV-A or IV-B.

Due to the potential contribution of mass timber to the fuel load and the limited ability for fire service aerial apparatus to apply water to elevated floor levels, the redundancy required for water supply now also applies to tall mass timber buildings of Type IV-B and IV-A construction. The threshold of 120 feet recognizes the limited reach of aerial apparatuses, as well as the historic height allowances for heavy timber construction. Consideration was also given to the difficulty of fire service personnel accessing elevated floors under fire conditions.

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404.1

Scope of Atrium Provisions

CHANGE TYPE: Clarification

CHANGE SUMMARY: Application of the atrium provisions have been clarified and several means of egress provisions have been relocated to Chapter 10.

2021 CODE TEXT: **404.1 General.** ~~In other than Group H occupancies, and where permitted by Section 712.1.7, the~~ The provisions of Sections 404.1 through 404.~~10~~11 shall apply to buildings containing atriums. Atriums are not permitted in buildings or structures ~~containing vertical openings defined as "Atriums."~~ classified as Group H.

> **Exception:** Vertical openings that comply with Sections 712.1.1 through 712.1.3, and Sections 712.1.9 through 712.1.14.

404.9 Exit access travel distance. Exit access travel distance for areas open to an atrium shall comply with the requirements of ~~this section~~ Section 1017.

1017.3.2 Atriums. Exit access travel distance for areas open to an atrium shall comply with the requirements of Sections 1017.3.2.1 through 1017.3.2.3.

~~404.9.1~~ 1017.3.2.1 Egress not through the atrium. Where required access to the exits is not through the atrium, exit access travel distance shall comply with Section 1017.2.

~~404.9.2~~ 1017.3.2.2 Exit access travel distance at the level of exit discharge. Where the path of egress travel is through an atrium space, exit access at the level of exit discharge shall be determined in accordance with Section 1017.2.

~~404.9.3~~ 1017.3.2.3 Exit access travel distance at other than the level of exit discharge. Where the path of egress travel is not at the level of exit discharge from the atrium, that portion of the total permitted



Photo courtesy of susib

Atrium.

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exit access travel distance that occurs within the atrium shall be not greater than 200 feet (60 960 mm).

404.~~10~~11 Interior exit ~~stairways~~ stairway discharge. ~~Not greater than 50 percent~~ Discharge of interior exit stairways ~~are permitted to egress~~ through an atrium ~~on the level of exit discharge~~ shall be in accordance with Section 1028.

CHANGE SIGNIFICANCE: Unprotected vertical openings are often identified as the factors responsible for fire spread in incidents involving fire fatalities or extensive property damage. Section 404 addresses one method for protection of these specific building features in lieu of providing a complete floor separation. Where an atrium is provided in conformance with this section, it is considered as an equivalent level of resistance to fire and smoke spread vertically from story to story. The application of the atrium provisions has been clarified, and several means of egress provisions applicable to atriums have been relocated to Chapter 10.

The atrium provisions of Section 404 are only one of the numerous options for addressing vertical openings as set forth in Sections 712.1.1 through 712.1.16. Atriums are identified in Section 712.1.7 and are considered acceptable when in compliance with the criteria of Section 404. Additionally, the code permits other types of vertical opening conditions that do not require compliance with the atrium provisions. For example, Section 712.1.1 continues to recognize the use of shaft enclosures for vertical opening protection. Section 712.1.2 permits openings within residential dwelling units to be unprotected. Other unprotected vertical openings that are permitted by the code include communicating spaces in buildings of Group I-3 (see Section 408.5); mezzanines (see Section 505); escalator openings (see Section 712.1.3); supplemental stairway openings (see Section 1019.3, Exception 4); open parking garages (see Section 406.5); enclosed parking garages (see Section 406.6); and other openings as detailed in Section 712.

Atriums in compliance with Section 404 are not to be considered unprotected vertical openings; rather, the vertical openings are protected by means other than enclosure by a shaft or a complete floor assembly. The provisions of Section 404 are not intended to apply to conditions that are addressed by Section 712.1 based on the itemized options, other than when Section 712.1.7 is the chosen method of compliance. In other words, if compliance with Section 712.1 is achieved by applying one of the options other than an atrium as permitted by Section 712.1.7, then the provisions of Section 404 are not applicable. Conversely, if the provisions of Section 404 have been complied with, then the other options listed in Section 712.1 do not need to be addressed. It is the intent that the revision to the scoping language of Section 404.1 will provide the needed clarity for when the atrium provisions are applied.

Regarding a related issue, a change in format has resulted in the special travel distance limitation provisions previously located in Section 404.9 being relocated to Chapter 10 in new Section 1017.3.2. Although the three potential exiting scenarios that are possible in an atrium situation may appear specific to atriums, they are not entirely self-contained. The limitations to travel must be evaluated as part of the general travel distance provisions of Section 1017, and thus have been relocated to that area of the code.

The acceptable use of interior exit stairways within an atrium for egress purposes has also been reformatted for reasons similar to that for the relocation of the atrium travel distance provisions and are now located in Section 1028.

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404.5

Smoke Control in Atriums

CHANGE TYPE: Modification

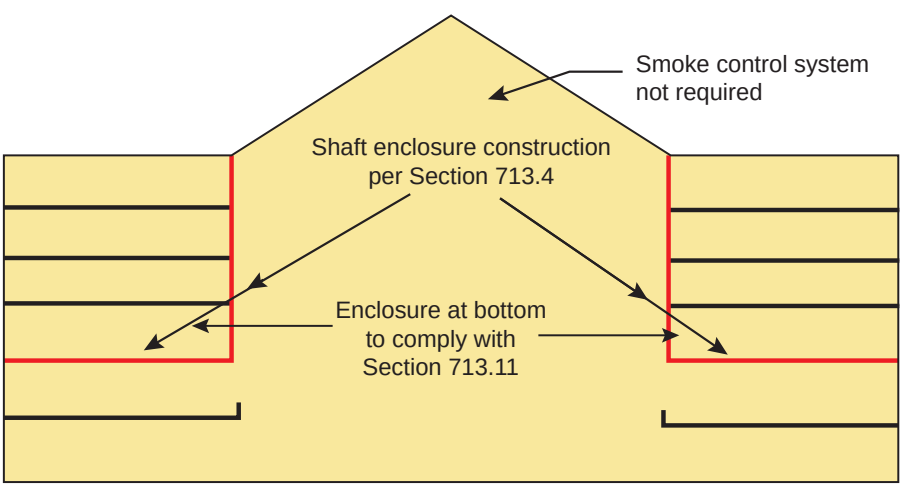
CHANGE SUMMARY: In the evaluation of whether a smoke control system is required for an atrium condition, vertical opening protection consisting of a combination of both the atrium and a shaft enclosure is now recognized.

2021 CODE TEXT: **404.5 Smoke control.** A smoke control system shall be installed in accordance with Section 909.

Exceptions:

1. In other than Group I-2, and Group I-1, Condition 2, smoke control is not required for atriums that connect only two stories.
2. A smoke control system is not required for atriums connecting more than two stories when all of the following are met:
   - 2.1 Only the two lowest stories shall be permitted to be open to the atrium.
   - 2.2 All stories above the lowest two stories shall be separated from the atrium in accordance with the provisions for a shaft in Section 713.4.

CHANGE SIGNIFICANCE: A major component of the life-safety system for a building containing an atrium is the required smoke control system. Intended to prevent the migration of smoke throughout interconnected stories of a building via the atrium, the design of the smoke control system is to be in accordance with Section 909. The smoke control system is to be installed in all atriums connecting more than two stories as well as those Group I-2 and Group I-1, Condition 2 buildings where atriums connect two or more stories. The extension of an atrium without smoke control beyond two stories has historically been prohibited; however, a new exception removes that limitation where two conditions are met. First, only the two lowest stories are permitted to be open to the atrium.



ATRIUM CONDITION

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Second, those stories located above the two lowest stories are required to be separated from the atrium with shaft enclosures having a minimum fire-resistance rating in compliance with Section 713.4. The new allowance recognizes that a combination vertical opening condition consisting of both an atrium and a shaft enclosure provides the necessary degree of separation expected between multiple stories, eliminating the need for a smoke control system.

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404.6

Horizontal Assemblies in Atriums

CHANGE TYPE: Modification

CHANGE SUMMARY: Horizontal assembly separation of the atrium from adjacent spaces is no longer required at those openings created for complying escalators and/or exit access stairways.

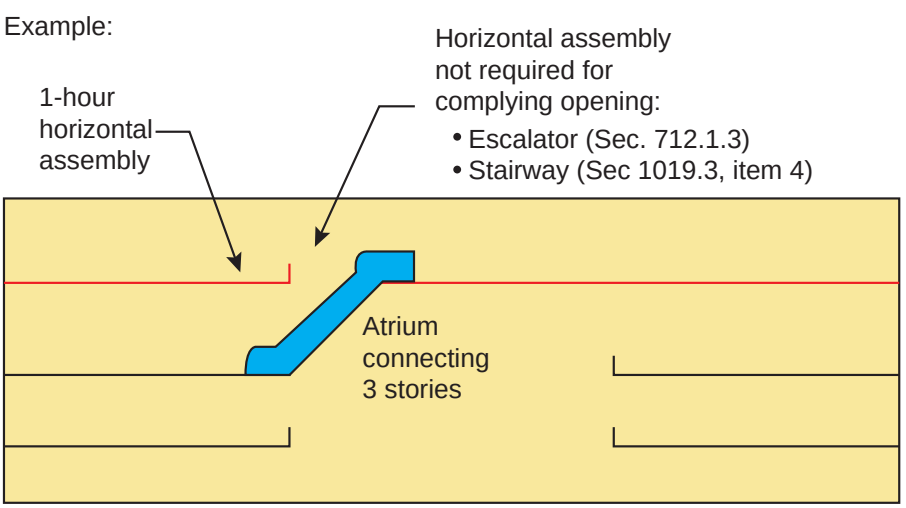
2021 CODE TEXT: **404.6 Enclosure of atriums.** Atrium spaces shall be separated from adjacent spaces by a 1-hour fire barrier constructed in accordance with Section 707 or a horizontal assembly constructed in accordance with Section 711, or both.

Exceptions:

(no changes to Exceptions 1-4)

5. A horizontal assembly is not required between the atrium and openings for escalators complying with Section 712.1.3.
6. A horizontal assembly is not required between the atrium and openings for exit access stairways and ramps complying with item 4 of Section 1019.3.

CHANGE SIGNIFICANCE: One of the basic premises of the atrium requirements is that an engineered smoke control system combined with an automatic fire sprinkler system that is properly supervised provides an adequate alternative to the fire-resistance rating of a shaft enclosure. It is also recognized that some form of a boundary is required to assist the smoke control system in containing smoke to just the atrium area. The basic requirement, therefore, is that the atrium space be separated from adjacent areas by fire barriers and horizontal assemblies having a fire-resistance rating of at least 1 hour. Two new exceptions to the enclosure requirements address conditions where escalators and/or exit access stairways penetrate the required horizontal assembly. These exceptions recognize that no horizontal assembly separation of the atrium is required at those locations where openings are created for such escalators and/or stairways.



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Unless specifically excepted, the boundary of an atrium must provide a full separation from surrounding spaces. Such separation would typically prohibit unprotected openings that pass through any horizontal assembly that creates a portion of the boundary. New Exception 5 now permits the omission of any required horizontal assembly where the floor opening contains an escalator and is in compliance with Section 712.1.3. A similar allowance has been established as Exception 6 for exit access stairways and ramps that comply with item 4 of Section 1019.3.

The allowance for such openings is based on the recognition that the floor openings are protected in a special manner through the use of draft curtains around the floor opening and additional sprinklers at the perimeter of the opening. The size of the floor opening is also limited based on the area devoted to the escalator or stairway. It is anticipated that the presence of the draft curtains and sprinklers limit the potential of smoke spread through the opening; thus, such areas that only communicate via these specific openings should not be considered as an extension of the atrium.

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406.2.4

Floor Surfaces in Parking Garages

CHANGE TYPE: Modification

CHANGE SUMMARY: The mandate for a sloping floor in the vehicle areas of parking garages has been reinstated in the IBC for those garages classified as Group S-2 occupancies.

2021 CODE TEXT: **406.2.4 Floor surfaces.** Floor surfaces shall be of concrete or similar approved noncombustible and nonabsorbent materials. The area of floor used for the parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway. The surface of vehicle fueling pads in motor fuel-dispensing facilities shall be in accordance with Section 406.7.1.

Exceptions:

1. *(no change to exception)*
2. ~~Floors of Group S-2 parking garages shall not be required to have a sloped surface.~~
3. ~~3.~~2. *(no change to exception)*

CHANGE SIGNIFICANCE: Motor-vehicle-related uses are regulated in a detailed manner through the special provisions found in Section 406. Those requirements applicable to all types of such uses, including parking garages, motor-fuel dispensing facilities and repair garages, are set forth in Section 406.2. Floor surfaces of these varied uses are addressed for a variety of concerns, such as surface material and floor slope. The need for a sloping floor in the vehicle areas, mandated in the IBC until the 2009 edition, has been reinstated for those parking garages classified as Group S-2 occupancies.



Photo courtesy of Jonas Ahrentorp/EyeEm

Enclosed parking garage.

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A sloped floor in parking garage vehicle areas provides a means to move liquids from the parking surface. Such liquids often include deleterious oils and de-icing salts that could potentially cause damage to the concrete surface and the reinforcement within the floor system. Although the base requirement in Section 406.2.4 mandates all such floors be sloped to address such concerns, Exception 2 has previously exempted Group S-2 public garages, both enclosed and open, from having sloped surfaces. The intent of the exception was to recognize that in some cases, such as large parking structures constructed of prefabricated materials, it may be difficult to design all vehicle surfaces to be sloped. However, it was determined that the need to provide proper drainage is a significant concern and thus the exception has now been deleted.

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407.3.1.1

Group I-2 Corridor Doors

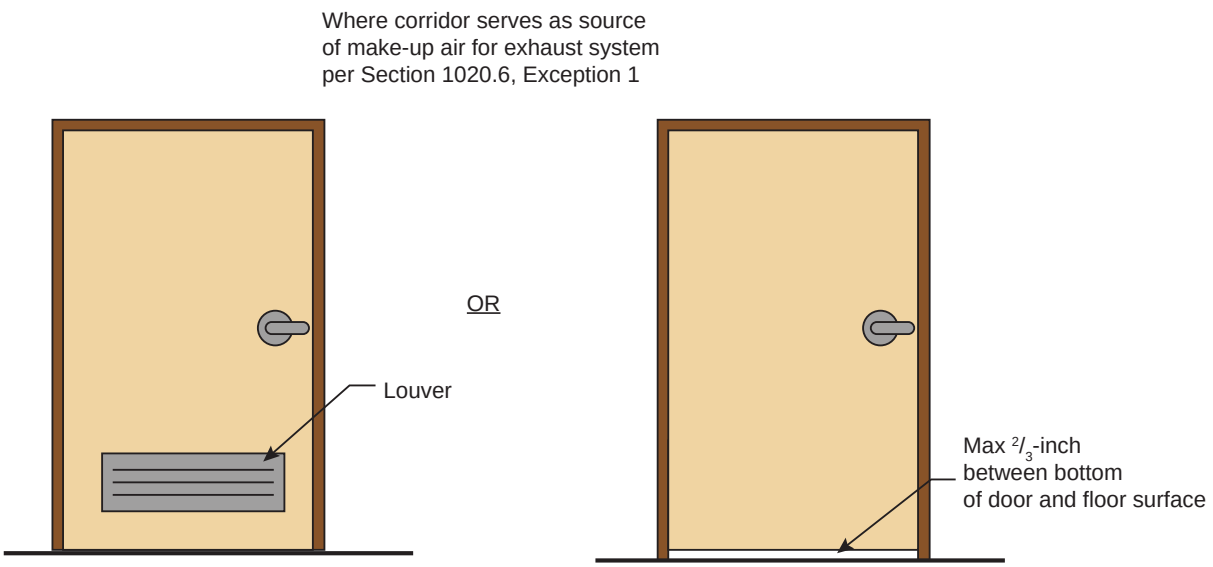
CHANGE TYPE: Clarification

CHANGE SUMMARY: Several specific conditions related to corridor doors have expanded the smoke-resistant criteria in order to address the various types of doors used in corridors of Group I-2 care facilities.

2021 CODE TEXT: **407.3.1.1 Door construction.** Doors in corridors not required to have a fire protection rating shall comply with the following:

1. Solid doors shall have close-fitting operational tolerances, head and jamb stops.
2. Dutch-style doors shall have an astragal, rabbet or bevel at the meeting edges of the upper and lower door sections. Both the upper and lower door sections shall have latching hardware. Dutch-style doors shall have hardware that connects the upper and lower sections to function as a single leaf.
3. To provide makeup air for exhaust systems in accordance with Section 1020.6, Exception 1, doors are permitted to have louvers or to have a clearance between the bottom of the door and the floor surface that is $^{2}/_{3}$ inch (19.1 mm) maximum.

CHANGE SIGNIFICANCE: Health care facilities classified as Group I-2 occupancies have multiple unique characteristics that cannot be addressed under the general provisions of the IBC. Therefore, any special considerations must be recognized separately in Chapter 4, specifically Section 407. Corridors in such facilities are intended to provide a relatively smoke-free environment for the relocation of patients during a fire or other emergency condition. The corridor walls must be constructed in a manner to limit smoke transfer. Accordingly, the corridor doors



Corridor doors in Group I-2

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must also assist in maintaining the smoke-protected environment. Several specific conditions related to corridor doors have expanded the criteria addressing the various types of doors used in corridors of care facilities.

Doors in corridor walls of Group I-2 occupancies are specifically regulated in Section 407.3.1. One of the provisions is performance in nature, requiring such corridor doors to "provide an effective barrier to limit the transfer of smoke." That performance statement has now been further expressed by allowing those necessary operational tolerances at the head and jamb stops, while continuing to be as close-fitting as possible. The smoke-resistant characteristics are further regulated in Condition 3, where louvers are permitted in doors. Or, as an alternative method of providing required make-up air for exhaust systems, a door undercut is acceptable up to a maximum of $^{2}/_{3}$ inch.

In addition, Dutch-style doors are now specifically permitted in Group I-2 corridors where several conditions are met. A bevel, rabbet or astragal is required at the meeting edges of the upper and lower door sections. In addition, latching hardware is mandated on both the upper and lower sections. There must also be a means for connecting the upper and lower door sections in a manner that will allow the entire assembly to function as a single leaf.

Additional clarity and guidance has been provided for addressing an intended function for Group I-2 corridor doors. An effective barrier at the door openings limits the movement of smoke between the egress corridor and adjacent rooms. Additionally, their introduction into Section 407 provides for alignment with the Centers for Medicare & Medicaid Services (CMS) federal standard.

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407.4.4.1, 407.4.4.3

Group I-2 Care Suites

CHANGE TYPE: Modification

CHANGE SUMMARY: Egress travel allowances, both within an individual care suite as well as from a suite into a corridor, have been revised to allow for additional design flexibility and consistency with the CMS federal standard.

2021 CODE TEXT: **407.4.4.1 Exit access through care suites.** Exit access from all other portions of a building not classified as a care suite shall not pass through a care suite. ~~In a care suite required to have more than one exit, one exit access is permitted to pass through an adjacent care suite provided that all of the other requirements of Sections 407.4 and 1016.2 are satisfied.~~

407.4.4.3 Access to corridor. Every care suite shall have a door leading to an exit access corridor or horizontal exit. Movement from habitable rooms within a care suite shall not require ~~passage through~~ more than ~~three doors and~~ 100 feet (30 480 mm) ~~distance of travel within the~~ of travel within the care suite to a door leading to the exit access corridor or horizontal exit. Where a care suite is required to have more than one exit access door by Section 407.4.4.5.2 or 407.4.4.6.2, the additional door shall lead directly to an exit access corridor, exit or an adjacent suite.

> **Exception:** ~~The distance of travel shall be permitted to be increased to 125 feet (38 100 mm) where an automatic smoke detection system is provided throughout the care suite and installed in accordance with NFPA 72.~~

CHANGE SIGNIFICANCE: Special means of egress provisions are provided for care suites in Group I-2 occupancies. The scope of such specialized requirements is limited to those areas of a health care facility



Photo courtesy of Johnny Greig

Hospital care suite.

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arranged in a manner where staff has an increased level of supervision of patients in specific treatment and sleeping rooms. The function of the care suite concept is to allow for an alternative means of egress system. Egress travel allowances, both within an individual care suite as well as from a suite into a corridor, have been revised to allow for additional design flexibility.

In order to reflect recent changes in the federal rules regulating health care facilities, modifications have been made to the exit access travel provisions for health care suites. Means of egress travel involving care suites has previously limited the number of intervening rooms that may be encountered along the travel path. In concert with the federal rules, the limitations are now based solely on the overall travel limit of 100 feet within the care suite to a door leading to a corridor or horizontal exit. There is no longer a limit on the number of rooms through which travel can occur provided the 100-foot distance is not exceeded. The revised methodology should provide additional clarity relating to exit access options for egress from a care suite.

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407.6.1

Automatic-Closing Doors in Group I-2

CHANGE TYPE: Modification

CHANGE SUMMARY: In Group I-2 occupancies, the closing of automatic-closing doors on hold-open devices must now also occur upon activation of the fire alarm system or automatic sprinkler system.

2021 CODE TEXT: **407.6.1 Activation of automatic-closing doors.** Automatic-closing doors on hold-open devices in accordance with Section 716.2.6.6 shall also close upon activation of a fire alarm system, an automatic sprinkler system, or both. The automatic release of the hold-open device on one door shall release all such doors within the same smoke compartment.

CHANGE SIGNIFICANCE: Automatic-closing doors with hold-open devices are mandated by the IBC in a very limited number of situations: those locations where it is critical that the doors will close automatically under smoke conditions. Two such locations are found in Group I-2 occupancies where 1) a pair of opposite-swinging doors in a smoke barrier wall are installed across a corridor, and 2) special purpose horizontal sliding, accordion or folding doors are installed in a smoke barrier. Historically, the IBC has only required such doors to close upon actuation of smoke detectors or loss of power to the smoke detector or hold-open device. Door closing must now also occur upon activation of the fire alarm system or automatic sprinkler system.

Section 407.6 addressing automatic-closing doors has previously been a simple reference statement leading to Sections 709.5 (openings in smoke barriers) and 716.2 (fire door assemblies). The reference to Section 709.5, including Section 709.5.1, identifies those specific locations where automatic-closing devices are required for cross-corridor doors with hold-open devices. Section 716.2, and more specifically Section 716.2.6.6,



Photo courtesy of SDI Productions

Cross-corridor doors in hospital.

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mandates that such automatic-closing doors with hold-open devices are to close upon 1) actuation of smoke detectors, or 2) loss of electrical power to the hold-open device or smoke detector. New Section 407.6.1 mandates that in addition to the requirements of Section 716.2.6.6, automatic-closing doors with hold-open devices must also close upon activation of a fire alarm system or an automatic sprinkler system. If one or more of these four conditions occur within the Group I-2 occupancy, the doors shall automatically close.

As an additional requirement, all automatic-closing doors with hold-open devices that are located within the same smoke compartment shall be released upon the automatic release of the hold-open device on any one of such doors.

A higher level of life safety is now provided for residents and care recipients of these care facilities. In addition, the new requirements provide consistency between the IBC provisions addressing Group I-2 occupancies and the Federal Standards and CMS enforcement rules.

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411.5
Puzzle Rooms

CHANGE TYPE: Addition

CHANGE SUMMARY: A new type of building use, the puzzle room, is now regulated in a manner consistent with traditional special amusement areas. In addition, special means of egress requirements have been established that are specific only to such puzzle rooms.

2021 CODE TEXT: **411.5 Puzzle room exiting.** Puzzle room exiting shall comply with one of the following:

1. Exiting in accordance with Chapter 10.
2. An alternative design approved by the building official.
3. Exits shall be open and readily available upon activation by the automatic fire alarm system, automatic sprinkler system, and a manual control at a constantly attended location.

CHANGE SIGNIFICANCE: Special conditions are applicable to buildings, or portions of buildings, defined as special amusement areas. Previously identified in the IBC as special amusement buildings, these areas have typically been limited to walk-through and ride-through attractions at amusement parks, as well as haunted houses. Such buildings and areas have much in common with other assembly uses, and as such are classified as Group A occupancies where the occupant load is 50 or more. As expected, a Group B classification is assigned where the occupant load does not exceed 49. Except where modified by Section 411, the code requirements applicable to special amusement areas are those that are mandated for other types of assembly uses. However, Section 411 recognizes the unique characteristics of those buildings and areas defined as special amusement areas and establishes specific provisions to address the unique hazards that are created. A new type of building use, that of



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Escape room.

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puzzle rooms, is now regulated by the code in a manner consistent with other traditional special amusement areas. In addition, unique means of egress requirements have been established that are applicable only to such puzzle rooms.

Puzzle rooms, often identified as escape rooms, are a relatively new business model where individuals enter a room and are required to solve a puzzle of some sort before they are able to exit the facility or travel to the next room in the puzzle. The rooms are typically small with a limited number of occupants within in each space. Puzzle rooms are designed in a manner to provide a unique and challenging experience for the customer. The intended design philosophy often incorporates a number of different features that are intended to disorient the occupants and/or disguise the egress route, resulting in a condition contrary to the foundation of code-specified means of egress provisions.

From a performance standpoint, three key assumptions should be taken into account regarding the regulation of puzzle rooms. One, occupants are awake, alert and predominantly able to exit without the assistance of others, but are also unfamiliar with the area. Two, the risk of injury assumed by occupants during their use of the area is potentially high and involuntary. Three, public expectations regarding the protection that is afforded to the occupants is also high.

The newly set forth definition of a puzzle room is that it is a "type of special amusement area in which occupants are encouraged to solve a challenge to escape from a room or series of rooms." Of primary importance is the recognition that a puzzle room is considered as a special amusement area, and as such is subject to all applicable code provisions set forth in Section 411. This would include requirements mandating an automatic sprinkler system, an automatic smoke detection system, an emergency voice/alarm communications system, special exit marking and Class A interior finishes. Of particular note is that these requirements are all applicable regardless of the occupancy classification of the puzzle room, as the special provisions of Section 411 apply in a consistent manner to both Group A and Group B puzzle rooms.

In addition to compliance with all provisions applicable to other special amusement areas, puzzle rooms must also meet one of three exiting methodologies as set forth in Section 411.5. The means of egress system shall either 1) comply with the applicable provisions based upon occupancy classification as established in Chapter 10, 2) gain building official approval of an alternative means of egress design, or 3) meet the performance goal of the exit being open and readily available upon activation by the automatic sprinkler system, the automatic fire alarm system, as well as a manual control at a constantly attended location.

Through the regulation of puzzle rooms, this special type of building use can now be addressed in a manner specific to its hazards. Their recognition as special amusement buildings and the introduction of various means of egress solutions provides a very high level of protection for the occupants experiencing such facilities.

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414.2.3

Fire Wall Use for Control Areas

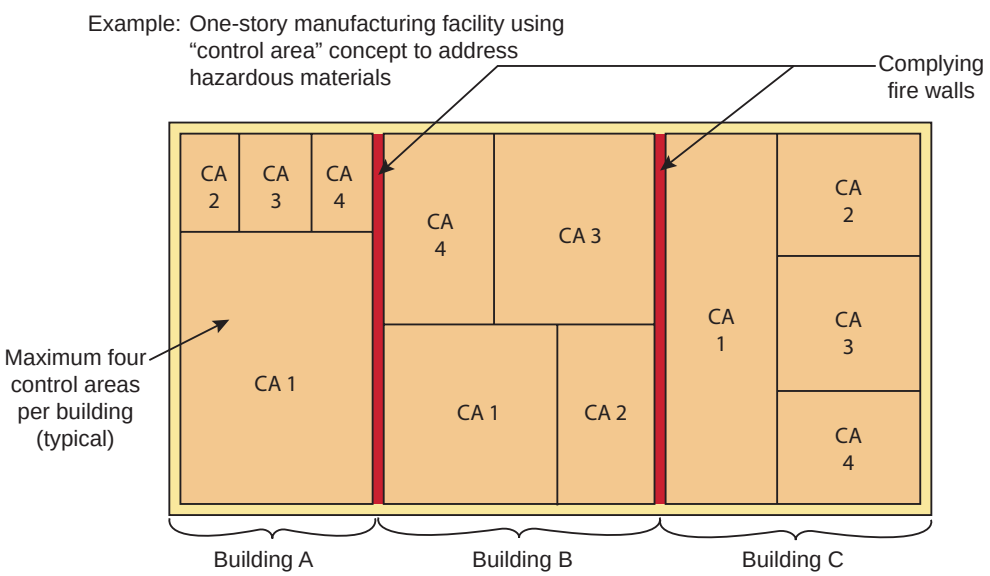
CHANGE TYPE: Addition

CHANGE SUMMARY: The scoping limitations of a fire wall's use to create separate buildings have been expanded through a new allowance for the number of control areas permitted.

2021 CODE TEXT: **414.2.3 Number.** The maximum number of control areas within a building shall be in accordance with Table 414.2.2. For the purposes of determining the number of control areas within a building, each portion of a building separated by one or more fire walls complying with Section 706 shall be considered a separate building.

CHANGE SIGNIFICANCE: Occupancy classifications of buildings containing hazardous materials are based on the maximum allowable quantities (MAQs) concept. As established in IBC Tables 307.1(1) and 307.1(2), the maximum amounts are identified for the various hazardous materials based on a variety of conditions. Where the MAQs are exceeded, the uses are to be classified as Group H occupancies. In those cases where the amounts do not exceed the MAQs, a classification other than Group H that best represents the building's use is assigned. It is often quite desirable to the designer that an occupancy classification of other than Group H be assigned due to the restrictive nature of the code when it regulates high-hazard uses. A fundamental method of maintaining a non-Group H condition is the creation of control areas.

Control areas are portions of a building that contain hazardous materials in amounts that do not exceed the MAQs and that are separated from other areas containing hazardous materials by fire-resistant construction. Any combination of hazardous materials, up to the MAQs, is permitted in a control area. The intent is that each control area is regulated for MAQs rather than the building as a whole, thereby increasing the amounts of hazardous materials that can be present without triggering a Group H classification. However, there is a limit to the number of control areas that



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can be created in a building as set forth in Table 414.2.2. For example, in a single-story building no more than four control areas can be provided. Therefore, a Group H classification will be mandated where the quantities of hazardous materials require the creation of more than four control areas. The use of one or more fire walls to create separate buildings is now applicable to the control area concept, allowing the permissible number of control areas to be increased. Where a structure is divided into separate buildings through the use of complying fire walls, each such separate building may now contain the maximum number of control areas permitted by Table 414.2.2.

The primary purpose of fire walls as regulated by Section 706 is to create separate buildings under one roof, providing an opportunity for the designer to regulate each of these buildings independently rather than as the entire structure. This highly regulated fire-resistance-rated vertical separation provides the necessary independence so that the portion of the structure on each side of the fire wall can be regulated individually. However, the application of the separate building concept is very limited. Section 503.1 mandates that a fire wall only creates separate buildings for the purposes of determining area limitations, height limitations and type of construction. This very short list, which reflects the scoping limitations of a fire wall's use to create separate buildings, has been expanded through a new allowance applicable to the limitation on the number of control areas permitted. As a result, an increased amount of hazardous materials may now be present without classification as a Group H occupancy where fire walls divide a structure into separate buildings.

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422.7

Cooking in Ambulatory Care Facilities

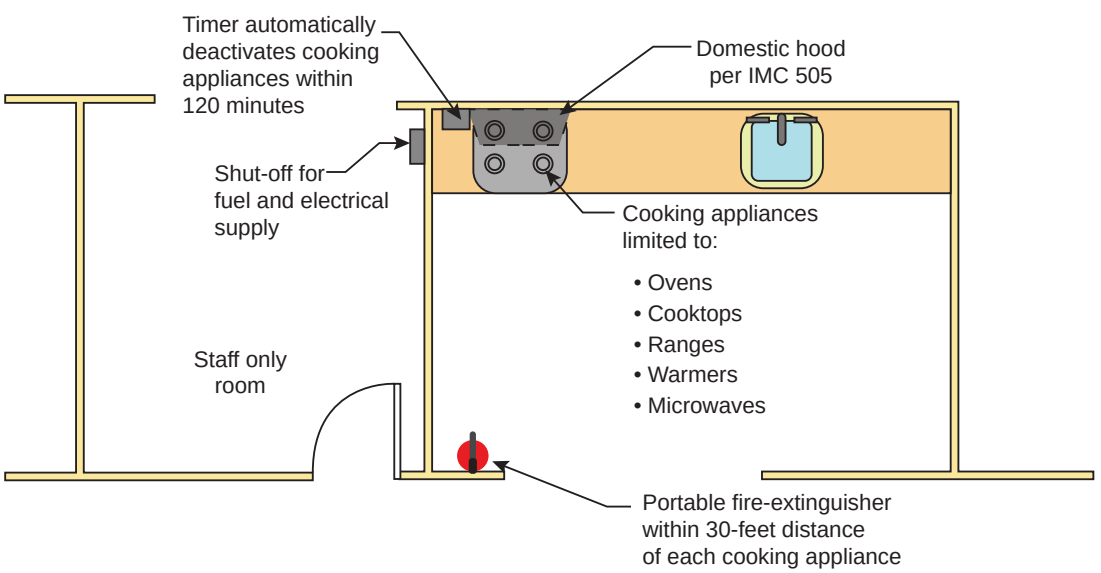
CHANGE TYPE: Modification

CHANGE SUMMARY: Where domestic cooking facilities are provided in ambulatory care facilities, conditions addressing the installation of the cooking appliances have now been established to address any fire concerns.

2021 CODE TEXT: **422.7 Domestic cooking.** Installation of cooking appliances used in domestic cooking facilities shall comply with all of the following:

1. The types of cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.
2. Domestic cooking hoods installed and constructed in accordance with Section 505 of the *International Mechanical Code* shall be provided over cooktops or ranges.
3. A shutoff for the fuel and electrical supply to the cooking equipment shall be provided in a location to which only staff has access.
4. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.
5. A portable fire extinguisher shall be provided. Installation shall be in accordance with Section 906 and the extinguisher shall be located within a 30-foot (9144 mm) distance of travel from each domestic cooking appliance.

CHANGE SIGNIFICANCE: Ambulatory care facilities, while classified as moderate-hazard Group B occupancies, pose life safety concerns due to the ongoing presence of individuals receiving care. Although such individuals are only in the facility for a limited period of time, they may be incapable of self-preservation and unable to egress. Therefore, such



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occupants must rely on staff to assist them under emergency conditions. Special conditions are placed on such facilities to create a protect-in-place environment, as well as to minimize the potential of a fire incident. Where domestic cooking facilities are provided in ambulatory care facilities, conditions addressing the installation of the cooking appliances have now been established to address any fire concerns.

Although not very common, there are times where physical therapy areas of ambulatory care facilities contain kitchens to educate patients in the safe operation of cooking equipment. Such training may be helpful to the patients for when they are cooking at home, or it may be a portion of nutrition counseling. The scope of the new provisions would also include domestic cooking facilities used for other purposes, such as where the cooking appliances are installed in an employee break room. Shared domestic cooking facilities in Group I-1 and I-2 facilities have been addressed in the IBC for several editions and provide a basis for extending similar regulations to Group B ambulatory care facilities.

There are five fundamental conditions of compliance that must be met to allow the installation of domestic cooking appliances in ambulatory care facilities. First, the only cooking appliances permitted are ovens, cooktops, ranges, warmers and microwaves. Second, ranges and cooktops must be provided with domestic cooking hoods constructed and installed in accordance with Section 505 of the *International Mechanical Code*® (IMC®), which regulates the exhaust equipment, exhaust ducts and required make-up air.

A third condition mandates that a shut-off be provided for the fuel and electrical supply to the cooking equipment. Such shut-off must be located in an area that is only accessible to staff. Fourth, a timer shall be provided to automatically shut down the cooking appliances within two hours. And fifth, a complying portable fire extinguisher shall be installed within 30 feet of travel of each cooking appliance.

Although ambulatory care facilities share many similarities with high-hazard Group I-1 and I-2 occupancies, it should be remembered that they are classified as moderate-hazard Group B occupancies. As such, the requirements applicable to cooking facilities in ambulatory care facilities are not as restrictive as those that apply to nursing homes, assisted living facilities, and other similar uses. For example, the domestic cooktop or range permitted in an ambulatory care facility is not required to be provided with an automatic fire-extinguishing system. However, the hazards presented by the installation of domestic cooking appliances do warrant some degree of regulation when such appliances are in a facility where individuals may be incapable of self-preservation for some limited time.

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424

Play Structures

CHANGE TYPE: Modification

CHANGE SUMMARY: The interior finish materials of play structures are now regulated for flame spread purposes. In addition, the scoping provisions have been modified to include larger structures, and the requirements are no longer limited to play structures for children's use.

2021 CODE TEXT:

SECTION 424
~~CHILDREN'S~~ PLAY STRUCTURES

424.2 Materials. ~~Children's play~~ Play structures shall be constructed of noncombustible materials or of combustible materials that comply with the following:

(no changes to Conditions 1 through 9)

10. Interior finishes for structures exceeding 600 square feet (56 m^2) in area or 10 feet (3048 mm) in height shall have a flame spread index not greater than that specified in Table 803.13 for the occupancy group and location designated. Interior wall and ceiling finish materials tested in accordance with NFPA 286 and meeting the acceptance criteria of Section 803.1.1.1 shall be permitted to be used where a Class A classification in accordance with ASTM E84 or UL 723 is required.

424.5 Area limits. ~~Children's play~~ Play structures shall not be greater than ~~300~~ 600 square feet (~~28~~ 56 m^2) in area, unless a special investigation, acceptable to the building official, has demonstrated adequate fire safety.



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Rock climbing wall.

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424.5.1 Design. Play structures exceeding 600 square feet (56 m^2) in area or 10 feet (3048 mm) in height shall be designed in accordance with Chapter 16.

CHANGE SIGNIFICANCE: Play structures for children's use were initially regulated by the IBC only where located within a covered mall building. As the use of such structures became more popular due to their presence in other types of buildings, such as fast-food restaurants and day care centers, the provisions were modified to regulate children's play structures regardless of the occupancy in which they are located. The code's primary concern related to these structures is the combustibility and flammability of its structure and contents. An additional condition of compliance has now been established as interior finish materials are now regulated for flame spread purposes. In addition, the scoping provisions have been modified to include larger structures, and the requirements are no longer limited to play structures for children's use.

Indoor structures used for recreational activities are not limited to use only by children. Rock climbing walls, laser tag arenas, skydiving facilities and many other types of indoor spaces are used by people of all ages. Obviously, the concerns relating to potential fire hazards are present regardless of the ages of the participants. It was deemed that the limitations on the materials used in such play structures should be applicable in all such structures, and not limited only to those designed for children's use. Therefore, all indoor play structures that fall within the scope of Section 424 are now regulated with no regard to the ages of those individuals participating in the play activity.

Unless constructed of noncombustible materials, the construction components of a play structure must comply with a number of specific conditions to address fire concerns. Another condition has been introduced that regulates the interior finishes of any play structure that exceeds 600 square feet in area or 10 feet in height. New Condition 10 references Table 803.13 addressing the flame spread index limit based on the occupancy classification of that portion of the building where the play structure is located.

Sole compliance with the conditions of Section 424.2 has previously been satisfactory regarding the regulation of combustible materials used in play structures provided the size of the structure was limited to 300 square feet in area. Where the area exceeded 300 square feet, a special investigation has been required to demonstrate adequate fire safety to the building official. That threshold at which a special investigation is required has been increased to 600 square feet in recognition of the adequacy of Section 424.2 in addressing the hazards involved with combustible play structure materials.

The threshold of 600 square feet in area, along with that for a maximum height of 10 feet, is also utilized in a new requirement that mandates the design of play structures in accordance with Chapter 16. It is increasingly common for play structures to be sizeable in area, height or both. Their structural systems should be designed in accordance with the provisions of Chapter 16 to address any special design considerations that may exist. There are often unique structural stability and anchorage requirements that must be considered. Therefore, where the play structure exceeds 10 feet in height, or where it exceeds 600 square feet in area, the structural requirements of Chapter 16 are applicable.

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503.1.4

Occupied Roof Allowances

CHANGE TYPE: Clarification

CHANGE SUMMARY: The proper approach to dealing with occupied roofs from the perspectives of building height, number of stories and installation of occupant notification features has been further clarified for a more consistent application of the code's intent.

2021 CODE TEXT: **503.1.4 Occupied roofs.** A roof level or portion thereof shall be permitted to be used as an occupied roof provided the occupancy of the roof is an occupancy that is permitted by Table 504.4 for the story immediately below the roof. The area of the occupied roofs shall not be included in the building area as regulated by Section 506. An occupied roof shall not be included in the building height or number of stories as regulated by Section 504, provided the penthouses and other enclosed roof structures comply with Section 1511.

Exceptions:

1. The occupancy located on an occupied roof shall not be limited to the occupancies allowed on the story immediately below the roof where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and occupant notification in accordance with ~~Section 907.5~~ Sections 907.5.2.1 and 907.5.2.3 is provided in the area of the occupied roof. Emergency voice/alarm communication system notification per Section 907.5.2.2 shall also be provided in the area of the occupied roof where such system is required elsewhere in the building.
2. *(no change to this exception)*



Photo courtesy of vgajic

Hotel rooftop cafe.

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CHANGE SIGNIFICANCE: The allowable building height in stories as limited by Table 504.4 is based on a combination of factors. A primary consideration is the building's type of construction, consistent with the application of Table 504.3 for allowable building height in feet. However, a significant difference between the two tables is the impact of the building's use on its maximum allowable height. The limits on stories above grade plane set forth in Table 504.4 vary widely based on the building's occupancy classification(s). New criteria were added to the 2018 IBC in order to establish the appropriate methodology for the determination of the allowable number of stories where one or more occupancies are located on the roof of the building. The proper approach to dealing with occupied roofs from an allowable height and an allowable number of stories perspective have been further clarified for a more consistent application of the code's intent.

The provisions now specifically state that in the determination of a building's allowable height and number of stories, an occupied roof is not to be considered as an additional story. In addition, it has also been clarified that compliance with Section 1511 for penthouses and other enclosed roof structures is necessary. The base requirement for allowing a roof level to be occupied remains unchanged, as the occupancy of the roof is limited to only those occupancies permitted by Table 504.4 to be located on the story directly below the roof. Only where the conditions of Exception 1 are met is an occupancy not in compliance with the base requirement allowed to be located on the roof.

An additional clarification addresses the conditions of Exception 1 recognizing there is no story limitation to be applied on rooftop occupancies where specified fire protection features are provided. In the application of the exception, the building must be provided with an automatic sprinkler system. In addition, occupant notification shall be extended to the occupiable area of the roof where a fire alarm system is required. The new provisions specifically reference Sections 907.5.2.1, 907.5.2.2 and 905.5.2.3 addressing audible alarms, emergency voice/alarm communication systems and visual alarms, respectively. However, due to the absence of scoping language mandating a fire alarm system be installed, occupant notification at the roof level is only applicable where an alarm system is already required elsewhere in the building.

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Table 504.3

Allowable Height in Feet

CHANGE TYPE: Addition

CHANGE SUMMARY: Height limits in feet above grade plane have now been established for the three new construction types addressing mass timber construction: IV-A, IV-B and I-VC.

2021 CODE TEXT: **504.3 Height in feet.** The maximum height, in feet, of a building shall not exceed the limits specified in Table 504.3.

TABLE 504.3 Allowable Building Height in Feet Above Grade Plane[a]

Occupancy Classification	See Footnotes	Type of Construction											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS[c,d]	UL	160	65	55	65	55	120	90	65	65	50	40
	S												
H-4	NS[c,d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d,e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS[d,e,f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d,g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R[h]	NS[d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

Footnotes not shown

CHANGE SIGNIFICANCE: Compliance with the limitations on a building's height in feet is one of three conditions in assigning a building's type of construction. Unlike the methodology for determining a building's allowable height in stories, the maximum permissible height in feet for each of the types of construction does not vary based on the building's occupancy groups. A building's allowable height in feet is typically determined based on only two conditions: the building's construction type and whether the building is sprinklered. Height limits in feet above grade plane have now been established for the three new construction types included in mass timber construction: IV-A, IV-B and IV-C.

During development of the allowable number of stories criteria for the new mass timber construction types, each individual type of construction was examined for its safety and efficacy in protecting occupants and the structure against risks associated with height above grade. Type IV-B limits were established to provide the same base fire-resistance requirements as Type IB construction, which sets forth requirements for 2-hour

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structural elements. Because of this comparison, and based on a review of the fire safety and structural integrity performance of protected mass timber that was verified by fire testing, the establishment of allowable height for the three new construction types started with setting Type IV-B story allowances equivalent to Type IB. However, note that the allowance for high-rise buildings in Section 403.2.1.1 to reduce IB construction to 1-hour structural elements is not allowed for Type IV-B construction. Essentially, where a high-rise building is permitted to be constructed of IB construction and has 1-hour fire protection, that same building will require 2-hour structural elements for Type IV-B construction. It was decided to take the more conservative approach in addressing the required fire-resistance for mass timber buildings.

It was also determined that Type IV-A should be permitted to be somewhat taller than Type IV-B since Type IV-A construction is entirely protected (no exposed mass timber permitted) and the required fire-resistance rating (FRR) of the structure is equivalent to requirements for Type IA construction (3-hour FRR for the structural frame). However, by continuing to take the more conservative approach, it was deemed unacceptable to allow the unlimited heights of Type IA to be applied to Type IV-A. For most occupancies in fully sprinklered buildings, a multiplier of 1.5 was applied to the heights developed for Type IV-B construction to develop reasonable height allowances for Type IV-A construction.

Type IV-C was viewed as similar to Type IV-HT construction, with the exception that Type IV-C has a 2-hour FRR where HT is accepted as fire resistant based on the large sizes of the members. As such, the height in feet for Type IV-C is consistently equal to the height in feet of Type IV-HT.

Of major importance is the intent that buildings of the three new types of mass timber construction should be protected by automatic sprinkler systems. Relying on Section 903.2.11.3 as a guide, which requires an automatic sprinkler system to be installed for most buildings with one or more stories located more than 55 feet above the lowest level of fire department vehicle access, the intent to have fully sprinklered buildings for the three new construction types has, in all practical terms, been met. However, the calculation of allowable area increase for open perimeter is based on the nonsprinklered building area (tabulated as NS in Table 506.2), so it was incumbent to provide tabulated NS values as well.

Of particular note is that no additional heights over what is permitted for Type IV-HT are permitted for nonsprinklered buildings of the new construction types. As such, where separate rows in Table 504.3 are provided for heights for the NS situation, the heights for Types IV-A, IV-B, and IV-C are consistent with those heights historically permitted for Type IV-HT. A similar approach is used for the allowable number of stories in Table 504.4. The historical recognition that nonsprinklered buildings of a specified construction type are limited to a height of 20 feet less than that permitted for a similar sprinklered building does not apply to the three new mass timber types of construction.

For occupancy groups A, B, E, F, M, R, S and U, the methodology described above reflects the development of the height in feet limits. After using this methodology to develop initial allowable building heights, professional judgment was applied (from both a fire safety and a structural perspective), cell by cell, for all occupancy types. A more thorough examination of the reasoning applied in the assignment of allowable building height is available in the publication *Mass Timber Buildings and the IBC*.

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Table 504.4

Allowable Height in Stories

CHANGE TYPE: Addition

CHANGE SUMMARY: Height limits in stories above grade plane have now been established for the three new construction types included in mass timber construction, and increases in allowable height for Group S-1 occupancies in sprinklered buildings of Type IIB and IIIB construction have been made.

2021 CODE TEXT: **504.4 Number of stories.** The maximum number of stories above grade plane of a building shall not exceed the limits specified in Table 504.4.

TABLE 504.4 Allowable Number of Stories Above Grade Plane[a,b]

Occupancy Classification	See Footnotes	Type of Construction											
		Type I		Type II		Type III		Type IV	Type IV	Type IV	Type IV	Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3
H-1	NS[c, d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS[c, d]	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS[c, d]	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS[c, d]	UL	7	5	3	5	3	5	5	5	5	3	2
	S	UL	8	6	4	6	4	8	7	6	6	4	3
H-5	NS[c, d]	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			

table continued

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TABLE 504.4 *continued*

Occupancy Classification	See Footnotes	Type of Construction											
		Type I		Type II		Type III		Type IV	Type IV	Type IV	Type IV	Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
I-1 Condition 1	NS[d,e]	UL	9	4	3	4	3	4	4	4	4	3	2
	S	UL	10	5	4	5	4	10	7	5	5	4	3
I-1 Condition 2	NS[d,e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d,f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d,e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2
I-4	NS[d,g]	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
M	NS	UL	11	4	2	4	2	4	4	4	4	3	1
	S	UL	12	5	3	5	3	12	8	6	5	4	2
R-1[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3[h]	NS[d]	UL	11									3	3
	S13D	4	4	4	4	4	4	4	4	4	4	3	3
	S13R	4	4									4	4
	S	UL	12	5	5	5	5	18	12	5	5	4	4
R-4[h]	NS[d]	UL	11									3	2
	S13D	4	4	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	4	4	4	3	1
	S	UL	12	5	~~3~~4	4	~~3~~4	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	~~4~~5	4	2
	S	UL	12	6	4	5	4	12	8	5	~~5~~6	5	3
U	NS	UL	5	4	2	3	2	4	4	4	4	2	1
	S	UL	6	5	3	4	3	9	6	5	5	3	2

Footnotes not shown

CHANGE SIGNIFICANCE: Along with allowable height in feet and allowable building areas, compliance with the limitations on a building's height in stories is one of three conditions in assigning a building's type of construction. Unlike the methodology for determining a building's allowable height in feet, the maximum permissible height in stories for each of the types of construction can vary considerably based on the building's occupancy classification(s). Height limits in stories above grade plane have now been established

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for the three new construction types included in mass timber construction. In addition, increases in allowable height have been made for Group S-1 occupancies in sprinklered buildings of Type IIB and IIIB construction.

Much of the rationale established in the development of the allowable height in feet limitations for new construction types (Types IV-A, IV-B and IV-C) is also applicable to the determination of a mass timber building's allowable number of stories. The allowable number of stories assigned to sprinklered Type IB buildings is also applied to buildings of Type IV-B construction for Group A, B, E, H-1, I-2, I-3, I-4, R and U occupancies. The allowable number of stories permitted for the remaining occupancies in a Type IV-B building has been selectively reduced below those permitted for Group I-B for various reasons. Tabular entries for Type IV-A and IV-C construction were also derived in a manner similar to that used for allowable height in feet limitations. Type IV-A limits are typically increased by a modifier of 1.5 applied to buildings of Type IV-B, and Type IV-C limits are generally consistent with those of Type IV-HT buildings. Consistent with the development of the limits on building height in feet and building area, each occupancy was reviewed individually to address any specific hazards that would warrant a variance from the established process.

Consistent with the limits placed on the allowable height in feet for Type IV-A, IV-B and IV-C buildings, no additional stories over those permitted for Type IV-HT are allowed for nonsprinklered buildings. As such, where separate rows in Table 504.4 are provided for the number of stories for the NS situation, the limits for Types IV-A, IV-B and IV-C are typically consistent with those historically permitted for Type IV-HT. A similar approach was used for the allowable height in feet in Table 504.3. The historical recognition that nonsprinklered buildings of a specified construction type are limited to a height in stories above grade plane of one fewer story than that permitted for a similar sprinklered building does not apply to the three new mass timber types of construction.

An additional change is specific only to moderate-hazard Group S-1 storage occupancies in sprinklered buildings of Type IIB and IIIB construction. The new allowance of up to four stories above grade plane is now consistent with the allowable height in stories permitted in the 2006 IBC and previous editions. For the 2009 edition of the IBC, several inconsistencies in the original allowable height thresholds were identified and reductions were made in the allowable number of stories for Group B, M, S-1 and S-2 occupancies in both sprinklered and nonsprinklered Type IIB and IIB buildings. Although the latest modification restores the allowable height to four stories per the 2006 IBC story limit for sprinklered Group S-1 occupancies in buildings of Type IIB and IIIB construction, it does not modify the maximum allowable height in stories above grade plane for Group B, M and S-2 occupancies. There is also no change in the story limit for nonsprinklered Group S-1 occupancies.

The allowable story heights have also been modified for Group S-2 occupancies in buildings of Type IV-HT construction. The limits of 4 stories in nonsprinklered buildings and five stories in sprinklered buildings have been increased to five stories and six stories, respectively. This modification corrects two tabular value errors that went undetected in the transition from Table 503 in the 2012 IBC to Table 504.4 in the 2015 edition. There was no intent at the time of the transition to make any technical changes to allowable building height from what was previously allowed.

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CHANGE TYPE: Addition

Table 506.2

Allowable Building Area

CHANGE SUMMARY: Building area limitations have now been established for the three new construction types included in mass timber construction, and an increase has occurred in allowable single-story floor area for Group I-3 occupancies in sprinklered buildings of Type IIA construction.

2021 CODE TEXT: **506.2 Allowable area determination.** The allowable area of a building shall be determined in accordance with the applicable provisions of Sections 506.2.1, 506.2.2 and 506.3.

TABLE 506.2 Allowable Area Factor (A_t = NS, S1, S13R, S13D or SM, as Applicable) in Square Feet[a,b]

Occupancy Classification	See Footnotes	Type of Construction											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS S1 SM	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500

table continued

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TABLE 506.2 *continued*

Occupancy Classification	See Footnotes	Type of Construction											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c] S1	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	NP
H-2	NS[c] S1 SM	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	3,000
H-3	NS[c] S1 SM	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500	10,000	5,000
H-4	NS[c,d]	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c,d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108,000	54,000	27,000
I-1	NS[d,e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d,f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d,e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	60,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d,g]	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	25,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1[h]	NS[d] S13R	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000

table continued

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TABLE 506.2 *continued*

Occupancy Classification	See Footnotes	Type of Construction											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
R-2[h]	NS[d] S13R	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-3[h]	NS[d] S13D S13R S1 SM	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
R-4[h]	NS[d] S13D S13R	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS[i]	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

Footnotes not shown

CHANGE SIGNIFICANCE: Allowable building area, as established in part by Table 506.2, limits the size of buildings in order to limit to a reasonable level the magnitude of a fire that potentially may develop. Whereas floor-area limitations are concerned primarily with property damage, life safety is enhanced as well by the fact that in the larger buildings there are typically more people at risk during a fire. The essential ingredients in the determination of allowable areas are 1) the amount of combustibles attributable to the use, and 2) the amount of combustibles in the construction of the building, both of which contribute to the potential fire severity. Building area limitations have now been established for the three new construction types included in mass timber construction. In addition, an increase in allowable floor area for Group I-3 occupancies in one-story sprinklered buildings of Type IIA construction has occurred.

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Because the allowable size of a building is directly related to its materials of construction, as well as the fire-resistance-rated protection of such materials, the assignment of allowable area factors for each of the three new mass timber construction types is an important decision. Recognizing the additional impact to the factors in Table 506.2 by the occupancy classification(s) involved, the allowable area factors for the new mass timber construction types also vary based on the hazards involved due to the building's use. The determination of appropriate allowable area factors was made in a rigorous fashion consistent with the efforts addressing allowable building height. Each of the three new construction types was examined for its fire safety characteristics. A multiplier was then assigned to each of the new construction types to be applied to the current factors applicable to Type IV-HT construction. The intended result was to reflect the additional passive fire protection provided by the new construction types (Types IV-A, IV-B and IV-C).

The allowable area factors of Table 506.2 for buildings of Type IV-HT construction were initially increased by the following multipliers:

- Type IV-C is 1.25 times the Type IV-HT allowable area factor.
- Type IV-B is 2.00 times the Type IV-HT allowable area factor.
- Type IV-A is 3.00 times the Type IV-HT allowable area factor.

The resulting allowable area factors were then reexamined on a case-by-case basis regarding their relative hazard and occupancy classification. Maintaining a conservative approach, some hazards were perceived to be of a greater concern, and the allowable area factors were adjusted downward. The two occupancy classifications considered as representing the most hazardous conditions, Group I and Group H, were ultimately assigned reduced factors from those determined solely by using the multipliers. Additionally, the allowable area factors for each occupancy were considered in conjunction with each occupancy's allowable height to conservatively address risks associated with allowable floor areas at specific heights.

The allowable area limits have also been modified for Group I-3 occupancies in one-story buildings of Type IIA construction. The limit of 45,000 square feet in single-story sprinklered buildings has been increased to 60,000 square feet. This modification corrects a tabular value error that went undetected in the transition from Table 503 in the 2012 IBC to Table 506.2 in the 2015 edition. There was no intent at the time of the transition to make any technical changes to allowable building area from what was previously allowed.

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506.3.2 Allowable Area Frontage Increase

CHANGE TYPE: Modification

CHANGE SUMMARY: The methodology for establishing the permissible allowable area increase for frontage has been simplified through the use of a tabular format to make for a more efficient approach to allowable area determination.

2021 CODE TEXT: **506.3.2 Minimum frontage distance.** To qualify for an area factor increase based on frontage, the public way or open space adjacent to the building perimeter shall have a minimum distance (*W*) of 20 feet (6096 mm) measured at right angles from the building face to any of the following:

1. The closest interior lot line.
2. The entire width of a street, alley or public way.
3. The exterior face of an adjacent building on the same property.

~~Where the value of *W* is greater than 30 feet (9144 mm), a value of 30 feet (9144 mm) shall be used in calculating the building area increase based on frontage, regardless of the actual width of the public way or open space. Where the value of *W* varies along the perimeter of the building, the calculation performed in accordance with Equation 5-5 shall be based on the weighted average calculated in accordance with Equation 5-4.~~

~~$$W = L_1 \times w_1 + L_2 \times w_2 + L_3 \times w_3 \ldots)/F$$ **(Equation 5-4)**~~

~~where:~~

~~*W* (Width: weighted average) = Calculated width of public way or open space (feet).~~
~~L_n = Length of a portion of the exterior perimeter wall.~~
~~w_n = Width (≥ 20 feet) of a public way or open space associated with that portion of the exterior perimeter wall.~~
~~*F* = Building perimeter that fronts on a public way or open space having a width of 20 feet (6096 mm) or more.~~

The frontage increase shall be based on the smallest public way or open space that is 20 feet (6096 mm) or greater, and the percentage of building perimeter having a minimum 20 feet (6096 mm) public way or open space.

506.3.3 Amount of increase. The area factor increase based on frontage shall be determined in accordance with ~~Equation 5-5:~~ Table 506.3.3.

~~$$I_f = [F/P - 0.25]W/30$$ **(Equation 5-5)**~~

~~where:~~

~~I_f = Area factor increase due to frontage.~~
~~*F* = Building perimeter that fronts on a public way or open space having minimum distance of 20 feet (6096 mm).~~
~~*P* = Perimeter of entire building (feet).~~
~~*W* = Width of public way or open space (feet) in accordance with Section 506.3.2.~~

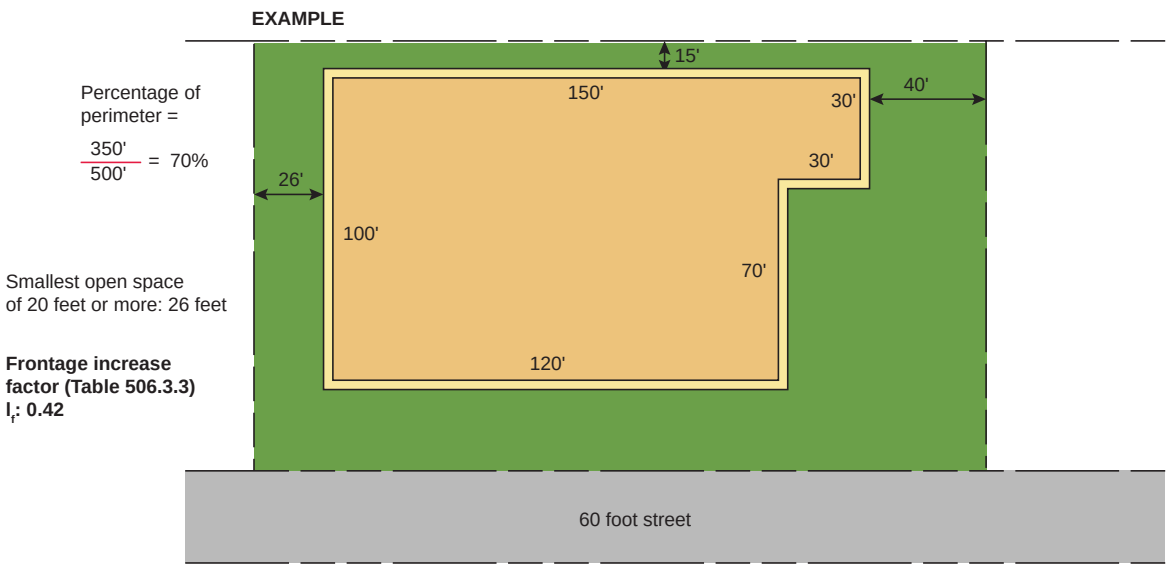
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TABLE 506.3.3 Frontage Increase Factor[a]

Percentage of Building Perimeter	Open Space			
	0 to less than 20 Feet	20 to less than 25 Feet	25 to less than 30 Feet	30 Feet or greater
0 to less than 25	0	0	0	0
25 to less than 50	0	0.17	0.21	0.25
50 to less than 75	0	0.33	0.42	0.50
75 to 100	0	0.50	0.63	0.75

a. Interpolation is permitted.



~~**Exception (to Section 506.3.2):**~~ **506.3.3.1 Section 507 buildings.** Where a building meets the requirements of Section 507, as applicable, except for compliance with the minimum 60-foot (18 288 mm) public way or yard requirement, ~~and the value of W is greater than 30 feet, the value of W shall not exceed 60 feet~~ the area factor increase based on frontage shall be determined in accordance with Table 506.3.3.1.

TABLE 506.3.3.1 Section 507 Buildings[a]

Percentage of Building Perimeter	Open Space					
	30 to less than 35 feet	35 to less than 40 feet	40 to less than 45 feet	45 to less than 50 feet	50 to less than 55 feet	55 to less than 60 feet
0 to less than 25	0	0	0	0	0	0
25 to less than 50	0.29	0.33	0.38	0.42	0.46	0.50
50 to less than 75	0.58	0.67	0.75	0.83	0.92	1.00
75 to 100	0.88	1.00	1.13	1.25	1.38	1.50

a. Interpolation is permitted.

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CHANGE SIGNIFICANCE: If a building is provided with frontage consisting of public ways and/or open space for a sizable portion of the perimeter of the building, some benefit will accrue based on better access for the fire department. Also, if the yards or public ways are wide enough, there will be a benefit due to the decreased exposure from adjoining hazards. Because of the beneficial aspects of open space adjacent to a building, the IBC permits increases in the tabular areas established from Table 506.2 based on the amount of open perimeter and width of the open space and public ways surrounding the building. The methodology for establishing the permissible allowable area increase for frontage has been simplified to make for a more efficient approach to allowable area determination.

Calculating the allowable area increase based on frontage has historically been a very confusing and time-consuming process with a relatively limited benefit, particularly as compared to the automatic sprinkler system increase. Two significant modifications were made in the effort to simplify the concept of allowing an increase in allowable floor area for those buildings that have a specified degree of open space surrounding the building. First, the allowance for "weighting" the open space area increase (Equation 5-4) has been eliminated and replaced with recognition of the smallest yard of 20 feet or more in width. Second, the calculation of the area factor increase due to frontage (Equation 5-5) has been deleted in favor of new Table 506.3.3, which provides a limited number of frontage increase factors based on percentage of perimeter open and width of open space ranges. The values in Table 506.3.3 have been based on the calculation process as previously established in Equation 5-5.

The use of a "weighted average" approach in determining the allowable frontage increase was first established in the 2003 IBC. Applicable only to those situations where the open space adjacent to a building's exterior wall was at least 20 feet in width, but less than 30 feet in width, the weighting of open space has been viewed by many as confusing and, as a result, has been seldom applied. Although the elimination of this concept may result in a slight reduction in the available frontage increase as determined by new Table 506.3.3, the impact of its deletion is relatively small due to the limited scope of its application. In addition, it removes a significant amount of the confusion related to the frontage increase determination.

The code will continue to recognize that no frontage increase is provided where an open space and/or public way is less than 20 feet in width. In addition, there is no change in the recognition that no additional credit is given for those open spaces greater than 30 feet in width. However, the methodology of "weighting" (a form of averaging) those open spaces that have a width between 20 feet and 30 feet is no longer utilized. In the new evaluation of the frontage increase, the smallest open space width that is 20 feet or greater is to be used in the application of new Table 506.3.3.

As mentioned, new Table 506.3.3 is based on the factors established in the now deleted Equation 5-5. The area increase factor I_f has previously been determined due to 1) the amount of building perimeter fronting on a minimum 20-foot open space or public way, 2) the building's entire perimeter, and 3) the width of the public way or open space as determined by the weighted average method. Items 1 and 2 will continue to be

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represented in the new table by a limited number of ranges representing the amount of perimeter considered to be open, while Item 3 is now represented by only the smallest open space that is 20 feet or more.

The streamlined process is simply a matter of 1) determining the percentage of perimeter considered to be open, 2) identifying the smallest open space or public way that is at least 20 feet in width, and 3) applying the applicable row and column in the table to identify the allowable frontage increase I_f for the building under consideration. In applying the factors established in Table 506.3.3, it is acceptable to interpolate both the percentage of perimeter and the width of the open space if necessary to gain an additional limited increase for frontage; however, such interpolation will typically not be necessary.

A related revision occurs with the replacement of the exception to Section 506.3.2 with new Table 506.3.3.1 for those buildings that comply with the conditions of Section 507 (unlimited area buildings) except for compliance with the minimum 60-foot public way or yard requirement. This new table is to be applied in the same manner as Table 506.3.3 in the determination of the frontage increase factor I_f.

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CHANGE TYPE: Clarification

508.4.4 Separated Occupancies

CHANGE SUMMARY: The clarity and functionality provided by a format change to Table 508.4.4 addressing separated occupancies is intended to eliminate any confusion as to the table's proper use.

2021 CODE TEXT: **508.4.4 Separation.** Individual occupancies shall be separated from adjacent occupancies in accordance with Table 508.4.

TABLE 508.4 Required Separation of Occupancies (Hours)[f]

	A, E		I-1[a], I-3, I-4		I-2		R[a]		F-2, S-2[b], U		B[e], F-1, M, S-1		H-1		H-2		H-3, H-4		H-5	
Occupancy	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1[a], I-3, I-4	1	2	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	2	NP	2	NP	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R[a]	1	2	1	NP	2	NP	N	N	1[c]	2[c]	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	N	1	1	2	2	NP	1[c]	2[c]	N	N	1	2	NP	NP	3	4	2	3	2	NP
B[e], F-1, M, S-1	1	2	1	2	2	NP	1	2	1	2	N	N	NP	NP	2	3	1	2	1	NP
H-1	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	N	NP	NP	NP	NP	NP	NP	NP
H-2	3	4	3	NP	3	NP	3	NP	3	4	2	3	NP	NP	N	NP	1	NP	1	NP
H-3, H-4	2	3	2	NP	2	NP	2	NP	2	3	1	2	NP	NP	1	NP	1[d]	NP	1	NP
H-5	2	NP	2	NP	2	NP	2	NP	2	NP	1	NP	NP	NP	1	NP	1	NP	N	NP

Footnotes not shown

CHANGE SIGNIFICANCE: Where a building contains multiple occupancy classifications, Section 508 requires that at least one of three established methodologies be applied to address the varied hazards. Separated occupancies, one of the three available methods, is based upon the similarities, or dissimilarities, of hazards posed by the adjacent occupancies being regulated. Where the hazards are deemed to be sufficiently dissimilar, some degree of fire-resistance-rated separation is required by Table 508.4. However, no fire-resistive separation is required by the table where the occupancies pose hazards that are somewhat similar. The table's format has been revised in a manner to help limit confusion in its application.

The use of Table 508.4 is dependent upon identifying the two occupancies being evaluated under the separated occupancies approach to mixed occupancy evaluation. One of the occupancies is selected from the horizontal row at the top of the table, the other from the vertical column along the table's left-hand side. The intersection of the applicable row and column is intended to provide the minimum hourly fire-resistance rating required for the fire barrier and/or horizontal assembly needed to provide the required separation. However, this methodology often appeared to indicate no requirement, as the intersecting row and column resulted in a dashed mark rather than a required hourly rating. This unintended application has been addressed by completing the balance of Table 508.4. The revision is simply editorial in nature, as no technical requirements have been modified. The clarity and functionality provided by the format change should eliminate any previous confusion as to the table's proper use.

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508.4.4.1, 509.4.1.1

Fire Separations of Mass Timber

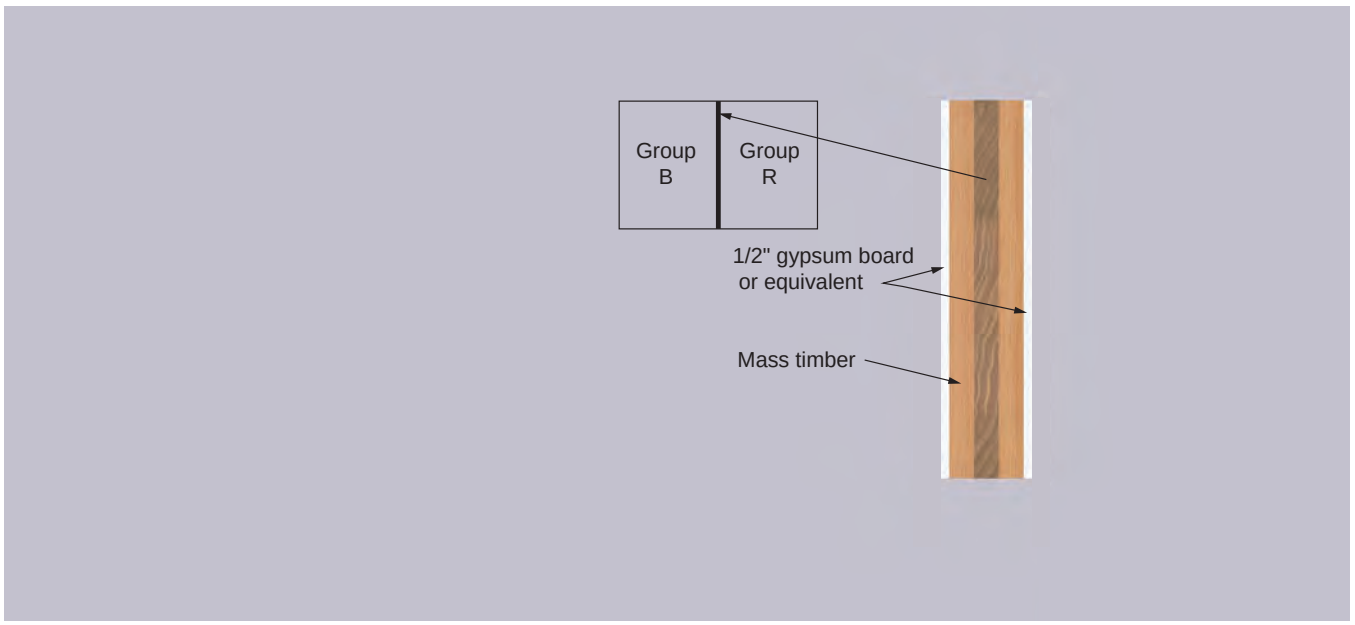
CHANGE TYPE: Addition

CHANGE SUMMARY: Additional criteria for the use of mass timber elements serving as fire barriers and horizontal assemblies in mass timber buildings include the installation of a thermal barrier as part of any required incidental use and occupancy separations.

2021 CODE TEXT: **508.4.4.1 Construction.** Required separations shall be fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both, so as to completely separate adjacent occupancies. Mass timber elements serving as fire barriers or horizontal assemblies to separate occupancies in Type IV-B or IV-C construction shall be separated from the interior of the building with an approved thermal barrier consisting of gypsum board that is not less than 1/2 inch (12.7 mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

509.4.1.1 Type IV-B and IV-C construction. Where Table 509.1 specifies a fire-resistance-rated separation, mass timber elements serving as fire barriers or horizontal assemblies in Type IV-B or IV-C construction shall be separated from the interior of the incidental use with an approved thermal barrier consisting of gypsum board that is not less than 1/2 inch (12.7 mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

CHANGE SIGNIFICANCE: Fire barriers and horizontal assemblies are referenced in both Sections 508.4.4 and 509.4.1 as the means to create a substantial fire separation where mandated for occupancy separations



Example: Type IV-C construction with mixed occupancy consisting of business and residential uses.

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and incidental use separations. The use of such fire-resistance-rated assemblies allows for the creation of a compartment that will, through containment, impede the spread of a fire to other areas outside of the compartment. Where the separated occupancies method is applied in a mixed-occupancy building, the fire barrier and/or horizontal assembly separation isolates dissimilar hazards to regulate each occupancy independently from other occupancies in the building. The use of fire barriers and/or horizontal assemblies provides a means to contain a fire in an incidental use area for an established period of time so it does not spread to surrounding areas. Additional criteria for such fire assemblies in Type IV-B and IV-C construction now include the installation of a thermal barrier as part of any required incidental use and occupancy separations.

The thermal protection of exposed mass timber elements used as occupancy separations or incidental use separations is only applicable to those buildings classified as Type IV-B or IV-C. There is no need to regulate Type IV-A construction due to the mandatory noncombustible protection of all mass timber elements. The requirements are generally consistent for both types of separation. Exposed mass timber in fire barriers and horizontal assemblies used as occupancy separations must be provided with a complying thermal barrier. For incidental use separations, the thermal barrier need only be installed on the side where the hazard occurs, that is, the side within the incidental use.

The installation of a thermal barrier delays or prevents ignition of the mass timber member, thus delaying or preventing its contribution to the fuel load. As a result, additional time is available for occupants to evacuate and fire personnel to respond. The thermal barrier may consist of gypsum board at least ½-inch in thickness or any material tested to and meeting the acceptance criteria of the Temperature Fire Test and the Integrity Fire Test established in the National Fire Protection Association standard NFPA 275, *Standard Method of Fire Tests for the Evaluation of Thermal Barriers*.

It is important to note that the thermal barrier requirements are only established to address the possible contribution of exposed mass timber surfaces to the fuel load. The thermal barrier is not intended to increase the fire-resistance ratings of mass timber fire barriers and/or horizontal assemblies used as occupancy separations or incidental use separations.

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508.5

Live/Work Units

CHANGE TYPE: Clarification

CHANGE SUMMARY: The criteria for live/work units has been relocated from the special use provisions of Chapter 4 to the mixed occupancy provisions of Section 508, with no change to the technical requirements.

2021 CODE TEXT:

~~**SECTION 419**~~
~~**LIVE/WORK UNITS**~~

508.1 General. Each portion of a building shall be individually classified in accordance with Section 302.1. Where a building contains more than one occupancy group, the building or portion thereof shall comply with the applicable provisions of Section 508.2, 508.3 ~~or~~, 508.4, or 508.5, or a combination of these sections.

Exceptions:

(no changes to Exceptions 1 and 2)

3. ~~Uses within live/work units, complying with Section 419, are not considered separate occupancies.~~



Photo courtesy of kaceyb

Live/work unit.

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~~**419.1 General**~~ **508.5 Live/work units.** A live/work unit shall comply with Sections ~~419.1~~ 508.5 through ~~419.9~~ 508.5.11.

(no change to Exception)

~~**419.1**~~ **508.5.1 through ~~419.9~~ 508.5.11.** *(no changes to provisions)*

CHANGE SIGNIFICANCE: The concept of live/work units typically combines a residential unit with a small business activity. Residential live/work units often include a dwelling unit along with some public service business, such as an artist's studio, coffee shop or chiropractor's office. There may be a small number of employees working within the unit, and the public is able to enter the work area of the unit to acquire service. Live/work units are a throwback to the 1900-era where residents could walk to all the needed services within their neighborhood. Provisions specifically addressing live/work units recognize the uniqueness of this type of use. By definition, such a unit is primarily residential in nature but has a sizable portion of the space devoted to nonresidential activities. The recognition of live/work units has been relocated from the special use provisions of Chapter 4 to the mixed occupancy provisions of Section 508, with no change to the technical requirements.

The singular benefit of buildings, or portions of buildings, that are in compliance with the live/work unit provisions is that such units are not considered as being a mixed occupancy condition. Classified solely as Group R-2 occupancies, live/work units need only comply with those code requirements applicable to the Group R-2 classification, unless specifically addressed in Sections 508.5.3 through 508.5.11. Within the unit, the mixed occupancy requirements of Section 508 are not applicable because the entire unit is considered as only one occupancy, Group R-2. The inclusion of the live/work provisions in Section 508 is actually more of an exception than a general requirement, as a live/work unit does not create a mixed occupancy condition. The change is simply a relocation of existing requirements, as no technical modifications have occurred.

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Table 509.1

Storage Battery Systems as Incidental Uses

CHANGE TYPE: Modification

CHANGE SUMMARY: The identification of stationary storage battery systems as incidental uses, and the corresponding fire separations required for such uses, have been deleted from Table 509.1 and are now more comprehensively regulated by Section 1207 of the IFC.

2021 CODE TEXT:

TABLE 509.1 Incidental Uses

Room or Area	Separation and/or Protection
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen fuel gas rooms, not classified as Group H	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and provide automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic sprinkler system
In Group E occupancies, laboratories and vocational shops not classified as Group H	1 hour or provide automatic sprinkler system
In Group I-2 occupancies, laboratories not classified as Group H	1 hour and provide automatic sprinkler system
In ambulatory care facilities, laboratories not classified as Group H	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
In Group I-2, laundry rooms over 100 square feet	1 hour
Group I-3 cells and Group I-2, patient rooms equipped with padded surfaces	1 hour
In Group I-2, physical plant maintenance shops	1 hour
In ambulatory care facilities or Group I-2 occupancies, waste and linen collection rooms with containers that have an aggregate volume of 10 cubic feet or greater	1 hour
In other than ambulatory care facilities and Group I-2 occupancies, waste and linen collection rooms over 100 square feet	1 hour or provide automatic sprinkler system
In ambulatory care facilities or Group I-2 occupancies, storage rooms greater than 100 square feet	1 hour
~~Stationary storage battery systems having an energy capacity greater than the threshold quantity specified in Table 1206.2 of the *International Fire Code*~~	~~1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.~~
Electrical installations and transformers	See Sections 110.26 through 110.34 and Sections 450.8 through 450.48 of NFPA 70 for protection and separation requirements.

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Photo courtesy of Mischa Keirjser

Storage battery system.

CHANGE SIGNIFICANCE: Incidental uses are limited to those uses listed in Table 509.1. The listed uses have been selected for inclusion because of the increased hazard they present to the other areas of the building. However, it is also recognized that the degree of hazard is such that a separate occupancy classification is not warranted. Through fire separation and/or fire protection requirements, the code provides safeguards to address the potential hazard these uses may pose. The requirements of Table 509.1 identifying stationary storage battery systems as incidental uses, and the corresponding fire separations required for such uses, have been deleted and are now more comprehensively regulated by Section 1207 of the IFC.

Section 1207 of the IFC, Electrical Energy Storage Systems, has added extensive protection features to such installations, including detection, suppression, fire separation and explosion control, along with large scale testing to document the effectiveness of chosen protection levels. With the increased level of protection mandated by the IFC, there is no longer a need to address areas containing stationary storage battery systems under the incidental use provisions.

For more information of the changes to IFC Section 1207 regarding electrical energy storage systems, see the ICC publication *Significant Changes to the International Fire Code, 2021 Edition*.

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510.2

Stairway Construction in Podium Buildings

CHANGE TYPE: Modification

CHANGE SUMMARY: Where a combustible building (Type III, IV or V) is located above the lower noncombustible (Type IA) building when applying the horizontal building separation allowance, interior exit stairways located within the Type IA building may be constructed of combustible materials where specified conditions are met.

2021 CODE TEXT: **510.2 Horizontal building separation allowance.** A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories and type of construction where the following conditions are met:

(no changes to Conditions 1-3)

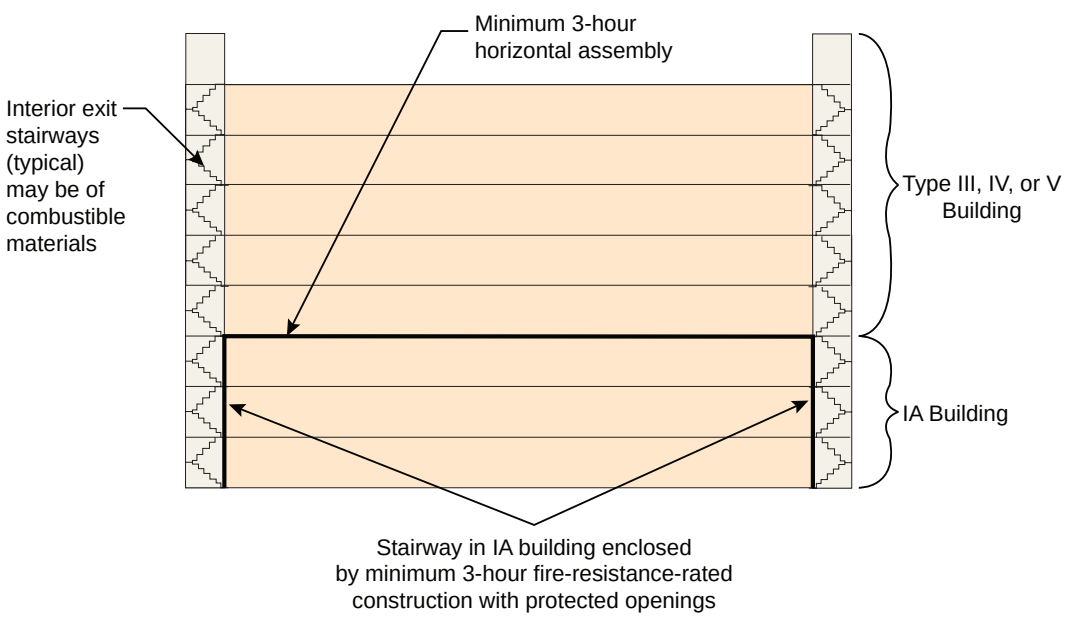
4. Interior exit stairways located within the Type IA building are permitted to be of combustible materials where the following requirements are met:

4.1 The building above the Type IA building is of Type III, IV, or V construction.

4.2 The stairway located in the Type IA building is enclosed by 3-hour fire-resistance-rated construction with opening protectives in accordance with Section 716.

(no changes to renumbered Conditions 5-7)

CHANGE SIGNIFICANCE: The provisions set forth in Section 510 allow for modifications or exceptions to the general provisions of Chapter 5 for allowable building heights and areas. These special provisions are viewed as specific in nature and take precedence over any general provisions that may apply. Section 510.2, addressing the horizontal building separation allowance, is one of the most common applications in use today.



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This methodology is often referred to as a "podium" or pedestal" building. Limited in application, the provisions create, in effect, an exception that allows those stories below a 3-hour horizontal fire separation to be considered portions of a separate building from the "building" above the horizontal fire separation. Multiple conditions must be met in order to take advantage of these provisions. A new allowance addresses the permissible materials of stairway construction where a combustible building (Type III, IV or V) is located above the lower noncombustible (Type IA) building.

Section 1011.7 indicates that stairways are to be built of materials consistent with those materials permitted for the building's type of construction. This mandate is easily addressed in most buildings, as the code requires a building to be classified as a single construction type. However, in those buildings designed and built under the special provisions of Section 510.2 allowing for a horizontal building separation, two types of construction are permitted. The lower building must be of Type IA construction; however, the upper building may be of any complying construction type. Where the upper buildings is built of combustible construction (Type III, IV or V), a conflict has existed regarding how the stairway that extends through both types of construction should be regulated. Noncombustible stairway construction would be required in the Type IA building, while combustible stairway construction would be permitted in the Type III, IV or V building.

Where an interior exit stairway is located in a building utilizing the horizontal building separation allowance, it is now permissible for the stairways to be constructed of combustible materials throughout, including in the Type IA portion of the building, provided two conditions are met. One, the upper building is classified as Type III, IV or V construction, and two, the stairway located in the lower building is enclosed by a minimum 3-hour fire-resistance-rated shaft enclosure. Where the upper building is of noncombustible construction (Type I or II), the entire stairway must be constructed of noncombustible materials.

Where new Condition 4 is applied, the minimum 3-hour fire-resistance-rated horizontal separation is extended vertically downward adjacent to the stairway enclosure, in effect isolating the exit stairway in the upper building. As a result, the interior exit stairways can be considered as located only in the upper building where combustible stairway construction is permitted.

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Table 601

Type IV Fire-Resistance

CHANGE TYPE: Addition

CHANGE SUMMARY: The minimum required fire-resistance ratings for the building elements of those structures classified as one of the new construction types (Types IV-A, IV-B and IV-C) have been established as set forth in Table 601.

2021 CODE TEXT:

TABLE 601 Fire-Resistance Rating Requirements for Building Elements (Hours)

	Type I		Type II		Type III		Type IV				Type V	
Building Element	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**C**	**HT**	**A**	**B**
Primary structural frame[f]	3[a,b]	2[a,b,c]	1[b,c]	0[c]	1[b,c]	0	3[a]	2[a]	2[a]	HT	1[b,c]	0
Bearing walls												
Exterior[e,f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table ~~602~~ 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1½[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	1½	1	1	HT	1[b,c]	0

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame member, floor framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of the code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
f. Not less than the fire-resistance rating as referenced in Section 704.10.
g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire-resistance rating of not less than 1 hour.

CHANGE SIGNIFICANCE: Table 601 provides the basic fire-resistance rating requirements for the various types of construction, as well as delineating those fire-resistance ratings required to qualify for a specific construction type. These designations, as further described in Sections 602.2 through 602.5 and used throughout the code to describe a specific type of construction, are not specifically defined in the IBC. Rather, their definitions can only be determined through the combination of the provisions of Chapter 6 along with those set forth in Table 601. A building's permissible types of construction are based primarily on the intended building size and anticipated use of the building. The minimum required

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fire-resistance ratings for the building elements of those structures classified as one of the new construction types (Types IV-A, IV-B and IV-C) have been established as set forth in Table 601.

The minimum required fire-resistance ratings set forth in the table for Type IV-A, IV-B and IV-C buildings were established in a manner consistent with the development of height and area limits for these new construction types. Correlations between the maximum building sizes and the various types of construction were established, then further evaluation addressed any unique conditions that needed to be addressed. As a point of comparison, the minimum required building element ratings for Type IB construction were also applied to Type IV-B buildings. In order to maintain a significant level of fire-resistance for all mass timber construction, the minimum required ratings for Type IV-C construction are the same as those of Type IV-B. See the discussion of Sections 603.4.1 through 602.4.3 for the distinction between Type IV-B and IV-C construction. For the highest level of mass timber construction, Type IV-A, an equivalency with Type IA was made. No modifications were made to the minimum required ratings for Type IV-HT construction.

The only differences involve interior bearing walls, where the fire-resistance ratings of interior bearing walls in Types IV-A, IV-B and IV-C construction are not allowed to be reduced by 1 hour where only supporting a roof (in accordance with Note a), as is permitted for Type IA and IB. While not specific to Table 601, it should also be noted that the reductions in fire-resistance ratings permitted by Section 403.2.1.1 for Type IA and IB high-rise buildings are not applicable to buildings of Type IV-A or IV-B construction.

Footnote c in Table 601 has historically allowed the use of heavy timber in lieu of the 1-hour rated roof construction that is required for many construction types. Because there is a separate row in the table addressing primary structural frame elements, its application to such elements has been in question. The footnote has been modified such that all components of the roof construction, including any structural frame members, may consist of heavy timber.

The addition of footnote g, applicable only to Type IV-HT construction, now requires heavy timber interior bearing walls supporting more than two floors, or a floor and a roof, to be fire-resistance-rated for at least 1 hour. With its application typically utilized for vertical elements in mid-rise buildings, this mandate may result in an increase in wall thickness in exposed heavy timber interior bearing walls supporting multiple stories in order to provide the minimum 1-hour rating.

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602.4

Mass Timber Type IV Buildings

CHANGE TYPE: Addition

CHANGE SUMMARY: While the past allowances for Type IV buildings have been maintained as Type IV-HT construction, three new construction types have been introduced to recognize other forms of mass timber construction.

2021 CODE TEXT: **602.4 Type IV.** ~~Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL), and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rating or heavy timber complying with Section 2304.11.2.2 shall be permitted.~~

Type IV construction is that type of construction in which the building elements are mass timber or noncombustible materials and have fire-resistance ratings in accordance with Table 601. Mass timber elements shall meet the fire-resistance-rating requirements of this section based on either the fire-resistance rating of the noncombustible protection, the mass timber, or a combination of both and shall be determined in accordance with Section 703.2. The minimum dimensions and permitted materials for building elements shall comply with the provisions of this section and Section 2304.11. Mass timber elements of Types IV-A, IV-B and IV-C construction shall be protected with noncombustible protection applied directly to the mass timber in accordance with Sections 602.4.1



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Mass timber construction.

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through 602.4.3. The time assigned to the noncombustible protection shall be determined in accordance with Section 703.6 and comply with 722.7.

Cross-laminated timber shall be labeled as conforming to ANSI/APA PRG 320 as referenced in Section 2303.1.4.

Exterior load-bearing walls and nonload-bearing walls shall be mass timber construction, or shall be of noncombustible construction.

> **Exception:** Exterior load-bearing walls and nonload-bearing walls of Type IV-HT construction in accordance with Section 602.4.4.

The interior building elements, including nonload-bearing walls and partitions, shall be mass timber construction or of noncombustible construction.

> **Exception:** Interior building elements and nonload-bearing walls and partitions of Type IV-HT construction in accordance with Section 602.4.4.

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

In buildings of Type IV-A, IV-B, and IV-C construction with an occupied floor located more than 75 feet (22 860 mm) above the lowest level of fire department access, up to and including 12 stories or 180 feet (54 864 mm) above grade plane, mass timber interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In buildings greater than 12 stories or 180 feet (54 864 mm) above grade plane, interior exit and elevator hoistway enclosures shall be constructed of noncombustible materials.

CHANGE SIGNIFICANCE: Type IV construction has traditionally been designated as heavy timber, based upon the minimum required cross-sectional dimensions of the wood members. This type of construction derived its fire-resistive protection solely from the size of the building elements, recognizing the slow-burning characteristics of the individual wood members. Very similar to Type III construction, Type IV buildings have been recognized for the inherent fire-resistance achieved independent of any additional protection afforded by gypsum board or other noncombustible insulating material. While the past allowances for Type IV buildings have been maintained as Type IV-HT construction, three new construction types have been introduced to recognize other forms of mass timber construction.

In the construction of Type IV buildings, both noncombustible assemblies and heavy timber members are permitted, with their fire-resistance capabilities continuing to be regulated by Table 601. For Type IV-HT buildings, compliance for fire-resistive purposes is typically based solely upon the cross-sectional dimension of the timber members as established by Table 2304.11. For the three new construction types, the required

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fire-resistance ratings may be met by 1) the rating of the mass timber member, 2) the rating of the noncombustible protection applied directly to the mass timber member, or 3) a rating based on a combination of both the timber member and its protective material. Reference is made to Chapter 7 regarding the length of time assigned to the noncombustible protection.

Only two types of materials are typically permitted in buildings of Type IV-A, IV-B and IV-C construction: mass timber and noncombustible. However, the use of fire-retardant-treated wood continues to be acceptable for framing and sheathing components within exterior walls of Type IV-HT buildings. In addition, Type IV-HT permits interior walls and partitions of solid wood construction as set forth in Section 2304.11.2.2.

As a general rule, combustible concealed spaces are not permitted due to the potential for a fire to smolder and spread undetected. However, from a design standpoint it is desirable to provide such concealed areas to accommodate piping, ductwork and similar building components. As a result, each of the four mass timber classifications provides guidance as to the necessary protection and limitations where concealed spaces are created.

The enclosure of interior exit stairways and elevator hoistways is also regulated in a specific manner in those high-rise buildings of Type IV-A, IV-B and IV-C construction. Where such enclosures do not exceed 12 stories above grade plane and are no more than 180 feet in height, they may be constructed of mass timber covered with the necessary noncombustible protection. Where 12 stories or 180 feet are exceeded, the enclosures must be constructed of noncombustible materials for the entire building height.

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602.4.1–602.4.3

Type IV-A, IV-B and IV-C Buildings

CHANGE TYPE: Addition

CHANGE SUMMARY: New construction types (Types IV-A, IV-B and IV-C) are defined based upon the varying percentages of mass timber surfaces that are permitted to be unprotected.

2021 CODE TEXT: **602.4.1 Type IV-A.** Building elements in Type IV-A construction shall be protected in accordance with Sections 602.4.1.1 through 602.4.1.6. The required fire-resistance rating of noncombustible elements and protected mass timber elements shall be determined in accordance with Section 703.2.

602.4.1.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Section 722.7.1(1). Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150 kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354 and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.1.2 Interior protection. Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mass timber roofs, shall be protected with materials complying with Section 703.3.



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Mass timber construction fire test.

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602.4.1.2.1 Protection time. Noncombustible protection shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.1.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the mass timber. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with 602.4.1.2.

602.4.1.4 Roofs. The interior surfaces of roof assemblies shall be protected in accordance with Section 602.4.1.2. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.1.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *International Mechanical Code*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Sections 602.4.1.2.

602.4.1.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and Section 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

602.4.2 Type IV-B. Building elements in Type IV-B construction shall be protected in accordance with Sections 602.4.2.1 through 602.4.2.6. The required fire resistance rating of noncombustible elements or mass timber elements shall be determined in accordance with Section 703.2.

602.4.2.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150 kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354, and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.2.2 Interior protection. Interior faces of all mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, shall be protected, as required by this section, with materials complying with Section 703.3.

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602.4.2.2.1 Protection time. Noncombustible protection shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.2.2.2 Protected area. Interior faces of mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, shall be protected in accordance with Section 602.4.2.2.1.

Exceptions: Unprotected portions of mass timber ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of mass timber ceilings and walls complying with one of the following:
   - 1.1 Unprotected portions of mass timber ceilings, including attached beams, shall be permitted and shall be limited to an area equal to 20 percent of the floor area in any dwelling unit or fire area.
   - 1.2 Unprotected portions of mass timber walls, including attached columns, shall be permitted and shall be limited to an area equal to 40 percent of the floor area in any dwelling unit or fire area.
   - 1.3 Unprotected portions of both walls and ceilings of mass timber, including attached columns and beams, in any dwelling unit or fire area shall be permitted in accordance with Section 602.4.2.2.3.
2. Mass timber columns and beams that are not an integral portion of walls or ceilings, respectively, shall be permitted to be unprotected without restriction of either aggregate area or separation from one another.

602.4.2.2.3 Mixed unprotected areas. In each dwelling unit or fire area, where both portions of ceilings and portions of walls are unprotected, the total allowable unprotected area shall be determined in accordance with Equation 6-1.

$$(U_{tc} / U_{ac}) + (U_{tw} / U_{aw}) \leq 1 \qquad \textbf{(Equation 6-1)}$$

where:

U_{tc} = Total unprotected mass timber ceiling areas

U_{ac} = Allowable unprotected mass timber ceiling area conforming to Exception 1.1 of Section 602.4.2.2.2

U_{tw} = Total unprotected mass timber wall areas

U_{aw} = Allowable unprotected mass timber wall area conforming to Exception 1.2 of Section 602.4.2.2.2

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each dwelling unit or fire area, unprotected portions of mass timber walls and ceilings shall be not less than 15 feet (4572 mm) from unprotected portions of other walls and ceilings, measured horizontally along the ceiling and from other unprotected portions of walls measured horizontally along the floor.

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602.4.2.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the mass timber. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

602.4.2.4 Roofs. The interior surfaces of roof assemblies shall be protected in accordance with 602.4.2.2 except, in nonoccupiable spaces, they shall be treated as a concealed space with no portion left unprotected. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.2.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *International Mechanical Code*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.2.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

602.4.3 Type IV-C. Building elements in Type IV-C construction shall be protected in accordance with Sections 602.4.3.1 through 602.4.3.6. The required fire-resistance rating of building elements shall be determined in accordance with Section 703.2.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as determined in Table 722.7.1(1). Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150 kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354 and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.3.2 Interior protection. Mass timber elements are permitted to be unprotected.

602.4.3.3 Floors. Floor finishes in accordance with Section 804 shall be permitted on top of the floor construction.

602.4.3.4 Roof coverings. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.3.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with

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Section 602 of the *International Mechanical Code*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1).

602.4.3.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Shafts and elevator hoistway and interior exit stairway enclosures shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1), on both the inside of the shaft and the outside of the shaft.

CHANGE SIGNIFICANCE: The primary purposes of providing three unique types of mass timber construction are to recognize and accommodate the use of solid timber structural elements in buildings of considerable height and area. The three new types vary based upon the percentage of mass timber surfaces that can be unprotected. The three established levels of protection include complete noncombustible protection of the mass timber members (Type IV-A), partial protection of such members (Type IV-B), and no required noncombustible protection of the mass timber (Type IV-C). An important consideration was the extent of any required protection, based on the degree to which noncombustible protection limits fuel contribution of mass timber to a fire. As such, it was determined that the conditions, materials and assemblies associated with Types IV-A, IV-B and IV-C construction be limited only to those that had been tested. See the discussion on Sections 703.6 and 722.7. This differs significantly from Type IV-HT construction where the fire-resistance is almost solely achieved through an evaluation of the cross-sectional dimensions of the mass timber members.

By definition, mass timber includes structural elements that primarily consist of solid, built-up, panelized or engineered wood products that meet the minimum dimensional criteria for Type IV construction. Combustible light-frame materials are specifically and totally excluded from these three new types of construction. In the three new types of construction, those materials of construction that do not qualify as mass timber must be noncombustible.

The three new types of construction are all defined by the specific requirements established in Sections 602.4.1 through 602.4.3. There is one major commonality, that the buildings are composed wholly, or in part, of heavy timber elements. The details of each individual construction type may differ when it comes to fire-resistive protection and other issues; however, the recognition of mass timber as a viable construction material for buildings of a significant size has been established.

The defining characteristic of Type IV-A construction is the mandate of completely protected mass timber structural elements. The details of the noncombustible protection are established in Section 602.4. Noncombustible assemblies are also permitted, such as light-gage steel framing, but combustible assemblies are specifically excluded. In addition, the minimum fire protection ratings required by Table 601 for construction type and Section 705.5 for exterior walls must be applied regardless of the materials of construction.

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Type IV-B construction is unique in that some degree of exposed interior wood surfaces of walls, ceilings, columns and beams are allowed. However, a significant amount of the mass timber elements must be protected in the same manner as applicable to Type IV-A buildings. The details identifying those elements that may be protected, and the allowable percentages of unprotected mass timber elements, are set forth in Sections 602.4.2.1 through 602.4.2.6. The allowance for unprotected building elements does not eliminate the need for any fire-resistance rating that may be mandated by the code. Mass timber structural elements permitted without noncombustible protection must still be evaluated for compliance with any required fire-resistance rating. Consistent with the limits on Type IV-A buildings, combustible light-frame construction, including the use of fire-retardant-treated wood, is not permitted.

Type IV-C construction differs significantly from Types IV-A and IV-B in that the mass timber located on the interior of the building can be fully exposed, with limited exceptions. No noncombustible protection is mandated except for components such as concealed spaces, shaft enclosures and interior exit stairways. Type IV-C differs from the traditional Type IV-HT construction when it comes to required fire-resistance-rated protection of the building elements. Minimum 2-hour ratings must be achieved by the bearing walls, floors and primary structural frame elements; however, such rated elements are not required to be covered with noncombustible protection.

Additional areas of commonality and differences among the new construction types include those related to exterior wall protection, floor and roof construction, concealed spaces and shaft enclosures. A comprehensive discussion regarding all of the 2021 code provisions related to the regulation of mass timber buildings can be found in the publication *Mass Timber Buildings and the IBC*, jointly published by ICC and the American Wood Council.

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602.4.4
Type IV-HT Buildings

CHANGE TYPE: Modification

CHANGE SUMMARY: The Type IV-HT designation has been introduced to differentiate the historical Type IV "heavy timber" construction type from the three new mass timber types of construction.

2021 CODE TEXT: ~~**602.4**~~ **602.4.4 Type IV-HT.** Type IV-HT (Heavy Timber) construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated ~~wood~~, heavy timber ~~(HT)~~ or structural composite lumber (SCL) without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, SCL and cross laminated timber (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section ~~602.4.1 or 602.4.2~~ 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance ~~rating~~ rated or heavy timber ~~complying~~ conforming with Section 2304.11.2.2 shall be permitted.

~~**602.4.1**~~ **602.4.4.1 Fire-retardant-treated wood in exterior walls.** Fire-retardant-treated wood framing and sheathing complying with Section 2303.2 shall be permitted within exterior wall assemblies ~~not less than 6 inches (152 mm) in thickness~~ with a 2-hour rating or less.

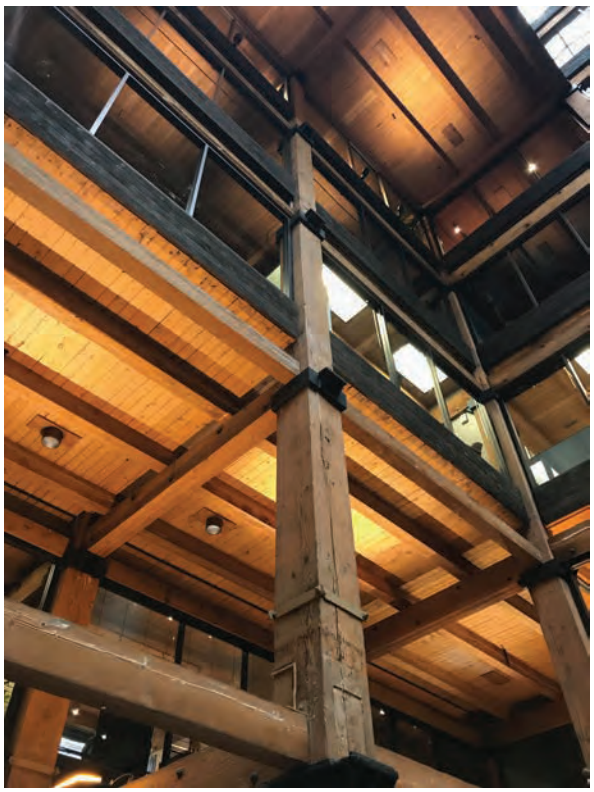


Photo courtesy of WoodWorks

Traditional heavy timber construction.

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~~602.4.2~~ 602.4.4.2 Cross-laminated timber in exterior walls. Cross-laminated timber (CLT) not less than 4 inches (102 mm) in thickness complying with Section 2303.1.4 shall be permitted within exterior wall assemblies ~~not less than 6 inches (152 mm) in thickness~~ with a 2-hour rating or less. Heavy timber structural members appurtenant to the CLT exterior wall shall meet the requirements of Table 2304.11 and be fire-resistance rated as required for the exterior wall. ~~provided the~~ The exterior surface of the cross-laminated timber ~~is~~ and heavy timber elements shall be protected by one the following:

1. Fire-retardant-treated wood sheathing complying with Section 2303.2 and not less than $^{15}/_{32}$ inch (12 mm) thick.
2. Gypsum board not less than $^{1}/_{2}$ inch (12.7 mm) thick.
3. A noncombustible material.

602.4.4.3. Concealed spaces. Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *International Mechanical Code*. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.
3. Surfaces within the concealed space shall be fully sheathed with not less than $^{5}/_{8}$-inch Type X gypsum board.

Exception: Concealed spaces within interior walls and partitions with a 1-hour or greater fire-resistance rating complying with Section 2304.11.2.2 shall not require additional protection.

~~602.4.3~~ 602.4.4.4 Exterior structural members. Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes complying with Section 2304.11 shall be permitted to be used externally.

CHANGE SIGNIFICANCE: Type IV construction has traditionally identified buildings that have characteristics much different than those of the other construction types. Relying almost solely on the minimum required cross-sectional dimensions of the wood members for fire-resistive protection, Type IV buildings have been regulated in a prescriptive manner rather than through performance-based criteria. Such structures are similar to those classified as Type III, as exterior walls are required to be composed of noncombustible materials or fire-retardant-treated wood, and interior building elements are permitted to be of combustible materials. This traditional construction type has been maintained and is now recognized as Type IV-HT in order to distinguish it from the three new

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mass timber construction types. In addition, limited modifications have been made to the Type IV-HT provisions addressing exterior wall construction and the creation of concealed spaces.

The allowance for the use of fire-retardant-treated wood framing and sheathing in wall assemblies of Type IV-HT buildings has been modified by removing the mandate that the wall assembly be at least 6 inches in minimum thickness. A minimum thickness requirement for the exterior wall assembly was deemed unnecessary since the required fire-resistance rating is a much more significant factor than the assembly thickness.

Two modifications related to the use of cross-laminated timber (CLT) in exterior walls have also occurred. A minimum overall thickness of 6 inches for the entire CLT wall assembly was previously mandated. However, a minimum actual thickness for just the CLT is a better parameter for structural integrity than an overall wall thickness, as the overall thickness could include exterior sheathing, cladding and insulation. Accordingly, the change provides for the minimum thickness of CLT itself: 4 inches. A second modification clarifies that other heavy timber elements, such as headers and boundary elements made of glulam, structural composite lumber or solid sawn lumber, are permitted to be within the CLT wall without fire-retardant treatment provided they meet the same rating, required thickness and protection that is required for the CLT in the wall.

Another change of significance now allows for concealed spaces in Type IV-HT construction. Historically not permitted in traditional heavy timber construction, such spaces are now allowed when specified protection of the concealed space includes at least one of the following:

- Automatic sprinkler protection throughout the building including installation within the concealed space.
- Filling of the entire space with noncombustible insulation.
- Covering all combustible surfaces with not less than $^{5}/_{8}$-inch Type X gypsum board.

The new allowance for protected concealed spaces in Type IV-HT buildings is important to encourage adaptive reuse of existing heavy timber buildings, as well as to provide for the installation of mechanical, electrical and plumbing systems.

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603.1

Combustible Materials in Types I and II

CHANGE TYPE: Modification

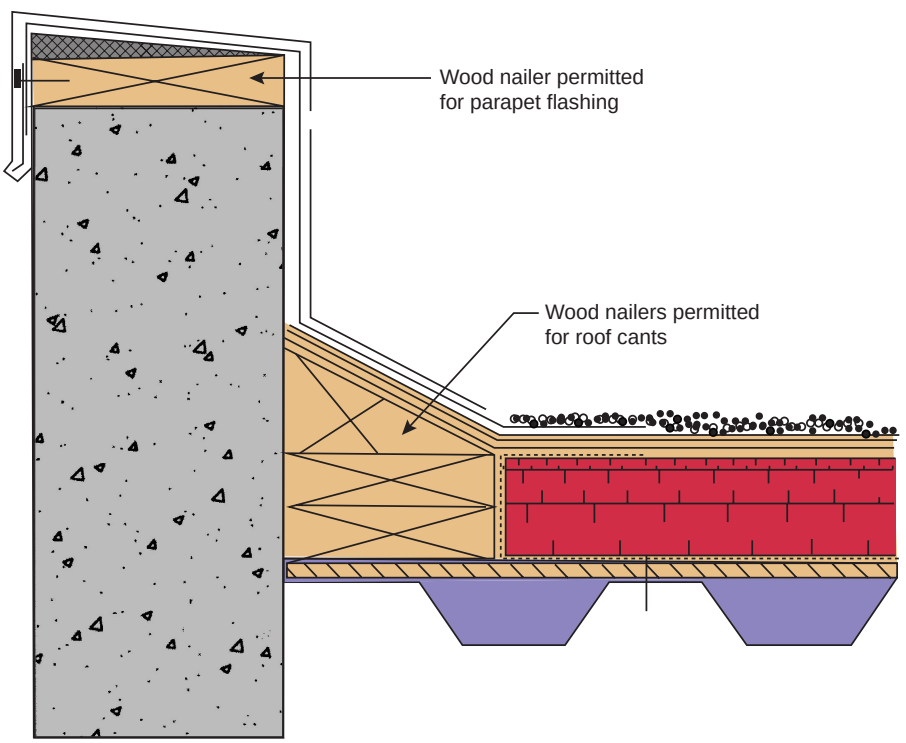
CHANGE SUMMARY: In buildings of Type I and II construction, the allowance for the use of fire-retardant-treated wood in shaft enclosure and roof construction has been modified for Group I-2 buildings. In addition, the use of wood nailers for parapet flashing and roof cants is permitted in all buildings.

2021 CODE TEXT: **603.1 Allowable materials.** Combustible materials shall be permitted in buildings of Type I or II construction in the following applications and in accordance with Sections 603.1.1 through 603.1.3:

1. Fire-retardant-treated wood shall be permitted in:
   - **1.1.** Nonbearing partitions where the required fire-resistance rating is 2 hours or less except in shaft enclosures within Group I-2 occupancies and ambulatory care facilities.
   - **1.2.** Nonbearing exterior walls where fire-resistance-rated construction is not required.
   - **1.3.** Roof construction, including girders, trusses, framing and decking.

Exceptions:

1. In buildings of Type IA construction exceeding two stories above grade plane, fire-retardant-treated wood is not permitted in roof construction where the vertical distance from the upper floor to the roof is less than 20 feet (6096 mm).



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2. Group I-2 roof construction containing fire-retardant-treated wood shall be covered by not less than a Class A roof covering or roof assembly, and the roof assembly shall have a fire-resistance rating where required by the construction type.

1.4. Balconies, porches, decks and exterior stairways not used as required exits on buildings three stories or less above grade plane.

(no change to applications 2 through 26)

27. Wood nailers for parapet flashing and roof cants.

CHANGE SIGNIFICANCE: Buildings of Type I and II construction are considered noncombustible structures. As such, all of the building elements, including walls, floors and roofs, are to be constructed of noncombustible materials. There are, however, a variety of exceptions to the general rule that allow a limited amount of combustibles to be used in the building's construction. It has been determined that the level of combustibles permitted by Section 603.1, as well as their control, does not adversely impact the fire severity caused by the materials of construction. In Type I and II buildings, the allowance for the use of fire-retardant-treated wood (FRTW) in shaft enclosure and roof construction has been modified for Group I-2 buildings, while a new entry specifically permits the use of wood nailers for parapet flashing and roof cants in all buildings.

Although FRTW does not meet the IBC criteria for a noncombustible material, it is permitted as an alternative to noncombustible materials in specific locations in Type I and II construction. One of those locations is nonbearing partitions having a fire-resistance rating of 2 hours or less. However, the use of FRTW is no longer permitted for such partitions that create shaft enclosures in Type I and II buildings housing Group I-2 occupancies or Group B ambulatory care facilities. The new limitations now provide conformity with the applicable Federal Standards and CMS enforcement rules. An additional modification addresses FRTW roof construction of buildings housing Group I-2 occupancies. In such buildings, the intent is to provide for a Class A roof covering or roof assembly where FRTW is used. This new mandate now provides consistency with the applicable federal certification requirements.

The new allowance permitting the use of wood nailers for parapet flashing and roof cants in buildings of Type I and II construction recognizes how they are necessary for the proper fastening of roofing materials. Much like the rationale for the use of wood in other limited applications such as blocking and millwork, the amount of combustible materials due to the use of wood nailers in roof construction is relatively insignificant.

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PART 3

Fire Protection

Chapters 7 through 9

- **Chapter 7** Fire and Smoke Protection Features
- **Chapter 8** Interior Finishes
- **Chapter 9** Fire Protection and Life Safety Systems

The fire protection provisions of the *International Building Code* (IBC) are found primarily in Chapters 7 through 9. There are two general categories of fire protection: active and passive. Chapter 7 details the use of fire and smoke resistance to protect building elements in a passive manner. Chapter 9 contains requirements for various active systems often utilized in the creation of a safe building environment, including automatic sprinkler systems, standpipe systems and fire alarm systems. To further address the rapid spread of fire, the provisions of Chapter 8 are intended to regulate interior finish materials, such as wall and floor coverings. ■

703.6, 703.7
Noncombustible Protection for Mass Timber

704.6.1
Secondary Attachments and Fireproofing

TABLE 705.5
Exterior Wall Ratings

707.4, 716
Separations of Energy Storage Systems

707.5
Enclosure of Exit Passageways

708.1, 708.4.1
Supporting Construction for Fire Partitions

709.4.1
Smoke Barrier Continuity

710.5.2.1, 710.5.3
Smoke Partition Openings

713.12
Top of Shaft Enclosure

715
Protection of Joints and Voids

716.2.2.1.1
Prohibited Use of Terminated Stops

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716.4
Fire-Protective Curtain Assemblies

TABLE 716.1(2)
Doors in Double Fire Walls

717.2.3, 717.6.2.1
Ceiling Radiation Dampers

717.4
Access to Dampers

717.5.2
Flex Connectors

722.7
Fire-Resistance Rating of Mass Timber

806.9
Combustible Lockers as Interior Finish

903.2.4, 903.2.7, 903.2.9
Upholstered Furniture and Mattresses

903.2.4.2, 903.2.9.3
Distilled Spirits

903.2.10
Sprinklers in Parking Garages

903.2.10.2
Mechanical-Access Parking Garages

903.3.1.2
NFPA 13R Sprinkler Protection

903.3.1.2.2
Corridor and Balcony Sprinklers

905.3.1
Standpipes in Parking Garages

907.2.10
Manual Alarms in Group S Buildings

907.5.2.1.3
Fire Alarm Occupant Notification

909.20
Smokeproof Enclosures

911
Fire Command Centers in Groups F-1 and S-1

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703.6, 703.7

Noncombustible Protection for Mass Timber

CHANGE TYPE: Addition

CHANGE SUMMARY: A test method has been provided to determine the contribution time of noncombustible protection to mass timber fire-resistance. In addition, edges and intersections between adjacent elements are to be sealed to limit smoke and air movement within a building.

2021 CODE TEXT: **703.6 Determination of noncombustible protection time contribution.** The time, in minutes, contributed to the fire-resistance rating by the noncombustible protection of mass timber building elements, components, or assemblies, shall be established through a comparison of assemblies tested using procedures set forth in ASTM E119 or UL 263. The test assemblies shall be identical in construction, loading, and materials, other than the noncombustible protection. The two test assemblies shall be tested to the same criteria of structural failure with the following conditions:

1. Test Assembly 1 shall be without protection.
2. Test Assembly 2 shall include the representative noncombustible protection. The protection shall be fully defined in terms of configuration details, attachment details, joint sealing details, accessories and all other relevant details.

The noncombustible protection time contribution shall be determined by subtracting the fire resistance time, in minutes, of Test Assembly 1 from the fire resistance time, in minutes, of Test Assembly 2.



Photo courtesy of ATF Fire Research Laboratory

Sealing of mass timber.



Photo courtesy of ATF Fire Research Laboratory

Mass timber and noncombustible protection.

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703.7 Sealing of adjacent mass timber elements. In buildings of Type IV-A, IV-B and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of mass timber building elements required to be fire-resistence rated.
2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire-resistence rated.

Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.

CHANGE SIGNIFICANCE: Materials and methods used for fire-resistance purposes are to be limited to those specified in Chapter 7, specifically Section 703. The new Section 703.6 provides the means to determine the contribution the noncombustible protection material makes to the fire-resistance rating. The impact, in minutes, that the protection material has on the mass timber building elements, components and assemblies is established using the performance method in this section. The protection time is established by conducting two fire tests, the first solely with the mass timber itself and the second with added protection provided by any applied noncombustible protection. Once the two tests are conducted, the noncombustible protection contribution can be determined by subtracting the time that was achieved by the unprotected mass timber assembly or structural element from the tested time of the protected assembly. During the establishment of fire-resistance requirements for new mass timber construction types (IV-A, IV-B and IV-C), it was determined that at least two-thirds of the required fire-resistance rating should come from noncombustible protection. The new provisions of Section 602.4 require the use of noncombustible protection on specified mass timber elements in Types IV-A and IV-B construction (and certain elements of Type IV-C such as egress and hoistway shafts).

Both a prescriptive and a performance path to determine the noncombustible protection material contribution have been provided. The prescriptive path is outlined in Section 722.7, and Section 703.6 provides the performance path by which the contribution of noncombustible materials that are not included in Table 722.7.1(2) can be determined.

The concept of determining fire resistance by evaluating and adding membrane contribution has historically been recognized in the code and has been confirmed by testing. Often recognized as the Component Additive Method (CAM) for wood construction, this approach is included in the calculated fire-resistance requirements of the *International Building Code* (IBC) Section 722.6 along with the times assigned to various membranes by Section 722.6.2.2 and Table 722.6.2(1). Testing by the American Wood Council (AWC) confirmed the values derived from historic testing, and the results of those and other tests are summarized in *Technical Report 10—Calculating the Fire Resistance of Wood Members and Assemblies*.

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The new Section 703.7 mandates that abutting edges and intersections between mass timber building elements (e.g. panels, beams or columns) be sealed where such elements are connected. This requirement for sealing applies to fire-resistant-rated assemblies whether the connected rated elements are mass timber building elements (Item 1 in 703.7) or mass timber elements connected to building elements of other materials (Item 2 in 703.7). Sealing these intersections helps limit the spread of fire, smoke and hot gasses. Periodic special inspection under the provisions of Section 1705.20 is also required to ensure compliance with these code provisions. Where fire-resistance-rated mass timber assemblies are successfully tested without sealants and adhesives at these intersections, an exception removes the sealing requirement.

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CHANGE TYPE: Modification

CHANGE SUMMARY: Guidance has been provided to ensure continuity of fire-resistive protection where secondary steel attaches to either primary or secondary fire-resistance-rated structural members.

704.6.1

Secondary Attachments and Fireproofing

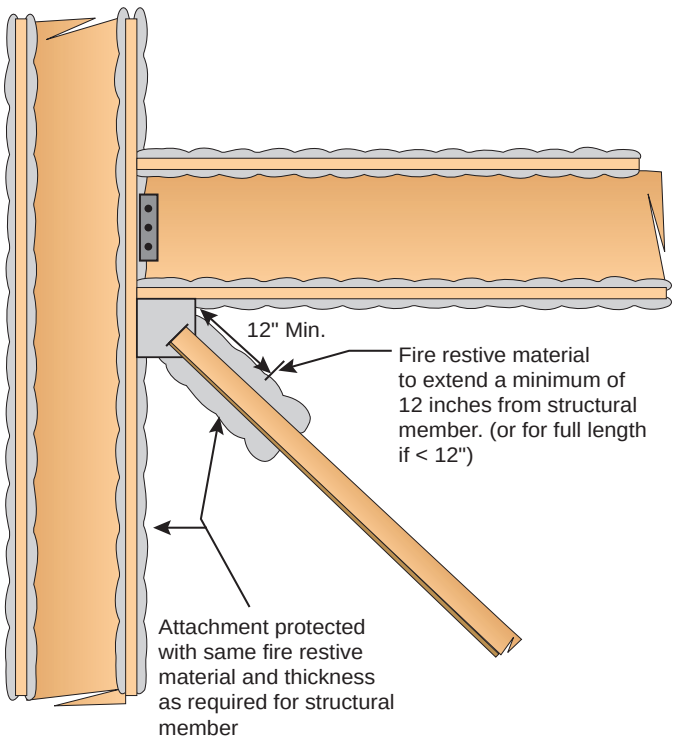
2021 CODE TEXT: **704.6.1 Secondary attachments to structural members.** Where primary and secondary structural steel members require fire protection, secondary steel attachments to those structural members shall be protected with the same fire resistive material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches (305 mm), or shall be applied to the entire length where the attachment is less than 12 inches (305 mm) long. Where an attachment is hollow and the ends are open, the fire-resistive material and thickness shall be applied to both the exterior and interior of the hollow steel attachment.

CHANGE SIGNIFICANCE: Structural frame members such as columns, beams and girders are typically regulated for fire resistance based on a building's type of construction. While Section 704.6 addressed protection for certain items that may be attached to a structural member, there was not enough detail to determine how the provisions would be applied to other elements. In many buildings, various items that do not require a fire-resistance rating end up being attached to structural elements that require protection. Examples of non-rated elements include lateral bracing elements for wind or seismic loads, or steel angles or tubes that are used to support an exterior curtainwall system. Where these nonrated and rated



International Code Council

Hollow attachment with open ends.



Protection of secondary attachments.

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elements connect, the code has not clearly identified how much of the attached element needs to be protected. Where steel attachments connect to the structural system, heat transfer from the unprotected element into the structure can occur and compromise the fire-resistance rating of the member or assembly. Under this new provision, an attached steel element must be protected for a minimum distance of 12 inches from the point of contact with the structural member, or, if it is less than 12 inches long, then it must be protected for its entire length. This 12-inch dimension was selected because it has traditionally been used in the general notes portion of UL 263 (UL's *BXUV General Information for Fire-resistance Ratings*) and as a written policy of some jurisdictions.

One added aspect of this new provision addresses the protection of attached hollow members with open ends. Because heat can impact both the interior and exterior of a hollow member, the fire-resistive protection must be installed on both the interior and exterior of the attached element for the required 12-inch distance.

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CHANGE TYPE: Modification

Table 705.5

Exterior Wall Ratings

CHANGE SUMMARY: The previous Table 602 dealing with exterior wall fire-resistance ratings based on fire separation distance has been relocated to Section 705 for inclusion with the general exterior wall requirements. The table was also revised to include the new mass timber construction types.

2021 CODE TEXT: **705.5 Fire-resistance ratings.** Exterior walls shall be fire-resistance rated in accordance with ~~Tables~~ Table 601, ~~and 602 and this section~~ based on the type of construction, and Table 705.5 based on the fire separation distance. The required fire-resistance rating of exterior walls with a fire separation distance of greater than 10 feet (3048 mm) shall be rated for exposure to fire from the inside. The required fire-resistance rating of exterior walls with a fire separation distance of less than or equal to 10 feet (3048 mm) shall be rated for exposure to fire from both sides.

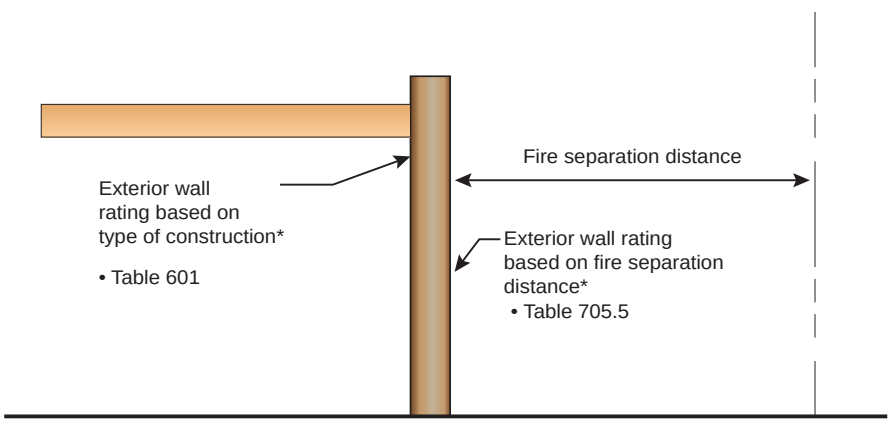
TABLE ~~602~~ 705.5 Fire-Resistance Rating Requirements for Exterior Walls Based on Fire Separation Distance[a,d,g]

Fire Separation Distance = X (feet)	Type Of Construction	Occupancy Group H[e]	Occupancy Group F-1, M, S-1[f]	Occupancy Group A, B, E, F-2, I, R[i], S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IV-A Others	3 2	2 1	1 1
10 ≤ X < 30	IA, IB, IV-A, IV-B IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

(No change to footnotes)

CHANGE SIGNIFICANCE: Table 602 from previous editions of the IBC has been relocated to Section 705 that addresses exterior walls. This table regulates fire-resistance ratings for exterior walls based on the



Rating of exterior wall.

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fire separation distance for each wall. Relocating the table was deemed appropriate because Section 705 is the primary location for establishing exterior wall requirements. The move from Chapter 6 to Chapter 7 will not create any technical changes or result in any change of application.

The only true technical changes that have been made in the table are simply to include the new mass timber types of construction. The Type IV-A requirements are consistent with those currently established for Type IA construction, and the exterior walls of Type IV-B buildings will be regulated in the same manner as those in Type IB buildings. Additionally, the Type IV-C requirements are consistent with those regulated as "others" (Type IIA, III, IV-HT and VA construction).

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707.4, 716

Separations of Energy Storage Systems

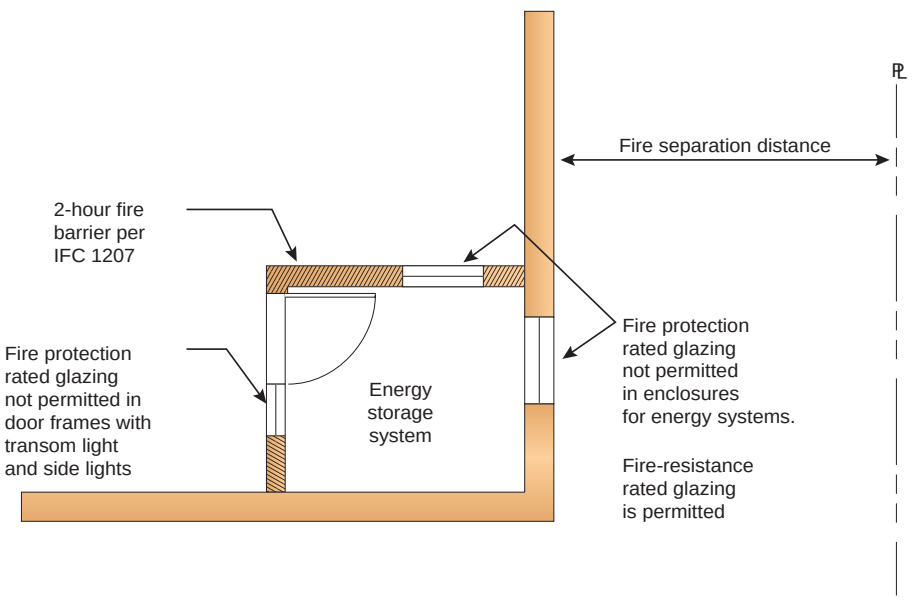
CHANGE TYPE: Modification

CHANGE SUMMARY: To both adequately isolate and protect energy storage systems from potential thermal runaway, the use of glazing with only a fire-protection rating is prohibited in fire-resistance-rated walls that are a portion of the enclosure of energy storage systems.

2021 CODE TEXT: **707.4 Exterior walls.** Where exterior walls serve as a part of a required fire-resistance-rated shaft, or ~~stairway~~ separation or ~~ramp~~ enclosure for a stairway, ramp or ~~separation,~~ exit passageway, such walls shall comply with the requirements of Section 705 for exterior walls and the fire-resistance-rated enclosure or separation requirements shall not apply.

Exceptions:

1. Exterior walls required to be fire-resistance rated in accordance with Section 1021 for exterior egress balconies, Section 1023.7 for interior exit stairways and ramps, Section 1024.8 for exit passageways and Section 1027.6 for exterior exit stairways and ramps.
2. Exterior walls required to be fire-resistance rated in accordance with Section 1207 of the International Fire Code for enclosure of energy storage systems.



Energy storage system separation.

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SECTION 716
OPENING PROTECTIVES

716.2 Fire door assemblies. Fire door assemblies required by other sections of this code shall comply with the provisions of this section. Fire door frames with transom lights, sidelights or both shall be permitted in accordance with Section 716.2.5.4.

716.2.5 Glazing in fire door assemblies. *Fire-rated glazing* conforming to the opening protection requirements in Section 716.2.1 shall be permitted in fire door assemblies.

716.2.5.4 Fire door frames with transom lights and sidelights. Fire-protection-rated glazing shall be permitted in door frames with transom lights, sidelights or both, where a $^{3}/_{4}$-hour fire protection rating or less is required and in 2-hour fire-resistance-rated exterior walls in accordance with Table 716.1(2). Fire door frames with transom lights, sidelights or both, installed with fire-resistance-rated glazing tested as an assembly in accordance with ASTM E119 or UL 263 shall be permitted where a fire protection rating exceeding $^{3}/_{4}$ hour is required in accordance with Table 716.1(2).

716.2.5.4.1 Energy storage system separation. Fire-protection-rated glazing shall not be permitted in fire door frames with transom lights and sidelights in fire barriers required by Section 1207 of the International Fire Code to enclose energy storage systems.

716.3 Fire window assemblies. Fire window assemblies required by other sections of this code shall comply with the provisions of this section.

716.3.2.1 Interior fire window assemblies. Fire-protection-rated glazing used in fire window assemblies located in fire partitions and fire barriers shall be limited to use in assemblies with a maximum fire-resistance rating of 1 hour in accordance with this section.

716.3.2.1.1 Where ¾-hour-fire-protection window assemblies permitted. Fire-protection-rated glazing requiring 45-minute opening protection in accordance with Table 716.1(3) shall be limited to fire partitions designed in accordance with Section 708 and fire barriers utilized in the applications set forth in Sections 707.3.6, 707.3.7 and 707.3.9 where the fire-resistance rating does not exceed 1 hour. Fire-resistance-rated glazing assemblies tested in accordance with ASTM E119 or UL 263 shall not be subject to the limitations of this section.

716.3.2.1.1.1 Energy storage system separation. Fire-protection-rated glazing is not permitted for use in fire window assemblies in fire barriers required by Section 1207 of the International Fire Code to enclose energy storage systems.

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TABLE 716.1(2)—continued
Opening Fire Protection Assemblies, Ratings And Markings

Type of Assembly	Required Wall Assembly Rating (Hours)	Minimum Fire Door and Fire Shutter Assembly Rating (Hours)	Door Vision Panel Size[a]	Fire-Rated Glazing Marking Door Vision Panel[b, c]	Minimum Sidelight/ Transom Assembly Rating (Hours)		Fire-Rated Glazing Marking Sidelight/ Transom Panel	
					Fire Protection	Fire Resistance	Fire Protection	Fire Resistance
Exterior walls	3	$1^1/_2$	100 sq. in.[a]	≤ 100 sq. in. = D-H-90 > 100 sq. in = D-H-W-90	Not Permitted	3	Not Permitted	W-180
	2	$1^1/_2$	Maximum size tested	D-H 90 or D-H-W-90	$1^1/_2$ [h]	2	D-H-OH-90[h]	W-120
				Fire protection				
	1	$^3/_4$	Maximum size tested	D-H-45	$^3/_4$ [h]		D-H-45[h]	

(Portions of table are not shown)

h. Fire-protection-rated glazing is not permitted for fire barriers required by Section 1207 of the International Fire Code to enclose energy storage systems. Fire-resistance-rated glazing assemblies tested to ASTM E119 or UL 263, as specified in Section 716.1.2.3, shall be permitted.

(Other footnotes not shown)

CHANGE SIGNIFICANCE: Additional new construction parameters related to enclosures for energy storage systems have been introduced in the IBC to supplement the *International Fire Code* (IFC) operational requirements for these systems. As the provisions are intended to ensure the enclosures for such systems are properly constructed and provide the IFC's intended protection, it is important to provide details and references within the IBC.

Energy storage systems (ESS), historically called battery storage systems, have traditionally required a separation to isolate them from the remainder of the building. These enclosure provisions applied when the systems reached certain sizes (See Table 1207.1 of the IFC) and required either a 1- or 2-hour fire-resistance-rated separation from other areas of the building in accordance with the incidental use provisions of IBC Section 509. It should be noted that in the 2021 IFC, the separation is required to be not less than a 2-hour fire barrier. One energy storage system hazard is thermal runaway leading to a fire event that can be significant and enduring. An ESS is required to prevent thermal runaway internally, however, in some cases, it can be induced by an exterior event such as a damaging impact or fire exposure. Although the IFC requires fire suppression of the space occupied by the ESS (IFC Section 1207.5.5), the remainder of the building and occupancy may not be protected.

The revisions reflect the concern that while fire-protection-rated glazing may help stop the spread of fire and smoke, it will not stop heat flow through the glazing. The concern is that radiant heat flow through the glazing could produce significant heat to cause a fire on the other side of the rated assembly. In a situation where energy storage systems are involved, this could cause a thermal runaway of the ESS. Therefore, the use of fire-protection-rated glazing is now prohibited such that any glazing must have a fire-resistance rating.

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While a new footnote "h" in Table 716.1(2) will prohibit fire-protection-rated glazing in exterior wall openings, it should be noted that Section 705.8 and Table 705.8 will continue to allow limited amounts of "unprotected" openings for both sprinklered and unsprinklered buildings. In addition, Section 705.8.2 includes an exception that would permit the use of a water curtain system instead of protected openings in fully sprinklered buildings. Both the limited amounts of unprotected openings and the water-curtain-protected openings would be allowed even though they are seemingly contrary to the new provisions' intended application. And, despite the addition of Exception 2 in Section 707.4, the requirements of IFC Section 1207.7.4 only require the 2-hour separation "from other areas in the building." Therefore, exterior wall ratings, including those enclosing energy storage systems, are regulated by the building's construction type and the adjacent fire separation distance.

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707.5

Enclosure of Exit Passageways

CHANGE TYPE: Modification

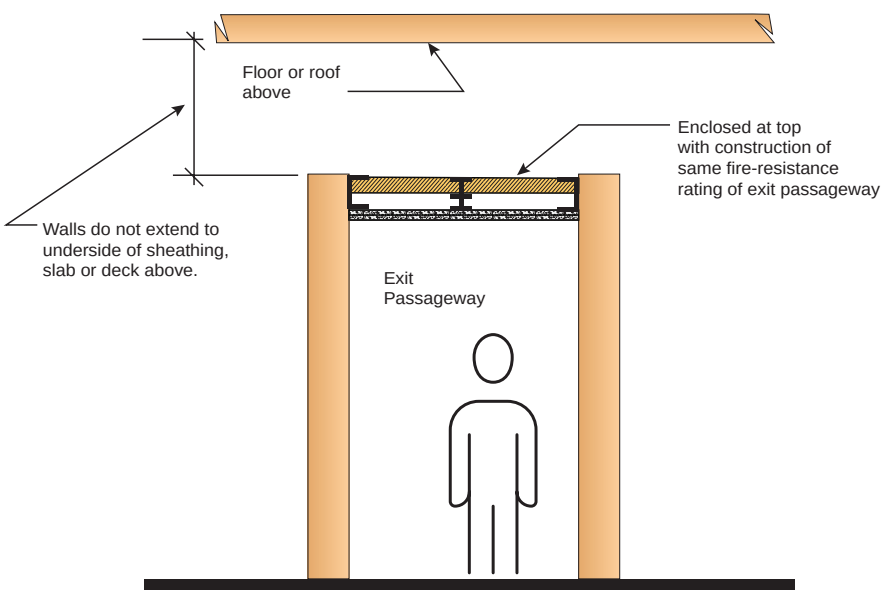
CHANGE SUMMARY: Fire barriers creating an exit passageway may now terminate at a fire-resistance-rated top (lid) instead of continuing to the underside of the roof slab above.

2021 CODE TEXT: **707.5 Continuity.** Fire barriers shall extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above and shall be securely attached thereto. Such fire barriers shall be continuous through concealed space, such as the space above a suspended ceiling. Joints and voids at intersections shall comply with Sections 707.8 and 707.9

Exceptions:

1. Shaft enclosures shall be permitted to terminate at a top enclosure complying with Section 713.12.
2. *Interior exit stairway* and *ramp* enclosures required by Section 1023 and *exit access stairway* and *ramp* enclosures required by Section 1019 shall be permitted to terminate at a top enclosure complying with Section 713.12.
3. An exit passageway enclosure required by Section 1024.3 that does not extend to the underside of the roof sheathing, slab or deck above shall be enclosed at the top with construction of the same fire-resistance rating as required for the exit passageway.

CHANGE SIGNIFICANCE: As fire barriers, walls forming an exit passageway enclosure must extend from the floor or foundation below to the underside of the floor or roof sheathing, slab or deck above. This continuity requirement essentially creates separate compartments by completely



Continuity at the top of an exit passageway.

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dividing a floor from deck to deck. A new exception recognizes that exit passageways only require the egress path to be isolated and protected from adjacent spaces, and that they are not intended to compartmentalize the entire story of the building as the general continuity provisions would impose. An example of where this exception may be useful is where an exit stair enclosure terminates within a building, and the exit path must be extended to the exterior wall.

Previously, fire barrier walls enclosing an exit passageway were required to extend up to the floor or roof deck above. Under the new exception, the fire-resistance-rated walls are permitted to terminate at a lower height and therefore allow mechanical, electrical or plumbing systems to pass above the passageway. This concept of stopping the walls at an equivalently-rated horizontal assembly has historically been allowed by Exception 2 for interior exit stairway and interior exit ramp enclosures.

While this concept is somewhat similar to the "tunnel corridor" system that is permitted for fire partitions by Exception 3 of Section 708.4, it is somewhat different because the horizontal assembly that serves as the passageway lid and the termination point for the fire barriers is required to be constructed with "the same fire-resistance rating as required for the exit passageway." Therefore, these horizontal assemblies would need to comply as 1- or 2-hour rated horizontal assemblies per Section 1024.3 and be constructed to comply with Sections 711 and 1024. It is important to recognize that the fire-resistance-rated horizontal assembly requirement ensures a higher level of protection than what is required for tunnel corridors. In addition, limitations are placed on openings, penetrations and ventilation systems related to an exit passageway.

One aspect that needs to be discussed with the code official is whether the exception is applicable where a floor occurs above the level with the passageway. The code text in the exception only mentions terminating at the "roof" sheathing, slab or deck. Therefore, while fire barriers are generally allowed to terminate at a "floor or roof…" above, the new exception appears much more limited. Whether this limitation was intentional was never discussed or mentioned during the code change process or in the proponent's reason statement. The exception probably should be applicable to both "floor and roof" systems but since the approved code text only mentions the roof, it needs to be discussed with the code official before applying it to passageways where a "floor" and additional story occur above.

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708.1, 708.4.1

Supporting Construction for Fire Partitions

CHANGE TYPE: Modification

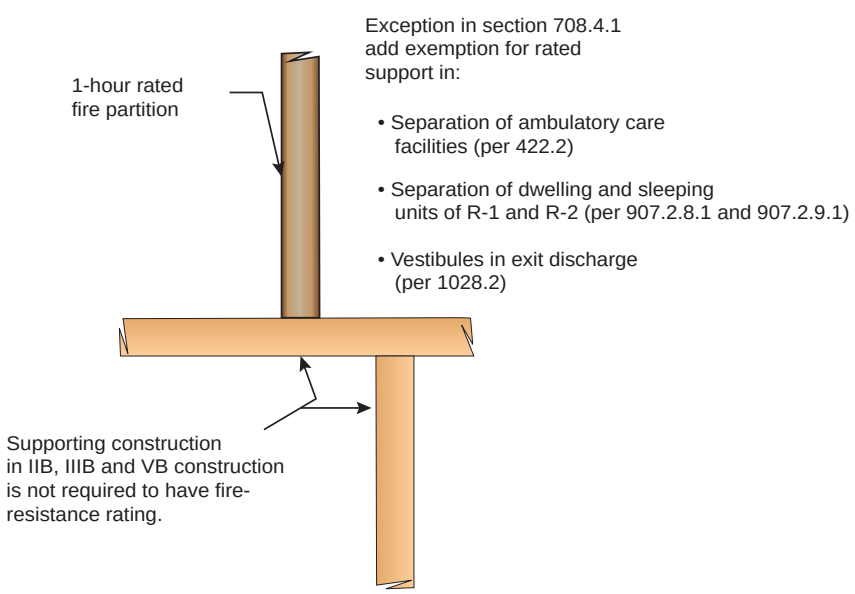
CHANGE SUMMARY: A more complete list of wall assemblies required to be constructed as fire partitions has been provided, and additional locations have been identified where fire partitions are permitted to be supported by non-rated construction.

2021 CODE TEXT:

SECTION 708
FIRE PARTITIONS

708.1 General. The following wall assemblies shall comply with this section:

1. Separation walls as required by Section 420.2 for Group I-1 and Group R occupancies.
2. Walls separating tenant spaces in covered and open mall buildings as required by Section 402.4.2.1.
3. Corridor walls as required by Section 1020.3.
4. Enclosed elevator lobby separation as required by Section ~~3006.2.~~ 3006.3
5. Egress balconies as required by Section 1021.2
6. Walls separating ambulatory care facilities from adjacent spaces, corridors or tenant as required by Section 422.2
7. Walls separating dwelling and sleeping units in Groups R-1 and R-2 in accordance with Sections 907.2.8.1, and 907.2.9.1.
8. Vestibules in accordance with Section 1028.2.



Exemption for rating supporting construction.

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708.4.1 Supporting construction. The supporting construction for a fire partition shall have a fire-resistance rating that is equal to or greater than the required fire-resistance rating of the supported fire partition.

> **Exception:** In buildings of Types IIB, IIIB and VB construction, the supporting construction requirement shall not apply to fire partitions separating tenant spaces in covered and open mall buildings, fire partitions separating dwelling units, fire partitions separating sleeping units, ~~and~~ fire partitions serving as corridor walls, fire partitions separating ambulatory care facilities from adjacent spaces or corridors, fire partitions separating dwelling and sleeping units from Groups R-1 and R-2 occupancies and fire partitions separating vestibules from the level of exit discharge.

CHANGE SIGNIFICANCE: Two separate changes related to fire partitions have occurred. Section 708.1 has been corrected by completing the listing of locations where fire partitions are already recognized. Additionally, the Section 708.4.1 exception that allows certain fire partitions to be supported by non-rated floors in Types IIB, IIIB and VB construction has been expanded.

Generally, a fire partition is required to be supported by construction that has the same fire-resistance rating as the fire partition itself. The exception allows certain fire partitions in Types IIB, IIIB and VB construction to be erected on non-rated floors. Applications included in the exception comprise situations where a fire partition establishes protection on a floor level as a priority over separation from adjacent stories. The exception has been modified to include fire partitions that create separations in ambulatory care facilities, those in Groups R-1 and R-2 that are installed to modify required fire alarm provisions, and those creating a vestibule regulated as an interior exit discharge element.

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709.4.1 Smoke Barrier Continuity

CHANGE TYPE: Modification

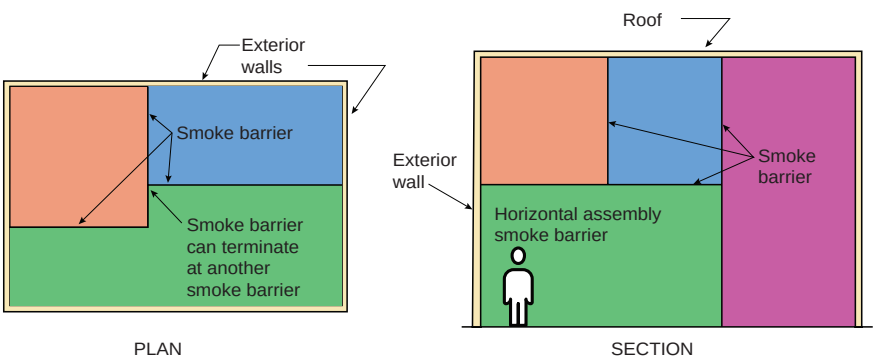
CHANGE SUMMARY: Smoke barrier and smoke compartment continuity needed to effectively serve their intended purposes have been clarified through revisions to the definition and enclosure provisions.

2021 CODE TEXT: **709.4.1 Smoke-barrier ~~walls~~ assemblies separating smoke compartments.** Smoke-barrier ~~walls~~ assemblies used to separate smoke compartments shall form an effective membrane enclosure that is continuous from an outside wall or smoke barrier wall to an outside wall or another smoke barrier wall and to the horizontal assemblies.

202 SMOKE COMPARTMENT. A space within a building ~~enclosed by smoke barriers on all sides, including the top and bottom~~ separated from other interior areas of the building by smoke barriers, including interior walls and horizontal assemblies.

CHANGE SIGNIFICANCE: The intent of smoke barriers is to separate interior building areas to create separate compartments. The previous definition stating that the compartments were to be enclosed "on all sides, including the top" was occasionally viewed as requiring roofs or exterior walls to be constructed as smoke barriers. Expecting a roof or exterior wall to be constructed as a smoke barrier—to prevent smoke from reaching the building exterior and potentially coming back into an adjacent compartment—was never the intent of the smoke compartment requirements. The definition now focuses on separations isolating "interior areas of the building" and clarifies that both walls and horizontal assemblies can create these separate compartments.

Section 709.4.1 provisions addressing smoke barrier continuity have also been revised to address several issues. First, the separation between adjacent smoke compartments may include both walls and horizontal



Smoke compartments are created by separating interior areas using smoke barriers that are continuous to:

- Exterior wall or roof
- Another smoke barrier (wall or horizontal assembly)

Smoke barrier continuity.

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assemblies. While both Sections 709.1 and 711.2.4.4 specifically reference horizontal smoke barriers, the continuity provisions only mentioned "walls" even though the general requirements call for an effective continuous separation. While designers may designate smoke compartments at various horizontal assemblies, the Group I-2 provisions of Section 407.5 and, specifically, Section 407.5.5 are perhaps the most common location where floors between levels are required to create smoke compartments on adjacent stories.

The second revision recognizes that smoke barriers are permitted to terminate at other smoke barriers and are not always required to extend to an exterior wall. Separation requirements in Section 709.4.2 already permit this for smoke barriers that create areas of refuge or elevator lobbies by stating that they may stop at "another smoke barrier wall or an outside wall." The important thing is that the smoke compartments are "separated from other interior areas … by smoke barriers" (per the definition of smoke compartment) and that the separation between compartments "form an effective membrane enclosure." Therefore, where a smoke barrier adjoins another smoke barrier, it will adequately isolate adjacent compartments and would not need to continue to an exterior wall. This additional option provides design flexibility for compartment layout and will continue to provide the intended separation between adjacent smoke compartments.

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710.5.2.1, 710.5.3

Smoke Partition Openings

CHANGE TYPE: Modification

CHANGE SUMMARY: Specific allowances are now provided for louvered doors and pass-through openings in smoke partitions that serve specified locations of a Group I-2 occupancy.

2021 CODE TEXT: **710.5.2 Doors.** Doors in smoke partitions shall comply with Sections 710.5.2.1 through 710.5.2.3.

710.5.2.1 Louvers. Doors in smoke partitions shall not include louvers.

Exception: Where permitted in accordance with Section 407.3.1.1.

710.5.2.2 Smoke and draft control doors. *(No changes)*

710.5.2.2.1 Smoke and draft control door labeling. *(No changes)*

710.5.2.3 Self- or automatic-closing doors. *(No changes)*

710.5.3 Pass-through openings in Group I-2, Condition 2. Where pass-through openings are provided in smoke partitions in Group I-2, Condition 2 occupancies, such openings shall comply with all of the following:

1. The smoke compartment in which the pass-through openings occur does not contain a patient care suite or sleeping room.
2. Pass-through openings are installed in a wall, door or vision panel that is not required to have a fire-resistance rating.
3. The top of the pass-through opening is located a maximum of 48 inches (1219 mm) above the floor.
4. The aggregate area of all such pass-through openings within a single room shall not exceed 80 square inches (0.05 m^2).



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Pass-through opening.

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CHANGE SIGNIFICANCE: Smoke partition requirements are commonly applied to hospital corridors under Section 407.3. Group I-2 hospital provisions within Section 407 often differ from general IBC provisions due to an ongoing effort to be generally consistent with federal regulations imposed by other codes and agencies as well as allowances for other protection and operational features common in such facilities. The new Section 710.5.2.1 exception and the added Section 710.5.3 are examples of specific modifications applicable to Group I-2 occupancies.

The new exception in Section 710.5.2.1 allows louvers within certain hospital corridor doors and is related to changes made in Section 407.3.1.1. While louvers would generally make a door ineffective at resisting smoke passage, the federal regulations from the Centers for Medicare and Medicaid Services (CMS) do allow transfer grilles or louvers in walls or doors serving auxiliary spaces that do not contain flammable or combustible materials and are not used to protect shaft enclosures or exitways. Where louvers are provided to allow makeup air for an exhaust system to enter the room as permitted by Section 1020.6, Exception 1, the use of louvers in the smoke partition doors is permitted.

The limited allowance for pass-through openings in Section 710.5.3 is also based on CMS regulations and the *National Fire Protection Association (NFPA) 101 Life Safety Code*® that serves as one of the primary regulatory documents for hospitals. Pass-throughs help accomplish several important functions such as maintaining security at pharmacy or payment counters or helping prevent the spread of contaminants, diseases or smoke because of air pressure differences. Where pass-throughs are installed in sprinklered buildings under the limitations established in Section 710.5.3, the limited pass-through sizes and locations of the pass-throughs are in keeping with the intended performance. These allowances have been proven effective under the federal regulations on which they are based.

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713.12 Top of Shaft Enclosure

CHANGE TYPE: Clarification

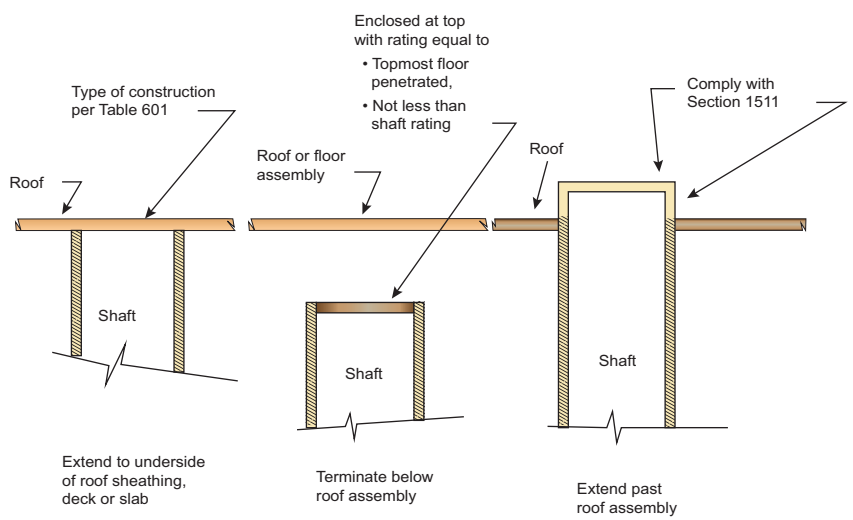
CHANGE SUMMARY: The three options for termination at the top of a shaft enclosure have been clarified.

2021 CODE TEXT: **713.12 Enclosure at top** ~~A shaft enclosure that does not~~ The top of shaft enclosures shall comply with one of the following:

1. Extend to the underside of the roof sheathing, deck or slab of the building, and the roof assembly shall comply with the requirements for the type of construction as specified in Table 601.
2. Terminate below the roof assembly and ~~shall~~ be enclosed at the top with construction of the same fire-resistance rating as the topmost floor penetrated by the shaft, but not less than the fire-resistance rating required for the shaft enclosure.
3. Extend past the roof assembly and comply with the requirements of Section 1511.

713.12.1 Penthouse mechanical rooms. A fire/smoke damper shall not be required at the penetration of the rooftop structure where shaft enclosures extend up through the roof assembly into a rooftop structure conforming to Section 1511. Ductwork in the shaft shall be connected directly to HVAC equipment.

CHANGE SIGNIFICANCE: Revisions shown in Section 713.12 help clarify how the top of a shaft is permitted to be terminated. The format is intended to mirror Section 713.11 for the bottom of the shaft and identify the common termination conditions and their requirements. These three termination conditions already exist in the code, therefore, this revision does not create any technical change to the code requirements. While conditions 1 and 2 are clearly created from existing text, Item



Enclosure options at the top of a shaft.

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1 now references the Table 601 roof construction provisions. Item 3 points to penthouse provisions in Section 1511. The definition for a penthouse indicates it is "an enclosed, unoccupied rooftop structure used for sheltering…vertical shaft openings." Adding this third condition provides details for the top of the shaft whether it terminates at, below, or above the roof.

The new Section 713.12.1 recognizes that not every penetration or opening that pierces a roof requires protection. The IBC typically does not address conditions where a fire spreads from the interior of the building to the exterior as illustrated in the acceptance of unprotected roof openings for penetrations (Section 714.5), ducts (Section 717.6), and skylights (Section 712.1.15). Where a mechanical penthouse provides an extension of a shaft enclosure from below, it has been clarified that neither a fire nor smoke damper is required at such penetrations provided all ductwork in the shaft enclosure is directly connected to heating, ventilation and air-conditioning (HVAC) equipment.

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CHANGE TYPE: Modification

CHANGE SUMMARY: The provisions for joints and voids have been reformatted and clarified to provide for more consistent application.

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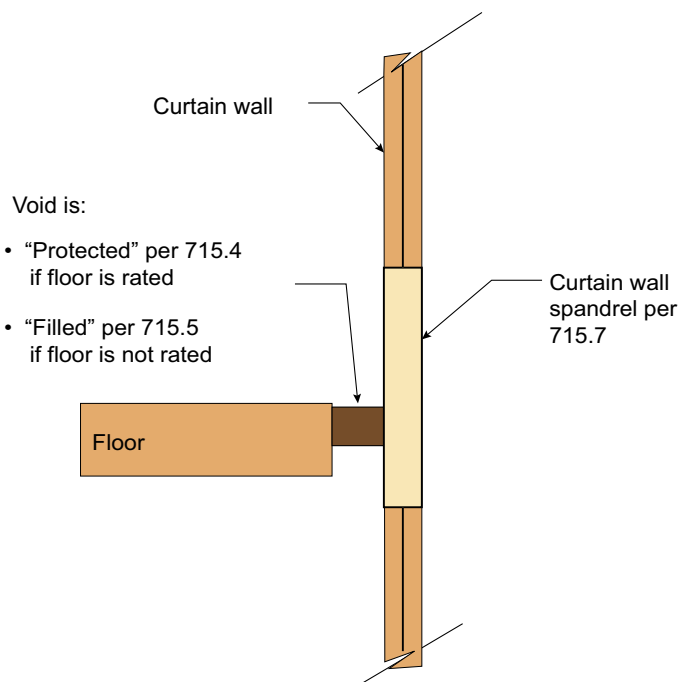
715
Protection of Joints and Voids

SECTION 715
~~FIRE-RESISTANT JOINT SYSTEMS~~

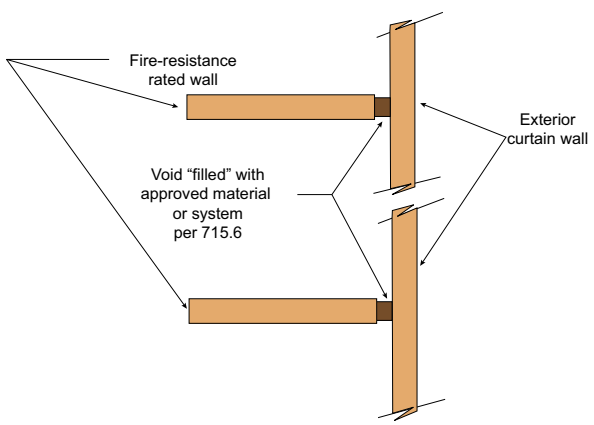
JOINTS AND VOIDS

715.1 General. The provisions of this section shall govern the materials and methods of construction used to protect joints and voids in or between horizontal and vertical assemblies.

715.2 Installation. ~~A fire-resistant joint system~~ Systems or materials protecting joints and voids shall be securely installed in accordance with the manufacturer's installation instructions ~~and the listing criteria~~ in or on the joint or void for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to resist the passage of fire and hot gases. Fire-resistant joint systems or systems used to protect voids at exterior curtain walls and fire-resistance-rated floor intersections shall also be installed in accordance with the listing criteria.



Sealing joints and voids - Section view.



Sealing joints and voids - Plan view.

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~~**715.1 General.**~~ **715.3 Fire-resistance-rated assembly intersections.** Joints installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies shall be protected by an approved fire-resistant joint system designed to resist the passage of fire for a time period not less than the required fire-resistance rating of the wall, floor or roof in or between which the system is installed. ~~Fire-resistant joint systems shall be tested in accordance with Section 715.3.~~

Exception: Fire-resistant joint systems shall not be required for joints in all of the following locations:

(No changes in Exceptions 1 through 10)

~~**715.1.1 Curtain wall assembly.** The void created at the intersection of a floor/ceiling assembly and an exterior curtain wall assembly shall be protected in accordance with Section 715.4.~~

~~**715.3**~~ **715.3.1 Fire test criteria.** *(No changes)*

715.4 Exterior curtain wall/fire-resistance-rated floor intersections. ~~Where fire-resistance-rated floor or floor/ceiling assemblies are required,~~ Voids created at the intersection of ~~the~~ exterior curtain wall assemblies and fire-resistance-rated floor or floor/ceiling assemblies shall be ~~sealed~~ protected with an approved perimeter fire containment system to prevent the interior spread of fire. Such systems shall ~~be securely installed and tested in accordance with ASTM E2307 to~~ provide an F rating for a time period not less than the fire-resistance rating of the floor or floor/ceiling assembly. ~~Height and fire-resistance requirements for curtain wall spandrels shall comply with Section 705.8.5.~~

~~**Exception:** Voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies where the vision glass extends to the finished floor level shall be permitted to be sealed with an approved material to prevent the interior spread of fire. Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch (0.254 mm) of water column (2.5 Pa) for the time period not less than the fire-resistance rating of the floor assembly.~~

715.4.1 Fire test criteria. Perimeter fire containment systems shall be tested in accordance with the requirements of ASTM E2307.

Exception: Voids created at the intersection of the exterior curtain wall assemblies and floor assemblies where the vision glass extends to the finished floor level shall be permitted to be protected with an approved material to prevent the interior spread of fire. Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E119 time-temperature fire conditions under a minimum

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positive pressure differential of 0.01 inch (0.254 mm) of water column (2.5 Pa) for the time period not less than the fire-resistance rating of the floor assembly.

~~**715.4.1**~~ **715.5 Exterior curtain wall/nonfire-resistance-rated floor assembly intersections.** Voids created at the intersection of exterior curtain wall assemblies and nonfire-resistance-rated floor or floor/ceiling assemblies shall be ~~sealed~~ filled with an approved material or system to retard the interior spread of fire and hot gases between stories.

~~**715.4.2**~~ **715.6 Exterior curtain wall/vertical fire barrier intersections.** Voids created at the intersection of nonfire-resistance-rated exterior curtain wall assemblies and vertical fire barriers shall be filled~~.~~ ~~An~~ with an approved material or system ~~shall be used to fill the void and shall be securely installed in or on the intersection for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and~~ to retard the ~~passage~~ interior spread of fire and hot gases.

~~**715.5**~~ **715.7 ~~Spandrel wall.~~ Curtain wall spandrels.** Height and fire-resistance requirements for curtain wall spandrels shall comply with Section 705.8.5. Where Section 705.8.5 does not require ~~a~~ fire-resistance-rated curtain wall spandrels, the requirements of ~~Section~~ Sections 715.4 and 715.5 shall still apply to the intersection between the curtain wall spandrels and the floor.

~~**715.6**~~ **715.8 ~~Fire-resistant joint systems~~ Joints and voids in smoke barriers.** Fire-resistant joint systems protecting joints in smoke barriers, and ~~joints~~ perimeter fire containment systems protecting voids at the intersection of a horizontal smoke barrier and an exterior curtain wall, shall be tested in accordance with the requirements of UL 2079 for air leakage. The L rating of the joint system shall not exceed 5 cubic feet per minute per linear foot (0.00775 m^3/s m) of joint at 0.30 inch (74.7 Pa) of water for both the ambient temperature and elevated temperature tests.

CHANGE SIGNIFICANCE: Provisions for joints and voids have been reformatted and clarified to provide more consistent application. Most of the revisions are editorial in nature and will not impact the application of the requirements. Other changes clarify the provisions by using more consistent terminology and more descriptive section titles. An example of reformatting is the creation of a new Section 715.1 to provide charging language similar to Section 714.1 for penetrations as well as expanding Section 715.2 to address the installation of all of joints and voids included in Section 715. A joint or void is to be "protected" where the protection method is required to be tested to a specific test standard. Where a void is only required to be "filled," there is no specific test standard or listing requirement.

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716.2.2.1.1

Prohibited Use of Terminated Stops

CHANGE TYPE: Modification

CHANGE SUMMARY: The use of "terminated stops" on door frames of doors providing smoke and draft control protection at elevator lobbies is now prohibited.

2021 CODE TEXT: **716.2.2.1.1 Smoke and draft control.** The air leakage rate of the door assembly shall not exceed 3.0 cubic feet per minute per square foot (0.01524 $m^3/s \times m^2$) of door opening at 0.10 inch (24.9 Pa) of water for both the ambient temperature and elevated temperature tests. Louvers shall be prohibited. Terminated stops shall be prohibited on doors required by Section 405.4.3 to comply with Section 716.2.2.1 and prohibited on doors required by Item 3 of Section 3006.3 or Section 3007.6.3 or 3008.6.3 to comply with this section.

202 TERMINATED STOPS. Factory feature of a door frame where the stops of the door frame are terminated not more than 6 inches from the bottom of the door frame. Terminated stops are also known as "hospital stops" or "sanitary stops".

CHANGE SIGNIFICANCE: Due to inconsistent interpretations and applications, terminated stops are now specifically defined and regulated. A terminated stop is simply a door frame stop that terminates a limited distance above the floor level. Removal of the stop for a limited height eliminates floor obstructions that can accumulate debris and are difficult to clean. Terminated stops are often used in hospitals and other occupancies to improve floor cleaning.



Photo courtesy of John Woestman

Door frame with terminated stop.

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The use of terminated stops is now specifically prohibited at four locations where the movement of equipment and floor cleaning are not considered as important as maintaining the required smoke and draft protection. Prohibited locations are all related to protecting elevator hoistways and limiting the potential for smoke movement to other parts of the building. Locations where terminated stops cannot be used include (a) an elevator serving multiple smoke compartments in an underground building, (b) additional doors providing smoke and draft control for elevator hoistway openings, (c) lobby doors serving a fire service access elevator, and (d) lobby doors serving occupant evacuation elevators. In all of these locations, the code specifically requires the doors to be tested to the UL 1784 standard "without an artificial bottom seal." The new prohibition will ensure that a terminated stop is not used on these door assemblies and that the assembly is installed as it was actually tested.

In all other locations, door assemblies that are required to meet smoke and draft control requirements are permitted to use a terminated stop. Any smoke and draft control doors using terminated stops must still be tested and installed in accordance with their listing. Smoke and draft control doors with terminated stops are to be tested using the UL 1784 test standard and allowed to have an artificial bottom seal installed during the testing. However, that type of seal is not required for the actual installation. Door assemblies with terminated stops would need to meet the 3.0 cubic feet per minute per square foot air leakage limit, but if they are installed in accordance with their listing, they are permitted. Due to the dynamics of positive pressure door testing, the bottom of the door is at a negative pressure and there is generally little concern with smoke movement through the door at that level. However, where the doors are protecting the four listed elevator hoistway locations, the pressure differences within the building and within the elevator hoistway cause greater concern.

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716.4

Fire-Protective Curtain Assemblies

CHANGE TYPE: Addition

CHANGE SUMMARY: Labeling and performance requirements for fabric fire-protective curtain assemblies have been established.

2021 CODE TEXT: **202 FIRE PROTECTIVE CURTAIN ASSEMBLY.** An assembly consisting of a fabric curtain, bottom bar, guides, coil, and an operating, and closing system.

716.4 Fire protective curtain assembly. Approved fire protective curtain assemblies shall be constructed of any materials or assembly of component materials tested without hose stream in accordance with UL 10D, and shall comply with the Sections 716.4.1 through 716.4.3

716.4.1 Label. Fire protective curtain assemblies used as opening protectives in fire-rated walls and smoke partitions shall be labeled in accordance with Section 716.2.9.

716.4.2 Smoke and draft control. Fire protective curtain assemblies used to protect openings where smoke and draft control assemblies are required shall comply with Section 716.2.1.4.

716.4.3 Installation. Fire protective curtain assemblies shall be installed in accordance with NFPA 80.

CHANGE SIGNIFICANCE: The establishment of provisions addressing fire-protective curtain assemblies is the first step in the specific regulation of these systems and provides building officials with guidance on how they are to be tested, labeled and installed. These systems are to



Photo courtesy of Smoke Guard Inc.

Vertically deploying fire protective curtain.

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be evaluated using the UL 10D *Standard for Fire Tests of Fire Protective Curtain Assemblies* standard. This test is similar to UL 10C *Positive Pressure Fire Tests of Door Assemblies*, but without the hose stream test. Though not required by the standard, opening protection tested to this standard can be evaluated to verify whether smoke and draft leakage through the opening complies with UL 1784, and some manufacturers have products that provide egress options. In addition, UL 10D provides for testing of both horizontal and vertical assemblies. Fire-protective curtain assemblies are required to meet the testing, labeling and installation requirements specified in Section 716.4 as appropriate, depending on assembly location and use.

The 2021 IBC doesn't specifically reference when or where these fire protective curtain assemblies can be used or accepted. It simply provides the code official with the standard to evaluate their performance. Therefore, their use, whether vertical or horizontal, will need to be reviewed and approved by the building official using the alternate methods provisions of Section 104.11. Because the code does not address where these protective curtain assemblies can be used, the limitation will really come based on the approval of the code official under the alternate methods provisions. These fire-protective curtain assemblies would be usable any place that Table 716.1(2) accepts a 20 minute or less rating or they could be used to supplement an opening protective and provide smoke and draft leakage or to establish a smoke reservoir at an upper floor or to close off a convenience stair. Potential uses, if accepted, would be as a supplemental means of protecting an opening at an atrium or a corridor as part of an engineered fire protection system. Another example of possible use is between two spaces with a cased opening between them but that would be viewed as separate areas for the purposes of a smoke control system. In this situation, the opening would allow the movement of both people and air between the spaces under normal circumstances, but, when needed, the fire protective curtain assembly would divide the spaces into separate smoke compartments. One important item of note is that, based on the limitations of the UL 10D and NFPA 80 standards, this fire-protective curtain assembly is not intended to be used as the proscenium curtain required by Section 410.2.5.

The scope of the UL 10D standard helps explain the intent of these systems when it states "These requirements cover the evaluation of fire protective curtain assemblies intended to provide supplemental passive fire protection as part of an engineered fire protection system. Fire protective curtain assemblies provide nonstructural separation only and are not intended to be substituted for structural hourly rated partitions or opening protectives that have been tested for fire endurance and hose stream performance." The standard includes several of these restrictions since the curtains do not limit the temperature rise on the unexposed side.

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Table 716.1(2)

Doors in Double Fire Walls

CHANGE TYPE: Modification

CHANGE SUMMARY: Appropriate opening protection is now addressed where two doors are used to protect a single opening, such as between adjacent hotel rooms or where a double fire wall is constructed.

2021 CODE TEXT:

(Partial view of Table 716.1(2))

TABLE 716.1(2) Opening Fire Protection Assemblies, Ratings and Markings

Type Of Assembly	Required Wall Assembly Rating (Hours)	Minimum Fire Door And Fire Shutter Assembly Rating (Hours)	Door Vision Panel Size[a]	Fire-Rated Glazing Marking Door Vision Panel[b,c]	Minimum Sidelight/ Transom Assembly Rating (Hours)		Fire-Rated Glazing Marking Sidelight/ Transom Panel	
					Fire Protection	Fire Resistance	Fire Protection	Fire Resistance
Fire walls and fire barriers having a required fire-resistance rating greater than 1 hour	4 3 2 $1\frac{1}{2}$	No changes in this portion of the table						
	Single-wall assembly rating (hours)[e]	Each wall of the double-wall assembly (hours)[f]						
Double fire walls constructed in accordance with NFPA 221	4	3	3	See note a	D-H-W-180	Not permitted	3	Not permitted	W-180
	3	2	$1\frac{1}{2}$	100 sq. in	<100 sq. in. = D-H-90 >100 sq. in.= D-H-W-90	Not permitted	2	Not permitted	W-120
	2	1	1	100 sq. in.	<100 sq. in. = D-H-60 >100 sq. in.= D-H-W-60	Not permitted	1	Not permitted	W-60
					Fire protection			
Other fire barriers	1		$\frac{3}{4}$	Maximum size tested	D-H	$\frac{3}{4}$[h]	D-H[h]	
Other fire partitions	1		$\frac{3}{4}$[i]	Maximum size tested	D-H-45	$\frac{3}{4}$	D-H-45	
	0.5		$\frac{1}{3}$	Maximum size tested	D-H-20	$\frac{1}{3}$	D-H-20	

table continued

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TABLE 716.1(2) *continued*

Type Of Assembly	Required Wall Assembly Rating (Hours)	Minimum Fire Door And Fire Shutter Assembly Rating (Hours)	Door Vision Panel Size[a]	Fire-Rated Glazing Marking Door Vision Panel[b,c]	Minimum Sidelight/ Transom Assembly Rating (Hours)		Fire-Rated Glazing Marking Sidelight/ Transom Panel	
					Fire Protection	Fire Resistance	Fire Protection	Fire Resistance
Exterior walls	2	$1^1/_2$	Maximum size tested	D-H 90 or D-H-W-90	$1^1/_2$[h]	2	D-H-OH-90[h]	W-120
					Fire protection			
	1	$^3/_4$	Maximum size tested	D-H-45	$^3/_4$[h]		D-H-45[h]	

For SI: 1 square inch = 645.2 mm.

a. ~~b.~~ Fire-resistance-rated glazing tested to ASTM E119 in accordance with Section 716.1.2.3 shall be permitted, in the maximum size tested.

b. ~~c.~~ Under the column heading "Fire-rated glazing marking door vision panel," W refers to the fire-resistance rating of the glazing, not the frame.

c. ~~e.~~ See Section 716.1.2.2.1 and Table 716.1(1) for additional permitted markings.

d. Two doors, each with a fire protection rating of $1^1/_2$ hours, installed on opposite sides of the same opening in a fire wall, shall be deemed equivalent in fire protection rating to one 3-hour fire door.

e. As required in Section 706.4.

f. As allowed in Section 4.6 of NFPA 221.

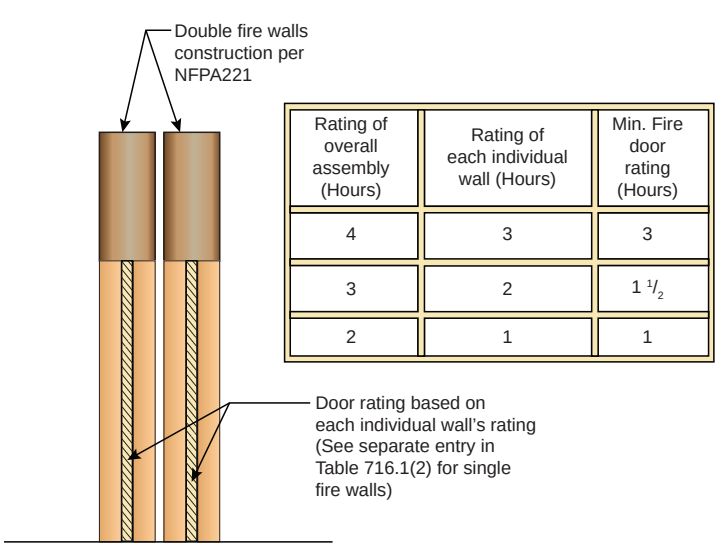
g. ~~d.~~ See Section 716.2.5.1.2.1.

h. Fire-protection-rated glazing is not permitted for fire barriers required by Section 1207 of the *International Fire Code* to enclose energy storage systems. Fire-resistance-rated glazing assemblies tested to ASTM E119 or UL 263, as specified in Section 716.1.2.3 shall be permitted.

i. ~~a.~~ Two doors, each with a fire rating of 20 minutes, installed on opposite sides of the same opening in a fire partition, shall be deemed equivalent in fire protection rating to one 45-minute fire door.

(No changes to other portions of Table 716.1(2))

CHANGE SIGNIFICANCE: Two changes occurred to Table 716.1(2) addressing conditions where two doors are used to protect a single opening. Door protection requirements have been introduced when a double fire wall designed and constructed in accordance with NFPA 221 is



Doors in double fire walls using NFPA 221.



Photo courtesy of Gerri Kielhofner

Fire partition with two 20-minute doors.

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provided instead of a single fire wall. This option of using two doors is also applicable to certain fire partitions. An additional change is the inclusion of footnote "h" dealing with glazing in the enclosures for energy storage systems, which was discussed previously in Section 707.4.

Section 706.2 requires that a fire wall be constructed to allow the collapse of the structure on either side without causing a collapse of the fire wall. One solution the code permits is the use of NFPA 221 for construction of two adjacent walls instead of a single wall. Table 716.1(2) clearly addresses the required door rating for a single fire wall but did not previously provide specific guidance where two walls were constructed directly adjacent to each other. Although designers and building officials could generally determine the appropriate rating where each of the double walls had either a 3-hour or 2-hour fire-resistance rating, there was no entry to address where a 1-hour wall is used for creating a double fire wall. It is important that code users recognize the unique requirements in the table for "double fire walls constructed in accordance with NFPA 221." One column now addresses a "single wall assembly rating" and the other column is for "each wall of the double wall assembly." If misapplied, it might be determined that a 3-hour single wall assembly only requires a 1-1/2 hour fire protection rating for the door and not recognize that it is the rating needed for the door in each of the two adjacent fire walls.

A second change is the inclusion of footnote "i" that will most likely be applied at the separation between adjacent sleeping units where Section 420.2 and Section 708.3 require a 1-hour rating between adjacent rooms. This footnote is referenced for "other fire partitions" where a wall requires a 1-hour fire-resistance rating and the door assembly requires a minimum 3/4-hour fire-protection rating. While one door with a 3/4-hour rating is required to be installed in this separation, it is common to install one door for each of the connecting rooms to allow occupants on either side of the wall to lock their door for security. The addition of this footnote will allow the installation of two 20-minute doors on each side of the opening, providing a general equivalency to the 45-minute rating mandated as the minimum fire-protection rating for a single door.

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717.2.3, 717.6.2.1

Ceiling Radiation Dampers

CHANGE TYPE: Modification

CHANGE SUMMARY: The use of static ceiling radiation dampers are now permitted where controls are used to shut down the airflow.

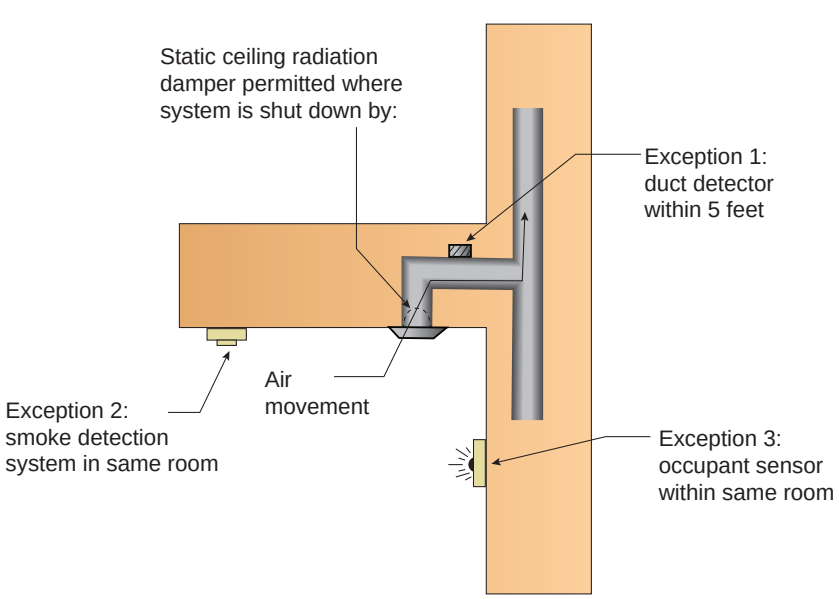
2021 CODE TEXT: **717.2 Installation.** Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers located within air distribution and smoke control systems shall be installed in accordance with the ~~requirements of this section,~~ the manufacturer's instructions ~~and~~ , the dampers' listing and Sections 717.2.1 through 717.2.3.

717.2.3 Static dampers. Fire dampers and ceiling radiation dampers that are listed for use in static systems shall only be installed in heating, ventilation and air-conditioning systems that are automatically shut down in the event of a fire.

717.3 Damper testing, ratings and actuation. Damper testing, ratings and actuation shall be in accordance with Sections 717.3.1 through 717.3.3.

717.3.1 Damper testing. Dampers shall be listed and labeled in accordance with the standards in this section.

1. *Fire dampers* shall comply with the requirements of UL 555. ~~Only *fire dampers* labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire.~~
2. Smoke dampers shall comply with the requirements of UL 555S.
3. Combination fire/smoke dampers shall comply with the requirements of both UL 555 and UL 555S.



Exceptions permitting static ceiling radiation damper.

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4. Ceiling radiation dampers shall comply with the requirements of UL 555C or shall be tested as part of a fire-resistance-rated floor/ceiling or roof/ceiling assembly in accordance with ASTM E119 or UL 263. ~~Only ceiling radiation dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire.~~
5. *Corridor dampers* shall comply with requirements of both UL 555 and UL 555S. *Corridor dampers* shall demonstrate acceptable closure performance when subjected to 150 feet per minute (0.76 mps) velocity across the face of the damper during the UL 555 fire exposure test.

717.6.2.1 Ceiling radiation dampers testing and installation. *(No changes)*

717.6.2.1.1 Dynamic systems. Only ceiling radiation dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire.

717.6.2.1.2 Static systems. Static ceiling radiation dampers shall be provided with systems which are not designed to operate during a fire.

Exceptions:

1. Where a static ceiling radiation damper is installed at the opening of a duct, a smoke detector shall be installed inside the duct or outside the duct with sampling tubes protruding into the duct. The detector or tubes within the duct shall be within 5 feet (1524 mm) of the damper. Air outlets and inlets shall not be located between the detector or tubes and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed. Other than in mechanical smoke control systems, dampers shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
2. Where a static ceiling radiation damper is installed in a ceiling, the ceiling radiation damper shall be permitted to be controlled by a smoke detection system installed in the same room or area as the ceiling radiation damper.
3. A static ceiling radiation damper shall be permitted to be installed in a room where an occupant sensor is provided within the room that will shut down the system.

CHANGE SIGNIFICANCE: UL 555C now has requirements to test ceiling radiation dampers (CRD) for closure under either dynamic or static conditions. Static-type fire dampers and ceiling radiation dampers are evaluated only for use where air movement is effectively stopped at the start of a fire. Dynamic-type dampers have been evaluated for use in mechanical systems where the airflow is operational during a fire, such as in a smoke control system or in situations where a fan system is operating

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at the time of a fire. Static damper installation limitations are appropriately relocated to a subsection of installation requirements rather than being addressed with each separate damper testing item.

Additionally, provisions have been added to specifically address how static CRDs can be installed within mechanical systems that have air movement during a fire. Because the UL CRD dynamic testing requirement is relatively new, all currently listed CRDs are essentially viewed as being static dampers. There are several situations where an exhaust system or fresh air make-up system can be operating during a fire and create conditions where dampers technically should be considered as dynamic systems. The Section 717.6.2.1.2 exceptions allow currently listed CRDs (and those listed in the future as static dampers) to be installed in locations where a dynamic damper should be used, provided that the damper is controlled as required by one of the exceptions. For example, many Group R-1 hotels have an exhaust fan in the bathroom of each unit. If the exhaust duct goes through a wall, there are dynamic fire dampers that can be used in this location. However, if the exhaust duct exits through the ceiling, then there currently are no listed CRDs that can be installed as listed when the exhaust system is operating. The three exceptions allow either a duct-mounted smoke detector, an area smoke detector installed within the room or an occupant sensor as a means of shutting down the air movement. For an occupant sensor, when the bathroom is vacant, the exhaust fan is assumed not to be running and the system can be considered static.

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717.4

Access to Dampers

CHANGE TYPE: Modification

CHANGE SUMMARY: Specific damper access requirements have been established, including an allowance for remote inspection where access cannot be provided.

2021 CODE TEXT: **717.3.3.1 Fire damper actuation ~~device~~.** ~~The fire damper actuation device~~ Primary heat responsive devices used to actuate fire dampers shall meet one of the following requirements:

1. The operating temperature shall be approximately 50°F (10°C) above the normal temperature within the duct system, but not less than 160°F (71°C).
2. The operating temperature shall be not more than 350°F (177°C) where located in a smoke control system complying with Section 909.

717.4 Access and identification. Access and identification of fire and smoke dampers shall comply with Sections 717.4.1 and 717.4.2.

717.4.1 Access. Fire and smoke dampers shall be provided with an approved means of access that is large enough to permit inspection and maintenance of the damper and its operating parts. Dampers equipped with fusible links, internal operators, or both shall be provided with an access door that is not less than 12 inches (305 mm) square or provided with a removable duct section.



Photo courtesy of Dave Nelsen, Norton and Schmidt Consulting Engineers

Damper access opening.

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717.4.1.1 Access openings. The access shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly. Access doors in ducts shall be tight fitting and suitable for the required duct construction.

717.4.1.2 Restricted access. Where space constraints or physical barriers restrict access to a damper for periodic inspection and testing, the damper shall be a single- or multi-blade type damper and shall comply with the remote inspection requirements of NFPA 80 or NFPA 105

717.4.2 Identification. Access points shall be permanently identified on the exterior by a label having letters not less than $\frac{1}{2}$ inch (12.7 mm) in height reading: "FIRE/SMOKE DAMPER," "SMOKE DAMPER" or "FIRE DAMPER."

CHANGE SIGNIFICANCE: While at first glance the revisions of Section 717.4 appear quite substantial, they are primarily an editorial reformatting of the existing provisions. Sections 717.4.1, 717.4.1.1 and 717.4.2 address three distinct topics: the need for access, the access opening itself and the identification of the access point. The only technical change is that a specific size requirement of a minimum 12-inch by 12-inch opening now provides an enforceable size requirement for the access opening. Previously an "approved" means of damper access was required that was adequate in size and location "to permit inspection and maintenance of the damper and its operating parts."

Recognizing that a 12-inch square access opening may not always be possible, especially when located in smaller ducts or in locations that have some type of barrier or obstruction, an option allows for "remote inspection." A remote testing and inspection alternative is recognized by the two referenced NFPA standards, NFPA 80 and NFPA 105, that are applicable to fire dampers and smoke dampers, respectively. These two standards address remote inspection, which is becoming more common, especially for larger facilities with numerous dampers, or for more efficient periodic inspections after the dampers have been in service for some time. Requirements for maintenance and periodic inspection are found in Section 706.1 of the *IFC* which references the provisions of the two NFPA standards.

Also of note is the terminology revision where "fire damper actuation device" is now identified as a "primary heat responsive device." This new terminology is consistent with the UL 555 standard.

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717.5.2

Flex Connectors

CHANGE TYPE: Modification

CHANGE SUMMARY: An allowance to eliminate fire dampers where a fully ducted HVAC system is provided has been modified to permit the use of flexible connections.

2021 CODE TEXT: **717.5.2 Fire barriers.** Ducts and air transfer openings of fire barriers shall be protected with listed fire dampers installed in accordance with their listing. Ducts and air transfer openings shall not penetrate enclosures for interior exit stairways and ramps and exit passageways, except as permitted by Sections 1023.5 and 1024.6, respectively.

Exceptions: Fire dampers are not required at penetrations of fire barriers where any of the following apply:

1. Penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.
2. Ducts are used as part of an approved smoke control system in accordance with Section 909 and where the use of a fire damper would interfere with the operation of a smoke control system.
3. Such walls are penetrated by fully ducted HVAC systems, have a required fire-resistance rating of 1 hour or less, are in areas of other than Group H and are in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. For the purposes of this exception, a fully ducted HVAC system shall be a duct system for conveying supply, return or exhaust air as part of the structure's HVAC system. Such a duct system shall be constructed



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Flex connector to ceiling diffuser.

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of sheet steel not less than No. 26 gage thickness and shall be continuous from the air-handling appliance or equipment to the air outlet and inlet terminals. Nonmetal flexible air connectors shall be permitted in the following locations:

3.1. At the duct connection to the air handling unit or equipment located within the mechanical room in accordance with Section 603.9 of the *International Mechanical Code.*

3.2. From an overhead metal duct to a ceiling diffuser within the same room in accordance with Section 603.6.2 of the *International Mechanical Code.*

CHANGE SIGNIFICANCE: Elimination of a fire damper in a 1-hour fire barrier penetration was previously not permitted if any portion of the ducted system was constructed of a material other than No. 26 gage sheet steel. Thus, any type of isolation connection between HVAC equipment and a duct system or to air diffusers located remotely from a duct penetration of a fire barrier was prohibited.

Flexible air connectors are now permitted at the two locations addressed by Items 3.1 and 3.2 when following appropriate provisions in the *International Mechanical Code* (IMC). Unprotected openings into the duct on both sides of the fire barrier have always been acceptable, therefore, the use of flexible air connectors at the locations specified is not deemed to constitute any greater hazard. Flexible air connectors are regulated by several provisions of both the IMC and IBC that address their performance, length, location, connections and sealing. See IMC Sections 603.6.2 through 603.6.4, and 603.9 as well as IBC Section 717.7 for more information.

The exception continues to be permitted only in a fully sprinklered building in an occupancy other than a Group H and for a maximum 1-hour rated assembly. By limiting allowable locations in the two new provisions, the flexible connectors will only occur at the end of the hard ductwork system. A steel duct, protected as a penetration (see Section 717.1.2), will continue to be required where a duct passes through a fire barrier.

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722.7

Fire-Resistance Rating of Mass Timber

CHANGE TYPE: Addition

CHANGE SUMMARY: A prescriptive approach has been provided to achieve the required fire-resistance ratings for new mass timber construction type members and assemblies.

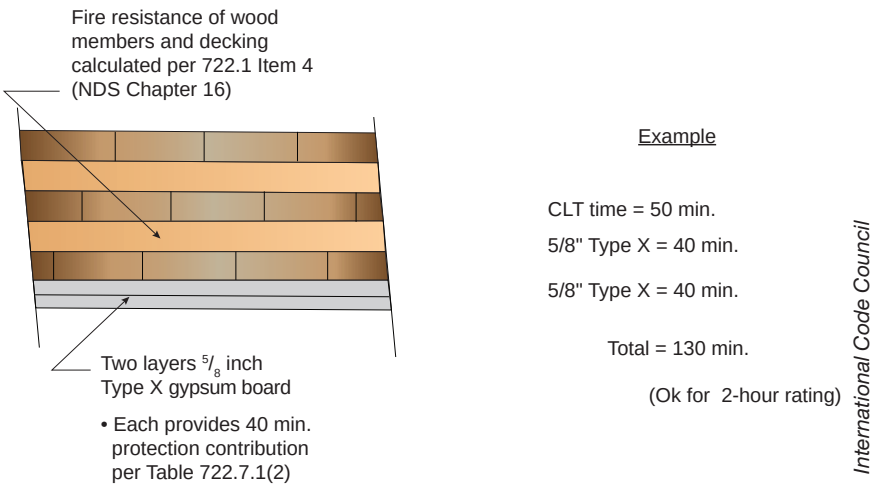
2021 CODE TEXT: **722.7 Fire-resistance for mass timber.** The required fire resistance of mass timber elements in Section 602.4 shall be determined in accordance with Section 703.2. The fire-resistance rating of building elements shall be as required in Tables 601 and 705.5 and as specified elsewhere in this code. The fire-resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element added to the protection time of the noncombustible protection.

722.7.1 Minimum required protection. Where required by Sections 602.4.1 through 602.4.3, noncombustible protection shall be provided for mass timber building elements in accordance with Table 722.7.1(1). The rating, in minutes, contributed by the noncombustible protection of mass timber building elements, components or assemblies, shall be established in accordance with Section 703.6. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement where installed and fastened in accordance with Section 722.7.2.

722.7.2 Installation of gypsum board noncombustible protection. Gypsum board complying with Table 722.7.1(2) shall be installed in accordance with this section.

722.7.2.1 Interior surfaces. Layers of Type X gypsum board serving as noncombustible protection for interior surfaces of wall and ceiling assemblies determined in accordance with Table 722.7.1(1) shall be installed in accordance with the following:

1. Each layer shall be attached with Type S drywall screws of sufficient length to penetrate the mass timber at least 1 inch (25 mm) when driven flush with the paper surface of the gypsum board.



Example – calculating fire-resistance.

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Exception: The third layer, where determined necessary by Section 722.7, shall be permitted to be attached with 1-inch (25 mm) No. 6 Type S drywall screws to furring channels in accordance with AISI S220.

2. Screws for attaching the base layer shall be 12 inches (305 mm) on center in both directions.
3. Screws for each layer after the base layer shall be 12 inches (305 mm) on center in both directions and offset from the screws of the previous layers by 4 inches (102 mm) in both directions.
4. All panel edges of any layer shall be offset 18 inches (457 mm) from those of the previous layer.
5. All panel edges shall be attached with screws sized and offset as in Items 1 through 4 above and placed at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge.
6. All panels installed at wall-to-ceiling intersections shall be installed such that ceiling panels are installed first and the wall panels are installed after the ceiling panel has been installed and is fitted tight to the ceiling panel. Where multiple layers are required, each layer shall repeat this process.
7. All panels installed at a wall-to-wall intersection shall be installed such that the panels covering an exterior wall or a wall with a greater fire-resistance rating shall be installed first and the panels covering the other wall shall be fitted tight to the panel covering the first wall. Where multiple layers are required, each layer shall repeat this process.
8. Panel edges of the face layer shall be taped and finished with joint compound. Fastener heads shall be covered with joint compound.
9. Panel edges protecting mass timber elements adjacent to unprotected mass timber elements in accordance with Section 602.4.2.2 shall be covered with $1^1/_4$-inch (32 mm) metal corner bead and finished with joint compound.

722.7.2.2 Exterior surfaces. Layers of Type X gypsum board serving as noncombustible protection for the outside of the exterior mass timber walls determined in accordance with Table 722.7.1(1) shall be fastened 12 inches (305 mm) on center each way and 6 inches (152 mm) on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 gage with a $^7/_{16}$-inch (11 mm) head of sufficient length to penetrate the mass timber a minimum of 1 inch (25 mm).
2. Screws that comply with ASTM C1002 (Type S, W or G) of sufficient length to penetrate the mass timber a minimum of 1 inch (25 mm).

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TABLE 722.7.1(1) Protection Required from Noncombustible Covering Material

Required Fire-Resistance Rating of Building Element per Tables 601 and 705.5 (hours)	Minimum Protection Required from Noncombustible Protection (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(2) Protection Provided by Noncombustible Covering MateriaL

Noncombustible Protection	Protection Contribution (minutes)
1/2-inch Type X gypsum board	25
5/8-inch Type X gypsum board	40

CHANGE SIGNIFICANCE: A prescriptive method has been established for achieving the fire resistance required to protect mass timber elements in new construction types IV-A, IV-B and IV-C. As an alternative to the tested assemblies established by Section 703.6, specific attachment and protection ratings are also provided. Section 703.6 addresses the performance method by which the fire-resistance rating of mass timber structural elements is to be determined. Section 722.7 is the prescriptive equivalent of Section 703.6 and provides a method to achieve fire resistance for mass timber buildings.

As stated in the last sentence of Section 722.7, "The fire-resistance rating of the mass timber elements shall consist of the fire-resistance rating of the unprotected element added to the protection time of the noncombustible protection." A calculated fire-resistance rating for an unprotected wood structural element is established using provisions found in Section 722.1 by applying Chapter 16 of the AWC National Design Specification for Wood Construction (NDS). Where required by Sections 602.4.1 through 602.4.3 for new construction types IV-A, IV-B and IV-C, provisions of Section 722.7.1 and Tables 722.7.1(1) and 722.7.1(2) are used to determine the required contribution of noncombustible protection needed for a wood structural member or assembly. Data from the broad testing of beams, columns, wall and ceiling panels was used to establish the values in Table 722.7.1(2).

When establishing the fire-resistance requirements for mass timber used in new construction types IV-A, IV-B and IV-C, it was determined that at least two-thirds of the required fire-resistance rating should come from noncombustible protection. When using the calculation (prescriptive) method, the protection required is set forth in Table 722.7.1(1), with Table 722.7.1(2) then establishing the protection provided by each layer of noncombustible material. For example, if an element required a minimum 2-hour fire-resistance rating, Table 722.7.1(1) would mandate a minimum contribution from the noncombustible covering of 80 minutes. Table 722.7.1(2) indicates that two layers of 5/8-inch Type X gypsum board would provide the needed 80 minutes of protection. The calculated fire-resistance of an exposed wood member is then determined from NDS Chapter 16 (a minimum of 40 minutes) and added to the 80-minute non-

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combustible protection. Where the total is no less than 120 minutes, with at least 80 minutes being provided by gypsum board, the 2-hour fire-resistance requirement is satisfied.

Because 722.7 is a prescriptive methodology, the gypsum board protection must be installed as indicated in Section 722.7.2. While an assembly tested in accordance with Section 703.6 would require the noncombustible protection to be installed as it was for the actually tested assembly, Section 722.7.2 provides specific details that must be followed when the prescriptive provisions are used. These prescriptive installation provisions must be followed just as those in Tables 721.1(1), 721.1(2) or 721.1(3) are used when constructing a rated assembly with those systems.

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806.9

Combustible Lockers as Interior Finish

CHANGE TYPE: Addition

CHANGE SUMMARY: Combustible lockers are now regulated for interior finish purposes.

2021 CODE TEXT: **806.9 Combustible lockers.** Where lockers constructed of combustible materials are used, the lockers shall be considered to be interior finish and shall comply with Section 803.

> **Exception:** Lockers constructed entirely of wood and noncombustible materials shall be permitted to be used wherever interior finish materials are required to meet a Class C classification in accordance with Section 803.1.2.

CHANGE SIGNIFICANCE: The regulation of combustible lockers, previously limited to Section 808.4 of the IFC, is now also addressed in the IBC. This allows for regulation before and during construction rather than only after occupancy during a fire service inspection.

Traditionally, lockers in schools, health clubs and similar facilities were primarily constructed of steel. In recent years, lockers constructed of combustible materials have become prevalent. These lockers typically line an entire wall (for example, a corridor in a school) and are generally not regulated by the IBC. They are not usually addressed for interior finish purposes and yet they also do not fall under the IBC's decorative materials and trim provisions. While IFC Chapter 8 does address other topics such as upholstered furniture, decorations, decorative vegetation, wastebaskets, linen containers and signs, lockers do not fall into any of those categories.



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Combustible lockers.

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Therefore, a specific provision was previously added to the "furnishings" section of the IFC. To ensure these requirements are not overlooked during design and construction, they are now also being added to the IBC.

Combustible lockers can present a significant fire load and, if ignited, are likely to spread fire in a manner similar to other materials with comparable interior finish conditions. Plastic lockers have the benefit of being more immune to the effects of water from wet clothing and are generally very durable, but with these benefits comes a fire hazard. One type of locker is constructed of $^{3}/_{8}$-inch-thick (9.52 mm) solid plastic bodies with heavy-duty $^{1}/_{2}$-inch-thick (12.7 mm) doors. Typically, the "solid plastic" used is either high-density polyethylene or polypropylene. Polypropylene is a thermoplastic that generates considerable energy and produces a pooling flammable liquid fire as it burns. Because of this potential hazard, compliance with general testing and flame spread limitations used for other wall and ceiling finishes in Section 803 is required.

The exception recognizes lockers that are constructed of wood as being acceptable in any application permitting Class C flame spread finish material. This is reasonable since most wood materials generally fall within either the Class B or Class C flame spread categories. Where a locker is constructed of noncombustible materials, it is not impacted due to the scoping limit statement of "constructed of combustible materials."

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903.2.4, 903.2.7, 903.2.9

Upholstered Furniture and Mattresses

CHANGE TYPE: Modification

CHANGE SUMMARY: The sprinkler provisions for upholstered furniture and mattresses have been modified to clearly indicate the scope of the required protection.

2021 CODE TEXT: **903.2.4 Group F-1.** An automatic sprinkler system shall be provided throughout all buildings containing a Group F-1 occupancy where one of the following conditions exists:

1. A Group F-1 fire area exceeds 12,000 square feet (1115 m^2).
2. A Group F-1 fire area is located more than three stories above grade plane.
3. The combined area of all Group F-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m^2).
4. ~~A Group F-1 occupancy used for the manufacture of upholstered furniture or mattresses exceeds 2,500 square feet (232 m^2).~~

903.2.4.1 Woodworking operations. *(No change)*

903.2.4.2 Group F-1 distilled spirits. *(New)*

903.2.4.3 Group F-1 upholstered furniture or mattresses. An automatic sprinkler system shall be provided throughout a Group F-1 fire area that exceeds 2,500 square feet (232 m^2) used for the manufacture of upholstered furniture or mattresses.

903.2.7 Group M. An automatic sprinkler system shall be provided throughout buildings containing a Group M occupancy where one of the following conditions exists:

1. A Group M fire area exceeds 12,000 square feet (1115 m^2).
2. A Group M fire area is located more than three stories above grade plane.



Fire area sprinkler requirement.

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3. The combined area of all Group M fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m^2).
~~4. A Group M occupancy used for the display and sale of upholstered furniture or mattresses exceeds 5,000 square feet (464 m^2).~~

903.2.7.1 High-piled storage. *(No change)*

903.2.7.2 Group M upholstered furniture or mattresses. An automatic sprinkler system shall be provided throughout a Group M fire area where the area used for the display and sale of upholstered furniture or mattresses exceeds 5,000 square feet (464 m^2).

903.2.9 Group S-1. An automatic sprinkler system shall be provided throughout all buildings containing a Group S-1 occupancy where one of the following conditions exists:

1. A Group S-1 fire area exceeds 12,000 square feet (1115 m^2).
2. A Group S-1 fire area is located more than three stories above grade plane.
3. The combined area of all Group S-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m^2).
4. A Group S-1 fire area used for the storage of commercial motor vehicles where the fire area exceeds 5,000 square feet (464 m^2).
~~5. A Group S-1 occupancy used for the storage of upholstered furniture or mattresses exceeds 2,500 square feet (232 m^2).~~

903.2.9.1 Repair garages. *(No change)*

903.2.9.2 Bulk storage of tires. *(No change)*

903.2.9.3 Group S-1 Distilled spirits or wine. *(New)*

903.2.9.4 Group S-1 upholstered furniture and mattresses. An automatic sprinkler system shall be provided throughout a Group S-1 fire area where the area used for the storage of upholstered furniture or mattresses exceeds 2,500 square feet (232 m^2).

Exception: Self-service storage facilities no greater than one story above grade plane where all storage spaces can be accessed directly from the exterior.

CHANGE SIGNIFICANCE: Since the sprinkler requirements specific to upholstered furniture and mattresses were first introduced into the IBC, there has been debate and discussion on exactly how the provisions are to be applied. Vague language has led to inconsistent application and, in some situations, to sprinklers being required where many people felt there was not a great enough hazard to justify the need for the protection.

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The sprinkler requirements for these special hazards that occur in Groups F-1, M and S-1 occupancies have been modified to help clarify not only when the requirements apply, but also where the sprinkler protection is required.

Previously, if a business involved in the manufacture of upholstered furniture was 6,000 square feet in size, but the area "used for the manufacture" of the furniture was only 1,000 square feet, it was difficult to determine if the provision was to be applied. It was often deemed that the sprinkler protection was required not only in the area to address the unique hazard the upholstered furniture creates, but also throughout the entire building.

The new upholstered furniture and mattress provisions have been relocated into a separate section for each of the three occupancies. The revised scoping will not only limit the floor area thresholds to the "fire area" instead of to the occupancy, but will also only require the sprinkler protection to be installed in that fire area instead of "throughout the building." For the Group M and S-1 occupancies, the provisions also clarify it is the actual area used for the upholstered furniture and mattresses that is the trigger and not the overall size of the fire area. Although it is now permissible to subdivide a building with multiple fire areas to avoid the sprinkler requirement, each of the three occupancy types would ultimately still face the general sprinkler limitations of having a 12,000 square foot fire area, being more than three stories above grade or having an aggregate area of 24,000 square feet for all the fire areas. While the option to subdivide with a 3-hour (Groups F-1 and S-1) or a 2-hour (Group M) separation can be used to eliminate the sprinklers in smaller facilities with upholstered furniture and mattresses, the overall building provisions would still ultimately trigger the sprinkler protection requirement for larger facilities. The unique hazard potential these products create is now directly addressed rather than possibly relating the protection threshold to portions of the occupancy that do not present that same level of risk.

A new exception applies specifically to Group S-1 self-service storage facilities that are a single story above grade plane and have all storage spaces accessed directly from the exterior. Under such conditions, the 2,500 square foot fire area limitation based on the storage of upholstered furniture or mattresses in a nonsprinklered building does not apply. However, this exception only eliminates the sprinkler requirement for upholstered furniture and mattress storage and does not eliminate the general Group S-1 sprinkler thresholds. Since these are low-rise structures with adequate exterior access for fire personnel, there is a reduced level of hazard compared to a multistory structure or one with central corridor access to the upholstered furniture or mattress storage areas.

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903.2.4.2, 903.2.9.3

Distilled Spirits

CHANGE TYPE: Addition

CHANGE SUMMARY: Imposes a sprinkler requirement for both the manufacturing and bulk storage of distilled spirits.

2021 CODE TEXT: **903.2.4.2 Group F-1 Distilled Spirits.** An automatic sprinkler system shall be provided throughout a Group F-1 fire area used for the manufacture of distilled spirits.

903.2.9.3 Group S-1 Distilled spirits or wine. An automatic sprinkler system shall be provided throughout a Group S-1 fire area used for the bulk storage of distilled spirits or wine.

CHANGE SIGNIFICANCE: A series of changes has been made throughout both the IBC and the IFC to eliminate confusion in the regulation of buildings that manufacture or store distilled spirits and wines. Distilled spirits have the properties of flammable liquids and proper safeguards must be provided for the occupancies and structures that house such activities.

With the changes to (a) clarify the proper occupancy classification of both manufacturing and storage, (b) deal with the different types of containers, (c) provide specific exclusions to indicate such facilities can be a "use other than Group H", and (d) add a new chapter in the IFC to address the "storage of distilled spirits and wines", it should now be easier to determine how these uses are to be regulated and should lead to more consistent enforcement. The new sprinkler requirements, along with all the other changes, will help reduce the hazard from these uses and coordinate with all the other important protection systems and controls.



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F-1 distilled spirits manufacturing.

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903.2.10

Sprinklers in Parking Garages

CHANGE TYPE: Modification

CHANGE SUMMARY: An automatic sprinkler system must now be installed in an open parking garage where a specific fire area or height threshold is exceeded.

2021 CODE TEXT: **903.2.10 Group S-2 ~~enclosed~~ parking garages.** An automatic sprinkler system shall be provided throughout buildings classified as ~~enclosed~~ parking garages ~~in accordance with Section 406.6 where either~~ where any of the following conditions exists:

1. Where the fire area of the enclosed parking garage in accordance with Section 406.6 exceeds 12,000 square feet (1115 m^2).
2. Where the enclosed parking garage in accordance with Section 406.6 is located beneath other groups.

   Exception: Enclosed parking garages located beneath Group R-3 occupancies.

3. Where the fire area of the open parking garage in accordance with Section 406.5 exceeds 48,000 square feet (4460 m^2).

403.3 Automatic sprinkler system. Buildings and structures shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 and a secondary water supply where required by Section 403.3.3.



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Sprinklered open parking garage.

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Exception: An automatic sprinkler system shall not be required in spaces or areas of:

~~1.~~ ~~Open parking garages in accordance with Section 406.5.~~

~~2.~~ *(no change)*

903.2.11.3 Buildings 55 feet or more in height. An automatic sprinkler system shall be installed throughout buildings that have one or more stories with an occupant load of 30 or more located 55 feet (16 764 mm) or more above the lowest level of fire department vehicle access, measured to the finished floor.

~~**Exceptions:**~~ **Exception**

~~1.~~ ~~Open parking structures.~~

~~2.~~ Occupancies in Group F-2.

CHANGE SIGNIFICANCE: Open parking garages have historically been exempted from the sprinkler system requirements due to both a relatively good fire record and previous fire test data. However, with the change in the construction of automobiles, there is an increased use of plastics and lightweight materials as opposed to the metals that were previously used. In addition, the types of fuels being used to power the vehicles are also different. Based on the greater hazards due to a vehicle's fire fuel loading and on a fire that occurred in a parking garage in Liverpool, England on December 31st, 2017, it was determined that sprinkler protection should be provided at an established threshold.

The 48,000 square-foot fire area threshold was selected predominately because it was four times the general 12,000 square foot limit and thus would lessen the impact of the new sprinkler requirement. This seemed like a reasonable step that would only impact larger garages. An additional justification for the area limit selected was its approximate equivalency to a 200-foot by 200-foot area and the limit of preconnected fire hoses. It should be noted that where any parking garage fire area exceeds 48,000 square feet, the entire building must be protected with an automatic sprinkler system.

Within the high-rise provisions of Section 403.3, there has historically been an exemption to eliminate sprinklers in open parking garages in high-rise buildings. That exemption has been removed, resulting in the required sprinkler protection of a high-rise building extending to any open parking garage in a high-rise building regardless of the size of the garage fire area.

A similar exception deletion occurred in Section 903.2.11.3 addressing buildings having one or more stories with an occupant load of 30 or more located 55 feet or more above the lowest level of fire department vehicle access. In those buildings containing an open parking garage where the occupant load and height thresholds are exceeded, the entire building, including the parking garage, is required to be sprinklered. Again, the sprinkler protection of the open garage is mandated regardless of the garage's fire area size. It is important to note that the provisions apply to both single-occupancy open parking garages as well as to mixed-occupancy conditions where a Group S-2 open parking garage is not the only occupancy in the building.

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903.2.10.2

Mechanical-Access Parking Garages

CHANGE TYPE: Addition

CHANGE SUMMARY: Mechanical-access enclosed parking garages are now defined and require an automatic sprinkler system.

2021 CODE TEXT: **903.2.10.2 Mechanical-access enclosed parking garages.** An approved automatic sprinkler system shall be provided throughout buildings used for the storage of motor vehicles in a mechanical-access enclosed parking garage. The portion of the building that contains the mechanical-access enclosed parking garage shall be protected with a specially engineered automatic sprinkler system.

202 MECHANICAL-ACCESS ENCLOSED PARKING GARAGE An enclosed parking garage which employs parking machines, lifts, elevators or other mechanical devices for vehicle moving from and to street level and in which public occupancy in the garage is prohibited in all areas except the vehicle access bay.

CHANGE SIGNIFICANCE: Enclosed mechanical-access parking garages are being constructed in the United States on an increasing basis. Classified as Group S-2, these occupancies are distinct from the traditional ramp-access parking garages in that there are very limited floor openings, sometimes there are no floors at all. Comparable to automated high rack storage systems, some of these facilities have no floors, no stairwells and no above-ground level access other than maintenance walkways and ladders.

An enclosed mechanical-access parking garage offers many firefighting challenges; i.e. most are constructed within a building shell, and there is no floor access to the upper levels. The vehicles are parked in a rack system with no safe elevated access to the interior of the structure.



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Enclosed mechanical-access parking garage.

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The construction components of newer vehicles and the new fuel sources being used create a substantial fire problem. Because of all these features and concerns, a specifically engineered automatic sprinkler system is required to be installed in these types of buildings.

In addition to the fire sprinkler requirement, the new Section 406.6.4 requires mechanical-access enclosed parking garages to provide the following:

- Separation from other occupancies by minimum 2-hour fire barriers or horizontal assemblies.
- Fire department access doors at the ground level as required for high-piled combustible storage.
- Mechanical smoke removal system.
- Manual emergency shutdown switch for use by emergency personnel.
- Fire control equipment room with exterior access housing the fire alarm control unit, mechanical ventilation controls and emergency shut down switch.

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903.3.1.2

NFPA 13R Sprinkler Protection

CHANGE TYPE: Modification

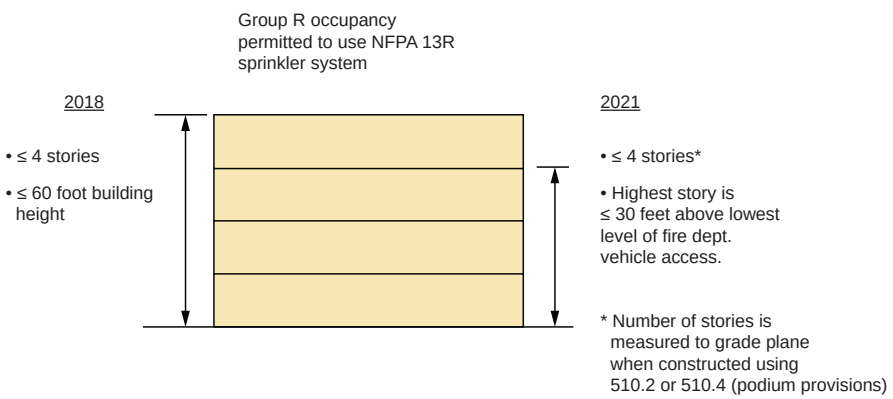
CHANGE SUMMARY: The maximum building height where an NFPA 13R sprinkler system is permitted has been reduced. In addition, where the podium provisions of Section 510 are applied, the story height measuring point has been changed to grade plane.

2021 CODE TEXT: **903.3.1.2 NFPA 13R sprinkler systems.** Automatic sprinkler systems in Group R occupancies ~~up to and including four stories in height in buildings not exceeding 60 feet (18 288 mm) in height above grade plane~~ shall be permitted to be installed throughout in accordance with NFPA 13R where the Group R occupancy meets all of the following conditions:.

1. Four stories or fewer above grade plane.
2. The floor level of the highest story is 30 feet (9114 mm) or less above the lowest level of fire department vehicle access.
3. The floor level of the lowest story is 30 feet (9114 mm) or less below the lowest level of fire department vehicle access.

The number of stories of Group R occupancies constructed in accordance with Sections 510.2 and 510.4 shall be measured from ~~the horizontal assembly creating separate buildings~~ grade plane.

CHANGE SIGNIFICANCE: An NFPA 13R sprinkler system is intended as a life safety system and is not expected to address all of the property protection concerns. As such, the sprinklers are allowed to be installed only in the occupied areas of the building and are not required to be installed within the attic or other concealed combustible spaces. While the IBC and the NFPA 13R standard both generally allow these systems to be installed in buildings "up to…four stories in height," the IBC has historically allowed measurement from the podium building's "horizontal assembly creating separate buildings." Although the overall height in feet remains consistent, counting the permitted number of stories starting at the podium deck has essentially made the residential sprinkler



Limits for using a 13R sprinkler system.

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system now applicable to what is seen from the ground as being a five-or six-story building. This allowance places the unsprinklered attic area of combustible construction at a higher and more difficult level for the fire department to reach or defend. Because of these concerns, the permissible use of an NFPA 13R sprinkler system has been modified to require the story height limit for podium buildings to be made from grade plane instead of from the horizontal assembly separating the upper and lower buildings.

In addition, the 60-foot building height limitation that was measured from "grade plane," has been replaced with a 30-foot maximum height measured to the floor level of the highest story from the lowest level of fire department vehicle access. This modification will be more restrictive than what has been previously allowed. The 30-foot floor level height and other triggers were selected based on the standpipe requirements found within Section 905.3.1. Using a single scoping limit for both the standpipe and the NFPA13 sprinkler systems makes for a logical point at which additional fire protection is warranted.

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903.3.1.2.2

Corridor and Balcony Sprinklers

CHANGE TYPE: Modification

CHANGE SUMMARY: Sprinkler protection must now be extended into corridors and balconies used in the means of egress, even though the location may be exempt based upon the NFPA 13R standard.

2021 CODE TEXT: **903.3.1.2.2 ~~Open-ended corridors~~ Corridors and balconies in the means of egress.** Sprinkler protection shall be provided in corridors and for balconies in the means of egress where any of the following conditions apply:

1. Corridors with combustible floor or walls.
2. Corridors with an interior change of direction exceeding 45 degrees (0.79 rad).
3. Corridors that are less than 50 percent open to the outside atmosphere at the ends.
4. Open-ended corridors and associated exterior stairways and ramps as specified in Section 1027.6, Exception 3.
5. Egress balconies not complying with Sections 1021.2 and 1021.3.

CHANGE SIGNIFICANCE: To fully understand the intent of this code change, it is important to review the way that reference standards are applied with the IBC and how it dictates which document takes precedence. A review of Section 102.4 indicates (a) that if there is a conflict, the code takes precedence, and (b) that where a subject is addressed both within the code and the standard, the scope from the code is the controlling provision. In this case, the IBC scopes where sprinkler systems



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Egress balconies.

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are required, but then indicates that they follow the technical provisions of the standard by stating the systems are to be "installed throughout in accordance with NFPA 13R." Under the technical requirements of that standard, any space "open" to outside temperature is allowed to eliminate the sprinkler protection in that unconditioned/open area. At issue is whether a space is interior and needs sprinkler protection or is exterior (read as "open" from the NFPA perspective) and does not need the sprinklers. While the IBC has historically addressed the requirement in some cases (see Item 3.1 in Exception 3 of IBC Section 1027.6 for open-ended corridors), where specific guidance is not provided, the provisions of the standard could be used to eliminate the sprinklers even though the egress element is essentially enclosed with only something minor leaving it "open" and unconditioned. The added scoping establishes priority over the standard and thus mandates that the sprinkler protection is required in these situations even though it may generally be exempt under the standard itself.

Code users should not view these changes as modifications to the IBC provisions such as Exception 3 in Section 1027.6, but instead view it as limiting the exemptions that the NFPA 13R standard would otherwise allow. Where a building is not required to be sprinklered, it is not the intent that this section would require a sprinkler system to be installed in these listed locations. This subsection of Section 903.3.1.2 is only applicable where some other provision (such as Section 903.2.8) has already required the sprinkler system to be installed, and once that occurs, Section 903.3.1.2.2 mandates that the required system also be extended into these elements of the means of egress even though the NFPA 13R standard indicates that the protection is not needed due to being "open" and unconditioned.

Another point to emphasize is that while Section 903.3.1.2.1 does require the NFPA 13R sprinkler protection to be extended onto the balconies and decks, it is important to recognize the difference in the scoping of that section compared to egress balconies addressed by Item 5 of the new text. While Section 903.3.1.2.1 regulates the balconies and decks "of dwelling units and sleeping units" under two conditions, the new text in Section 903.3.1.2.2 applies to "egress balconies" that serve as a part of the means of egress system and may serve the overall building or areas that are not a part of a dwelling unit or sleeping unit. Therefore, the spaces regulated by this Item 5 are different than the spaces regulated by Section 903.3.1.2.1.

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905.3.1

Standpipes in Parking Garages

CHANGE TYPE: Modification

CHANGE SUMMARY: The standpipe requirements for both open and enclosed parking garages have been modified impacting the type of system, the threshold heights, and the necessary water supply.

2021 CODE TEXT: **905.3.1 Height.** Class III standpipe systems shall be installed throughout buildings where any of the following conditions exist:

1. Four or more stories are above or below grade plane.
2. The floor level of the highest story is located more than 30 feet (9144 mm) above the lowest level of fire department vehicle access.
3. The floor level of the lowest story is located more than 30 feet (9144 mm) below the highest level of fire department vehicle access.

Exceptions:

1. *(No changes)*
2. *(No changes)*
3. Class I ~~manual~~ standpipes are allowed in ~~open~~ parking garages ~~where the highest floor is located not more than 150 feet (45 720 mm) above the lowest level of fire department vehicle access~~.



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Class I standpipe in parking garage.

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~~4.~~ ~~Class I manual dry standpipes are allowed in open parking garages that are subject to freezing temperatures, provided that the hose connections are located as required for Class II standpipes in accordance with Section 905.5.~~

~~5~~4. *(No changes)*

~~6~~5. *(No changes)*

~~7~~6. *(No changes)*

~~7.1~~6.1. *(No changes)*

~~7.2~~6.2. *(No changes).*

CHANGE SIGNIFICANCE: Consistent with revisions to Section 903.2.10 mandating sprinkler systems in larger open parking garages, it has also been recognized that both the materials and fuel types used in vehicles have changed. Therefore, it is important that fire fighters have a water supply available where open parking garages require sprinkler protection. As with any multiple-story building, it is important that quick action is taken to get water onto a fire to limit its growth and potentially extinguish it, thereby protecting both life and property. Where buildings exceed the threshold limits, a Class III standpipe system must typically be installed. These systems are established not only for use by the fire department but are also provided with smaller hose connections that allow for the building occupants to fight the fire during its incipient stages. With the use of lighter weight and thinner metals, along with more synthetic combustible materials being used in the construction of the vehicles and a wider variety of fuel types, there is now a greater potential for larger multiple-vehicle fires within parking garages. Thus, the exceptions have been modified to provide the necessary water supply for the parking garage and accelerate the fire department's response to any vehicle fire.

Exception 3 previously provided an important exemption for open parking garages. Instead of a Class III standpipe system, a Class I could be installed under specified conditions. Class I systems are intended for fire fighter operations and are not intended for occupant use. These Class I systems could have been "manual" systems that either did not have their own water supply or had an inadequate water supply to meet the anticipated demand. The Class I manual systems were limited to a maximum of 150 feet, at which point a compliant water supply was required. All aspects of the exception were in recognition of the lower hazard level that open parking garages were viewed as having. With the revisions, the exception is now applicable to both open and enclosed parking garages, but, perhaps more importantly, once the standpipe system is required, the exception will no longer address the type of water supply that is required.

The deletion of Exception 4 will result in applying the exception in Section 905.8 to determine the type of water supply to be used for the standpipe system in open parking garages where freezing is a concern. Section 905.3.1 addresses the class of standpipe system to be used, and Section 905.8 will address the type of water supply for the system. The combined impact of revising the two exceptions results in allowing a designer to select which type of water supply can be used for the standpipe system in an open parking garage. This could include automatic, semi-automatic or even a manual system, and those automatic or manual systems could also be either wet or dry pipe systems.

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907.2.10

Manual Alarms in Group S Buildings

CHANGE TYPE: Addition

CHANGE SUMMARY: A manual fire alarm system is now required in self-storage facilities that are three stories or more in height and have interior corridors.

2021 CODE TEXT: **907.2.10 Group S.** A manual fire alarm system that activates the occupant notification system in accordance with Section 907.5 shall be installed in Group S public- and self-storage occupancies three stories or greater in height for interior corridors and interior common areas. Visible notification appliances are not required within storage units.

> **Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1, and the occupant notification appliances will activate throughout the notification zones upon sprinkler water flow.

CHANGE SIGNIFICANCE: Manual fire alarm systems are now required in self-storage facilities that consist of three or more stories and have interior corridors or interior common areas. A multiple-story self-storage building often has dozens, if not hundreds, of storage units, each with a different owner or renter. The users know how to access their unit, but typically are not familiar with the entire facility. It is important that notification to the various occupants who could be inside the building at any one time be provided by a fire alarm system.



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Storage building requiring a fire alarm.

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Visible notification appliances are not required within the storage units. Thus the visual alarm appliances are only required in the interior corridors and common areas. In addition, manual fire alarm boxes are not required if the building is sprinklered. Section 903.4.2 mandates that where a fire alarm system is installed, the sprinkler system shall be monitored by the fire alarm system and shall activate the fire alarm system when the sprinkler operates. Therefore, this exception results in the elimination of the manual fire alarm boxes (pull stations) but retains the audible and visible notification devices. Section 907.2 states that when the code allows the elimination of manual fire alarm boxes due to the installation of fire sprinklers, at least one manual fire alarm box must be installed at an approved location.

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907.5.2.1.3

Fire Alarm Occupant Notification

CHANGE TYPE: Modification

CHANGE SUMMARY: Where a fire alarm system is required in Group R-1 and R-2 occupancies, a low-frequency signal shall be used in the sleeping rooms to improve the waking effectiveness of the occupant notification devices.

2021 CODE TEXT: **907.4 Initiating devices.** Where ~~manual or automatic alarm initiation is required as part of a fire alarm system, the initiating~~ a fire alarm system is required by another section of this code, occupant notification in accordance with Section 907.5 shall be initiated by one or more of the following. Initiating devices shall be installed in accordance with Sections 907.4.1 through 907.4.3.1.

1. Manual fire alarm boxes.
2. Automatic fire detectors.
3. Automatic sprinkler system waterflow devices.
4. Automatic fire-extinguishing systems.

907.5 Occupant notification systems. ~~A fire alarm system shall annunciate at the fire alarm control unit and shall initiate occupant notification upon activation,~~ Occupant notification by fire alarms shall be in accordance with Sections 907.5.1 through 907.5.2.3.3. ~~Where a fire alarm system is required by another section of this code, it shall be activated by:~~ Occupant notification by smoke alarms in Groups R-1 and R-2 occupancies shall comply with Section 907.5.2.1.3.2.

~~1. Automatic fire detectors.~~
~~2. Automatic sprinkler system waterflow devices.~~
~~3. Manual fire alarm boxes.~~
~~4. Automatic fire-extinguishing systems.~~



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Sleeping room in R-1 hotel.

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~~**Exception:** Where notification systems are allowed elsewhere in Section 907 to annunciate at a constantly attended location.~~

907.5.1 Alarm activation and annunciation. Upon activation, fire alarm systems shall initiate occupant notification and shall annunciate at the fire alarm control unit, or where allowed elsewhere by Section 907, at a constantly attended location.

~~**907.5.1**~~ **907.5.1.1 Presignal feature.** A presignal feature shall ~~not~~ be ~~installed unless~~ provided only where approved ~~by the fire code official~~. ~~Where a~~ The presignal ~~feature is provided, a signal~~ shall be annunciated at an approved constantly attended location, ~~approved by the fire code official, so that occupant notification can be activated~~ having the capability to activate the occupant notification system in the event of a fire or other emergency.

907.5.2 Alarm notification appliances. *(No change)*

907.5.2.1 Audible alarms. *(No change)*

907.5.2.1.1 Average sound pressure. *(No change)*

907.5.2.1.2 Maximum sound pressure. The ~~maximum~~ total sound pressure level ~~for audible alarm~~ produced by combining the ambient sound pressure level with all audible notification appliances operating shall ~~be~~ not exceed 110 dBA at the minimum hearing distance from the audible appliance. Where the average ambient noise is greater than ~~95~~ 105 dBA, visible alarm notification appliances shall be provided in accordance with NFPA 72 and audible alarm notification appliances shall not be required.

907.5.2.1.3 Audible signal frequency in Group R-1 and R-2 sleeping rooms. Audible signal frequency in Group R-1 and R-2 occupancies shall be in accordance with Sections 907.5.2.1.3.1 and 907.5.2.1.3.2.

907.5.2.1.3.1 Fire alarm system signal. In sleeping rooms of Group R-1 and R-2 occupancies, the audible alarm activated by a fire alarm system shall be a 520-Hz low-frequency signal complying with NFPA 72.

907.5.2.1.3.2 Smoke alarm signal in sleeping rooms. In sleeping rooms of Group R-1 and R-2 occupancies that are required by Section 907.2.8 or 907.2.9 to have a fire alarm system, the audible alarm signal activated by single- or multiple-station smoke alarms in the dwelling unit or sleeping unit shall be a 520-Hz signal complying with NFPA 72. Where a sleeping room smoke alarm is unable to produce a 520-Hz signal, the 520-Hz alarm signal shall be provided by a listed notification appliance or a smoke detector with an integral 520-Hz sounder.

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CHANGE SIGNIFICANCE: Where a fire alarm system is required in Group R-1 and R-2 occupancies, the fire alarm system signal in the sleeping area must be a 520 Hz low-frequency signal that complies with NFPA 72. In addition, where a fire alarm system is mandated, all single- or multiple-station smoke alarms that are located within the sleeping rooms are to also provide a 520 Hz signal. It is important to note that the low-frequency signal for the smoke alarms is only required if the Group R-1 or R-2 occupancy is required to have a fire alarm system. This limitation is due to the limited number of smoke alarms that are currently available and capable of meeting the low-frequency requirement.

The low-frequency (520 Hz) audible fire alarm signal has been shown to improve the waking effectiveness for several high-risk segments of the population. Research has shown that the low frequency is six times more effective than the standard 3 kHz signal at waking the high-risk occupants (such as people over 65 who are hard of hearing, school-age children and people who are alcohol impaired). While NFPA 72 does recognize the effectiveness of the low-frequency alarm signal by requiring it in sleeping rooms of hotels, dormitories and apartment buildings with a fire alarm system, it is only required for smoke alarm systems on a voluntary basis or as the need is identified for persons with hearing loss. This difference in the audible signal requirement between a fire alarm and smoke alarm system has caused confusion and inconsistent application. Therefore, in the case of smoke alarms, Section 907.5.2.1.3.2 will provide the scoping for the low-frequency alarm signal and take precedence over the scoping provisions in Chapter 29 of NFPA 72.

As previously addressed, it is important to review and understand the provisions in Section 907.5.2.1.3.2 since there are currently very few smoke alarms capable of providing the 520 Hz alarm signal, especially when operating in the battery backup mode. However, there are several product solutions that are currently available and capable of providing the 520 Hz signal. These include (a) fire alarm system horns and horn/strobes, (b) smoke detectors with integral sounder bases, and (c) speakers connected to an Emergency Voice Alarm Communication (EVAC) system.

The remaining changes, particularly those in Section 907.4 and 907.5, are primarily an editorial reformatting with Section 907.4 focusing on the initiating devices and Section 907.5 addressing the occupant notification aspects of the system.

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909.20 Smokeproof Enclosures

CHANGE TYPE: Modification

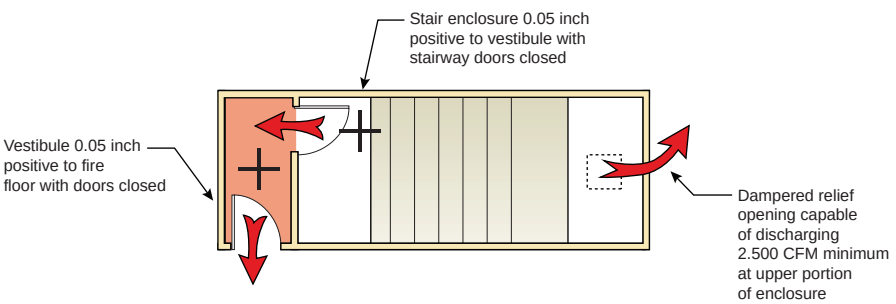
CHANGE SUMMARY: A new alternative method of pressurizing both the stair enclosure and the vestibule relative to the fire floor has been established for smokeproof enclosures.

2021 CODE TEXT: **909.20 Smokeproof enclosures.** Where required by Section 1023.12, a smokeproof enclosure shall be constructed in accordance with this section. A smokeproof enclosure shall consist of an interior exit stairway or ramp that is enclosed in accordance with the applicable provisions of Section 1023 and an open exterior balcony ~~or,~~ ventilated vestibule or pressurized stair and pressurized entrance vestibule meeting the requirements of this section. Where access to the roof is required by the International Fire Code, such access shall be from the smokeproof enclosure where a smokeproof enclosure is required.

909.20.6 Pressurized stair and vestibule alternative. The provisions of Sections 909.20.6.1 through 909.20.6.3 shall apply to smokeproof enclosures using a pressurized stair and pressurized entrance vestibule.

909.20.6.1 Vestibule doors. The door assembly from the building into the vestibule shall be a fire door assembly complying with Section 716.2.2.1. The door assembly from the vestibule to the stairway shall not have less than a 20-minute fire protection rating and meet the requirements for a smoke door assembly in accordance with Section 716.2.2.1. The door shall be installed in accordance with NFPA 105.

909.20.6.2 Pressure difference. The stair enclosure shall be pressurized to not less than 0.05 inch of water gage (12.44 Pa) positive pressure relative to the vestibule with all stairway doors closed under the maximum anticipated stack pressures. The vestibule, with doors closed, shall have not less than 0.05 inch of water gage (12.44 Pa) positive pressure relative to the fire floor. The pressure difference across doors shall not exceed 30 pounds (133-N) maximum force to begin opening the door.



Smokeproof enclosure – alternative option.

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909.20.6.3 Dampered relief opening. A controlled relief vent having the capacity to discharge not less than 2,500 cubic feet per minute (1180 L/s) of air at the design pressure difference shall be located in the upper portion of the pressurized exit enclosure.

~~909.20.6~~ 909.20.7 Ventilating equipment. The activation of ventilating equipment required by the alternatives in Sections 909.20.4, 909.20.5 and ~~909.20.5~~ 909.20.6 shall be by smoke detectors installed at each floor level at an approved location at the entrance to the smokeproof enclosure. When the closing device for the stairway and ramp shaft and vestibule doors is activated by smoke detection or power failure, the mechanical equipment shall activate and operate at the required performance levels. Smoke detectors shall be installed in accordance with Section 907.3.

CHANGE SIGNIFICANCE: Another means of creating and protecting smokeproof enclosures has been added to ensure that smoke entry is limited and will not impact the means of egress. Currently, a smokeproof enclosure is permitted to be constructed using either a naturally- or mechanically-ventilated vestibule, or, alternatively, without a vestibule by pressurizing the enclosure itself relative to the fire floor. This new option allows for a combination of the existing methods by including a vestibule and using the pressurization between the vestibule and the fire floor, as well as the pressure difference between the exit enclosure and the vestibule, to minimize or prevent smoke from entering into the enclosure. Essentially, the smoke would need to "swim upstream" by first overcoming the pressure to enter the vestibule, and then overcoming the additional pressure that comes from the exit enclosure itself.

An arrangement very similar to this was previously allowed by one of the IBC legacy codes and has been used effectively for several decades. Perhaps the easiest way to conceptually think about the difference between this new option and Section 909.20.4 (Mechanical Ventilation Alternative) is that instead of the vestibule inviting the smoke to enter and then capturing and exhausting the smoke out, as Section 909.20.4.2 would do, the new method attempts to discourage the smoke from even entering the vestibule by placing a positive pressure differential in the vestibule to force the smoke away from it. Therefore, the goal is to not allow the smoke to enter into the vestibule in the first place.

This new fourth option for constructing smokeproof enclosures will work well for high-rise buildings where the height of the building and outdoor air temperatures cause stack effect conditions. In taller buildings where these pressure differences caused by the stack effect get larger, it can make the pressurization option of Section 909.20.5 more difficult to design, implement and properly control so that it is effective. By using a vestibule that is pressurized, it essentially creates an "airlock" between the stairway and the remainder of the building and thus makes it easier to maintain the pressure difference of 0.10 inch of water (25 Pa) within the exit without over pressurizing the stair. Depending on the design and the required pressures, this new option may be less expensive to design,

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construct and maintain than the ventilated vestibule option that is allowed by Section 909.20.4.2. In some situations, leakage under or around the door separating the stairway from the vestibule may be sufficient to pressurize the vestibule without the need for additional ductwork or fans as would be needed for the vestibules required by Section 909.20.4.2 and the long-standing mechanical ventilation alternative.

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911

Fire Command Centers in Groups F-1 and S-1

CHANGE TYPE: Modification

CHANGE SUMMARY: A fire command center is now required in buildings housing Group F-1 or S-1 occupancies where the building footprint is over 500,000 square feet in size.

2021 CODE TEXT: **911.1 General.** Where required by other sections of this code, ~~and~~ in buildings classified as high-rise buildings by this code and in all F-1 and S-1 occupancies with a building footprint of over 500,000 square feet (46 452 m^2), a fire command center for fire department operations shall be provided and shall comply with Sections 911.1.1 through ~~911.1.6~~ 911.1.7.

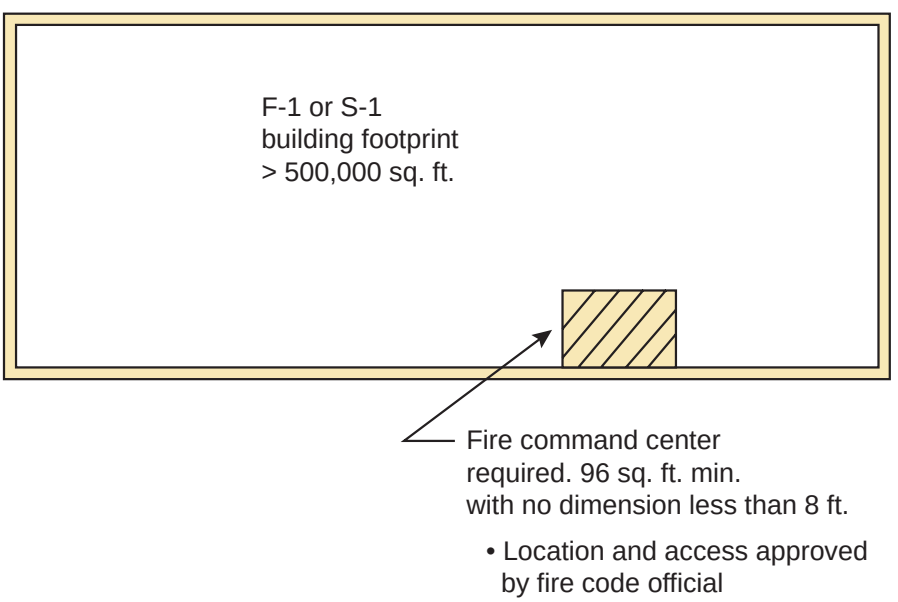
911.1.1 Location and access. The location and access ~~accessibility of~~ to the fire command center shall be approved by the fire code official.

911.1.2 Separation. *(No changes)*

911.1.3 Size. The fire command center shall be not less than 0.015 percent of the total building area of the facility served or 200 square feet (19 m^2) in area, whichever is greater, with a minimum dimension of 0.7 times the square root of the room area or 10 feet (3048 mm), whichever is greater. Where a fire command is required for Group F-1 and S-1 occupancies with a building footprint greater than 500,000 square feet (46 452 m^2) in area, the fire command center shall have a minimum size of 96 square feet (9 m^2) with a minimum dimension of 8 feet (2348 mm) where approved by the fire code official.

911.1.4 Layout approval. *(No changes)*

911.1.5 Storage. *(No changes)*



Required fire command center in F-1 and S-1.

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911.1.6 Required features. *(No changes)*

911.1.7 Fire command center identification. The fire command center shall be identified by a permanent easily visible sign stating "FIRE COMMAND CENTER" located on the door to the fire command center.

CHANGE SIGNIFICANCE: Buildings with a large footprint can present many challenges to fire department access to fight a fire. Providing a protected fire command center in these types of large buildings will allow the fire department's incident commander to see at a glance where the fire is, the building layout and the status of any active fire protection so they can quickly see the problem and develop a strategy to address and control it. The fire command center criteria for these large and complex buildings essentially remain unchanged, except for a clarification regarding access and a mandate for identification of the space. The more significant change is the mandate that extremely large manufacturing and storage buildings must now also be provided with a complying fire command center.

In Section 911.1.1, the term "accessibility" was replaced with "access" to avoid confusion with the requirements related to disability access set forth in Chapter 11. As a side note, Exception 3 to Section 1110.15 provides a reference to ICC A117.1 standard that eliminates the accessibility requirements for devices that are "used only for emergencies by emergency personnel acting in their official capacity." In addition, the new Section 911.7 now requires that a fire command center be identified with a sign located on the door.

High-rise buildings have historically been the only building type where fire command centers are required. Now, buildings housing Group F-1 manufacturing occupancies and/or Group S-1 storage occupancies must be provided with a fire command center where the building exceeds 500,000 square feet in floor area. The floor area threshold and applicable occupancies were selected based on the complexity of operations for fighting a fire in such a large building that does not always allow for a quick assessment of the tactical situation. In addition, the fire loading conditions can be significant. Providing a fire command center will allow the incident commander to identify at a glance, from a protected location, the building layout, the fire location and any active fire protection to establish the best strategy to mitigate the problem.

The criteria for central control centers are essentially consistent regardless of building type. As the only departure from the general requirements, the minimum required room size has been reduced for Group F-1 and S-1 buildings to a minimum 96 square-foot floor area with no dimension less than 8 feet. However, this reduced size can only be applied "where approved by the fire code official."

Although the features set forth in Sections 911.1.6 are required, it is apparent that a number of them may not be present in Group F-1 or S-1 buildings. It is intended that only those features that exist in the building are to be addressed, not necessarily all 18 items. As an example, the building may not include an elevator, and, thus, the recall feature in Item 17 would not be applicable.

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PART 4

Means of Egress

Chapter 10

■ **Chapter 10** Means of Egress

The criteria set forth in Chapter 10 regulating the design of means of egress are established as the primary method for protection of people in buildings. Both prescriptive and performance language is utilized in the chapter to provide for a basic approach in the determination of a safe exiting system for all occupancies. Chapter 10 addresses all portions of the egress system and includes design requirements as well as provisions regulating individual components. A zonal approach to egress provides a general basis for the chapter's format through the regulation of the exit access, exit, and exit discharge portions of the means of egress. ■

1006.2.1
Egress from Mechanical Rooms and Penthouses

1006.3
Egress from Occupied Roofs

1006.3.4
Single Exit Stories

1008.2.1
Stairway Illumination

1009.2.1
Accessible Elevators to Occupied Roofs

1009.6.2
Areas of Refuge

1009.6.3, 3008.6.4
Area of Refuge Floor Space

1010.1.1
Door Widths

1010.1.1.1
Projections into Door Openings

1010.1.3
Door Opening Forces

1010.2.4
Locks and Latches

1010.2.8
Locking Arrangements in Group I-4

1011.6
Stairway Landings

1016.2
Egress Through Intervening Spaces

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1019.3
Exit Access Stairways

1020.5
Dead-End Corridors

1030.16
Handrails at Social Stairs

1031
Emergency Escape and Rescue Openings

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1006.2.1

Egress from Mechanical Rooms and Penthouses

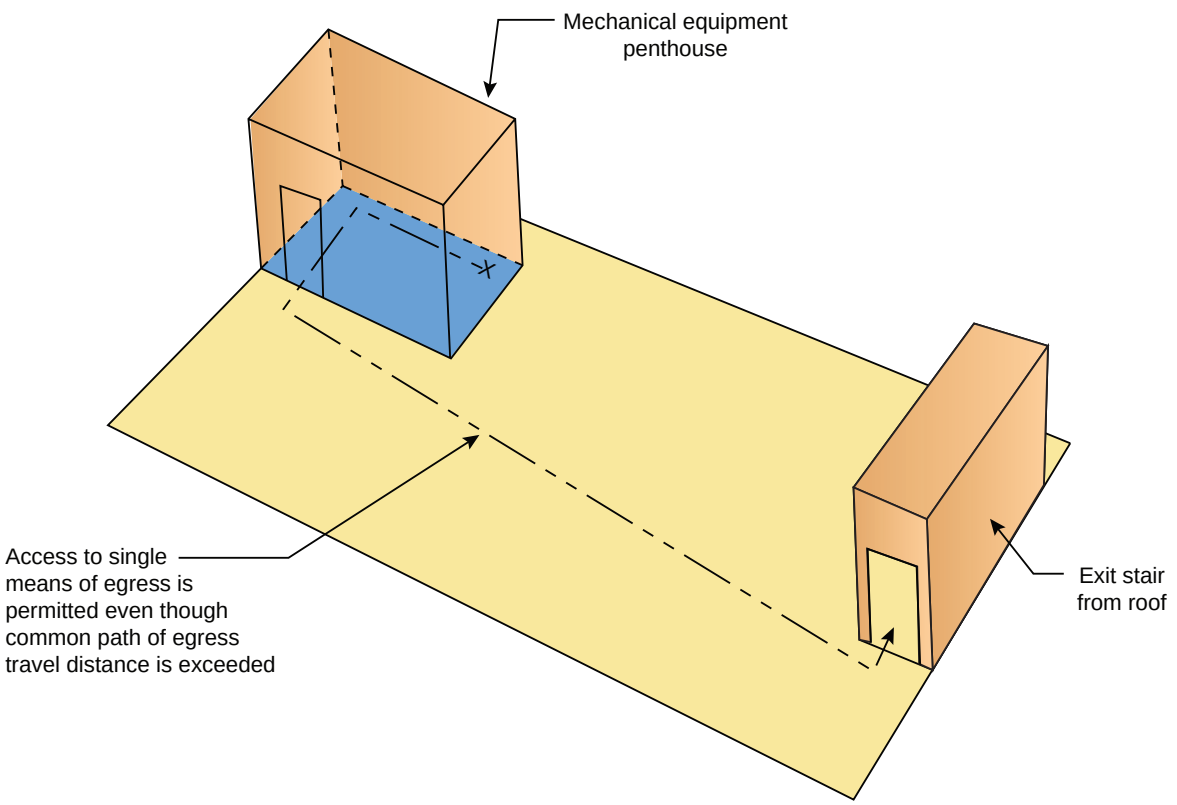
CHANGE TYPE: Modification

CHANGE SUMMARY: The common path of travel distance limitations for unoccupied mechanical rooms and penthouses have been eliminated.

2021 CODE TEXT: **1006.2.1 Egress based on occupant load and common path of egress travel distance.** Two exits or exit access doorways from any space shall be provided where the design occupant load or the common path of egress travel distance exceeds the values listed in Table 1006.2.1. The cumulative occupant load from adjacent rooms, areas or spaces shall be determined in accordance with Section 1004.2.

Exceptions:

1. The number of exits from foyers, lobbies, vestibules or similar spaces need not be based on cumulative occupant loads for areas discharging through such spaces, but the capacity of the exits from such spaces shall be based on applicable cumulative occupant loads.
2. Care suites in Group I-2 occupancies complying with Section 407.4.
3. Unoccupied mechanical rooms and penthouses are not required to comply with the common path of egress travel distance measurement.



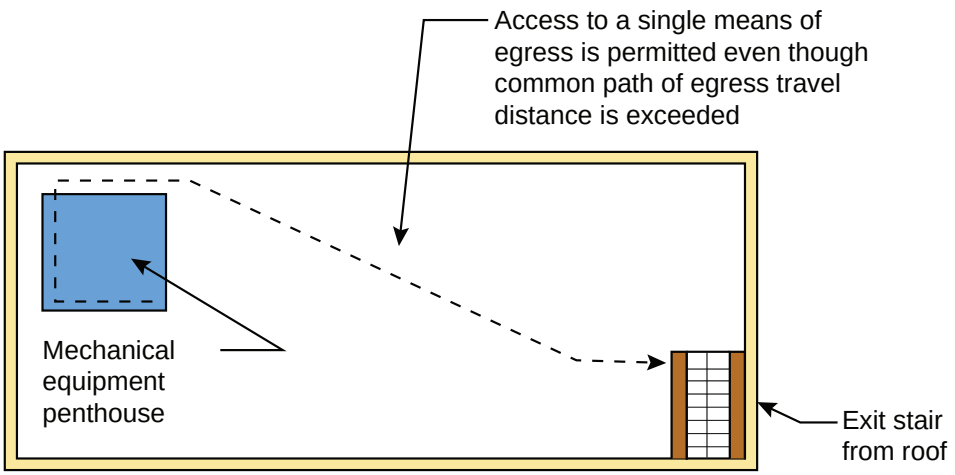
Egress from penthouse.

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CHANGE SIGNIFICANCE: Generally, spaces with only a single means of egress are limited to both a small occupant load and travel distance by Table 1006.2.1. In areas like unoccupied mechanical rooms and penthouses, this limitation on the travel distance to reach the exit within the "common path of travel" distance would occasionally result in the need for an additional means of egress. This mandate could apply even though the rooms might have a very low occupant load or typically only be occupied during the periods when technicians were performing routine maintenance or during the replacement of the equipment. While some jurisdictions may have viewed these as unoccupied spaces and used the *International Mechanical Code's* (IMC's) access provisions instead of the *International Building Code's* (IBC's) egress requirements, others did view even a limited occupancy of the space as a trigger for the IBC's egress requirements.

The new exception will continue to regulate these limited use spaces based on the occupant load (Table 1006.2.1) and the exit access travel distance (Table 1017.2) to determine if adequate egress is being provided. The occupants within these spaces will not need to reach the single exit within the travel limitations that are established in Table 1006.2.1.



Roof top plan

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1006.3

Egress from Occupied Roofs

CHANGE TYPE: Modification

CHANGE SUMMARY: The means of egress provisions applicable to occupied roofs have been clarified.

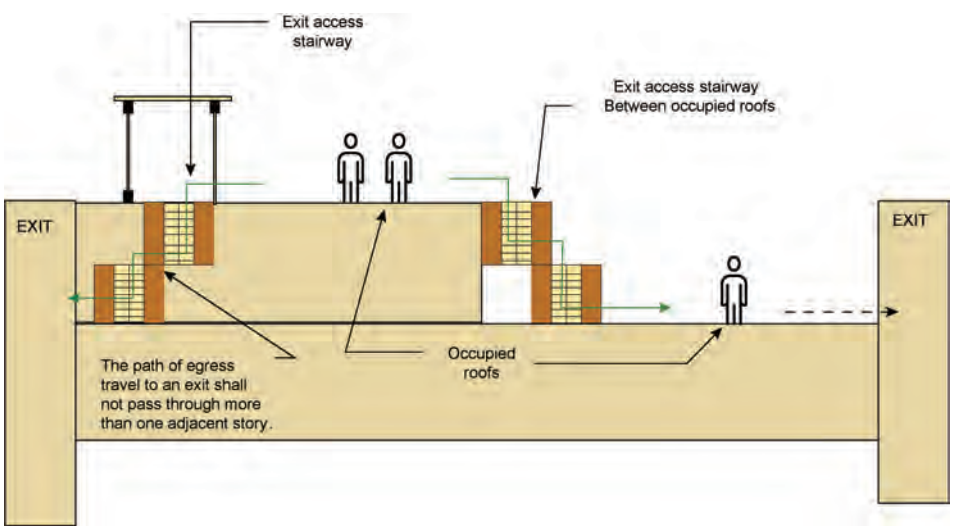
2021 CODE TEXT: **1006.3 Egress from stories or occupied roofs.** The means of egress system serving any story or occupied roof shall be provided with the number of separate and distinct exits or access to exits based on the aggregate occupant load served in accordance with this section. ~~Where stairways serve more than one story, only the occupant load of each story considered individually shall be used in calculating the required number of exits or access to exits serving that story.~~

1006.3.1 Occupant load. Where stairways serve more than one story, or more than one story and an occupied roof, only the occupant load of each story or occupied roof, considered individually, shall be used when calculating the required number of exits or access to exits serving that story.

~~**1006.3.1**~~ **1006.3.2** ~~**Adjacent story.**~~ **Path of egress travel.** The path of egress travel to an exit shall not pass through more than one adjacent story.

Exception: The path of egress travel to an exit shall be permitted to pass through more than one adjacent story in any of the following:

1. In Group R-1, R-2 or R-3 occupancies, exit access stairways and ramps connecting four stories or less serving and contained within an individual dwelling unit, sleeping unit or live/work unit.
2. Exit access stairways serving and contained within a Group R-3 congregate residence or a Group R-4 facility.
3. Exit access stairways and ramps within an atrium complying with Section 404.



Egress from occupied roofs.

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4.~~3.~~ Exit access stairways and ramps in open parking garages that serve only the parking garage.

5.~~4.~~ Exit access stairways and ramps serving open-air assembly seating complying with the exit access travel distance requirements of Section ~~1029.7~~ 1030.7.

6.~~5.~~ Exit access stairways and ramps between the balcony, gallery or press box and the main assembly floor in occupancies such as theaters, places of religious worship, auditoriums and sports facilities.

7. Exterior exit access stairways and ramps between occupied roofs.

CHANGE SIGNIFICANCE: The trend of clarifying how various code provisions should be applied to occupied roofs continues through these revisions. For years, the only code requirements specific to occupied roofs were that they meet the increased structural loading and that they needed to be provided with a means of egress in the same manner as stories; even though they did not meet the definition for being a story. This caused confusion in the application of other provisions that are now starting to be addressed.

Previously, it was clearly stated that only the occupant load of a single story was to be used for calculating the egress requirements. However, that statement began with the limitation that it applied "where stairways serve more than one story." As an occupied roof does not meet the definition of a story, an argument could be made that a combined occupant load was intended to be used where a story and an occupied roof were the levels under consideration. Although the change may not seem significant, the simple fact that the code specifically addresses this issue should provide more consistency in application and make understanding the intent easier for code users.

The intent of Exception 3 is to recognize that, although an exit access stairway can generally serve as a portion of the required egress path for travel through only one adjacent story, it is permissible that the egress stairway be unenclosed and connect to multiple stories within an atrium. This coordinates with Exception 5 of Section 1019.3 allowing the exit access stairway to be in the atrium instead of being in a shaft enclosure. Therefore, a traditional open exit access stairway (or a convenience stairway) in an atrium may pass through multiple stories, and, based on this new exception, it could be used for travel through multiple floors before it would need to provide access to a compliant exit element. Because this is an exit access stairway, the travel distance would be limited by both the general requirements of Section 1017 as well as the limits applicable to atriums as established in Section 1017.3.2.

Since an occupied roof does not qualify as a story, the new Exception 7 is simply providing guidance regarding exit access stairways that serve or connect to occupied roofs and allowing a connection to adjacent roof levels. This exception addresses that vertical travel connecting occupied roofs may be provided by exterior exit access stairways, permitted to be unenclosed while serving as a part of the required egress path. Where the egress travel is "between occupied roofs," as stated in Exception 7, travel is permitted to more than one level; however, if the egress is from an enclosed story, the egress path is only permitted to pass through one adjacent story.

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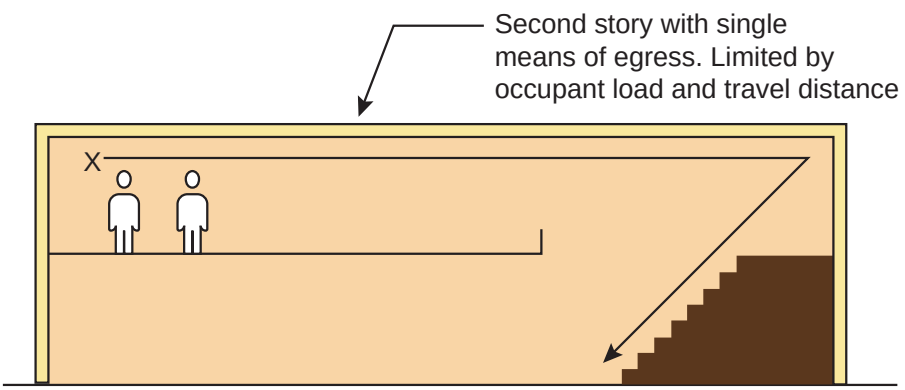
1006.3.4
Single Exit Stories

CHANGE TYPE: Modification

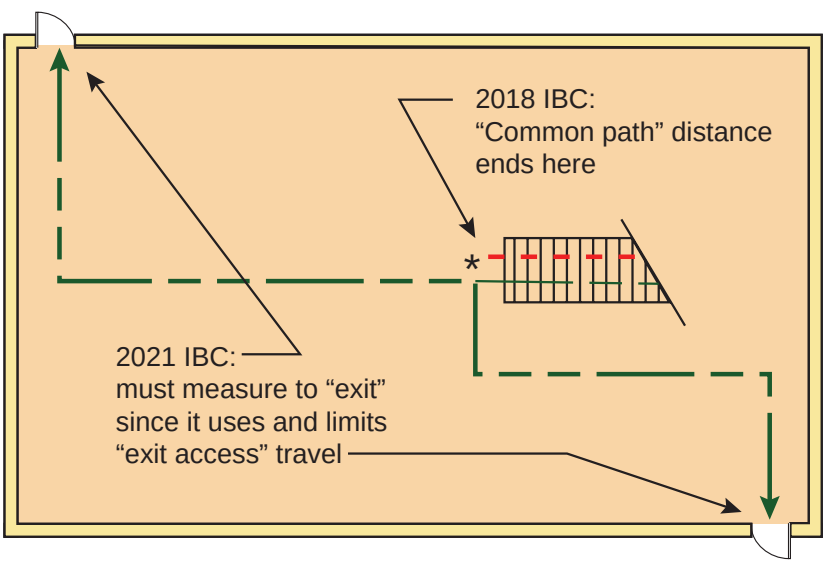
CHANGE SUMMARY: For single-exit stories, the travel distance limits are now based on the exit access travel distance as opposed to the common path of egress travel.

2021 CODE TEXT: ~~**1006.3.3**~~ **1006.3.4 Single exits.** A single exit or access to a single exit shall be permitted from any story or occupied roof where one of the following conditions exists:

1. The occupant load, number of dwelling units and ~~common path of egress~~ exit access travel distance do not exceed the values in Table ~~1006.3.3(1) or 1006.3.3(2)~~ 1006.3.4(1) or 1006.3.4(2).
2. Rooms, areas and spaces complying with Section 1006.2.1 with exits that discharge directly to the exterior at the level of exit discharge, are permitted to have one exit or access to a single exit.



Section



Plan

Example: 2018 "common path" vs. 2021 "exit access".

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TABLE ~~1006.3.3(1)~~ 1006.3.4(1) Stories with One Exit or Access to One Exit for R-2 Occupancies

Story	Occupancy	Maximum Number of Dwelling Units	Maximum ~~Common Path of Egress~~ Exit Access Travel Distance
Basement, first, second or third story above grade plane	R-2[a,b]	4 dwelling units	125 feet
Fourth story above grade plane and higher	NP	NA	NA

For SI: 1 foot = 3048 mm.
NP = Not Permitted.
NA = Not Applicable.
a. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section ~~1030~~ 1031.
b. This table is used for R-2 occupancies consisting of dwelling units. For R-2 occupancies consisting of sleeping units, use Table ~~1006.3.3(2)~~ 1006.3.4(2).

TABLE ~~1006.3.3(2)~~ 1006.3.4(2) Stories with One Exit or Access to One Exit for Other Occupancies

Story	Occupancy	Maximum Occupant Load per Story	Maximum ~~Common Path of Egress~~ Exit Access Travel Distance (Feet)
First story above or below grade plane	A, B[b], E, F[b], M, U	49	75
	H-2, H-3	3	25
	H-4, H-5, I, R-1, R-2[a,c]	10	75
	S[b,d]	29	75
Second story above grade plane	B, F, M, S[d]	29	75
Third story above grade plane and higher	NP	NA	NA

For SI: 1 foot = 304.8 mm.
NP = Not Permitted.
NA = Not Applicable.
a. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section ~~1030~~ 1031.
b. Group B, F and S occupancies in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 shall have a maximum exit access travel distance of 100 feet.
c. This table is used for R-2 occupancies consisting of sleeping units. For R-2 occupancies consisting of dwelling units, use Table ~~1006.3.3(1)~~ 1006.3.4(1).
d. The length of exit access travel distance in a Group S-2 open parking garage shall be not more than 100 feet.

3. Parking garages where vehicles are mechanically parked shall be permitted to have one exit or access to a single exit.
4. Group R-3 and R-4 occupancies shall be permitted to have one exit or access to a single exit.
5. Individual single-story or multistory dwelling units shall be permitted to have a single exit or access to a single exit from the dwelling unit provided that both of the following criteria are met:
5.1. The dwelling unit complies with Section 1006.2.1 as a space with one means of egress.
5.2. Either the exit from the dwelling unit discharges directly to the exterior at the level of exit discharge, or the exit access outside the dwelling unit's entrance door provides access to not less than two approved independent exits.

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CHANGE SIGNIFICANCE: "Common path of egress travel" is generally only applied to locations where a single means of egress is available. It is used as a second condition, along with the occupant load, to determine when a second means of egress is needed from an area. Tables 1006.3.4(1) and 1006.3.4(2) are applicable to stories with a single means of egress and also as an exception for the minimum of two means of egress that are typically required from a story by Table 1006.3.3. At issue was whether it was appropriate to use "common path of egress travel" in a compliant single means of egress space or whether it should be "exit access travel" distance. Although the tabular distances will remain unchanged, the revision will impact the end point of the travel measurement.

Since the "common path" measurement is allowed to end either at the door of an exit, or at the "point where the occupants have separate and distinct access to two exits or exit access doorways", the revision to "exit access travel distance" will mean that the occupants must actually be able to reach the door of an exit within that distance. The travel limit is no longer measured to the point where the egress path can split to lead to two separate exits. Although this difference may not seem significant, it will mean that the occupants must be able to reach the door of an exit within that travel distance limitation and that simply having a divergent path to two means of egress will not be adequate.

Code users will want to remember that the common path of travel continues to be a valid concept and its other applications have been maintained. Section 1006.2 and Table 1006.2.1 regulating single means of egress spaces will continue to use the "common path of egress travel" as the distance measurement, and spaces with a small occupant load and limited travel can be provided with a single means of egress where they can reach a point where they have egress options within that distance limitation. The change is limited to the application of egress from stories as set forth in Section 1006.3, such that a story having a single egress path must comply with the more limited and restrictive "exit access travel distance."

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1008.2.1
Stairway Illumination

CHANGE TYPE: Modification

CHANGE SUMMARY: The minimum illumination level for both exit and exit access stairways has been increased from 1 foot-candle to 10 foot-candles.

2021 CODE TEXT: **1008.2.1 Illumination level under normal power.** The means of egress illumination level shall be not less than 1 footcandle (11 lux) at the walking surface. Along exit access stairways, exit stairways and at their required landings, the illumination level shall not be less than 10 footcandles (108 lux) at the walking surface when the stairway is in use.

Exception: For auditoriums, theaters, concert or opera halls and similar assembly occupancies, the illumination at the walking surface is permitted to be reduced during performances by one of the following methods provided that the required illumination is automatically restored upon activation of a premises' fire alarm system:

1. Externally illuminated walking surfaces shall be permitted to be illuminated to not less than 0.2 footcandle (2.15 lux).
2. Steps, landings and the sides of ramps shall be permitted to be marked with self-luminous materials in accordance with Sections 1025.2.1, 1025.2.2 and 1025.2.4 by systems listed in accordance with UL 1994.

CHANGE SIGNIFICANCE: Adequately illuminating the stairways and landings that serve as a part of either the exit or exit access is one of the easiest ways to help improve stairway safety. Increasing the required illumination level will help not only people with low vision and the elderly, but also will allow all stair users to better perceive the location

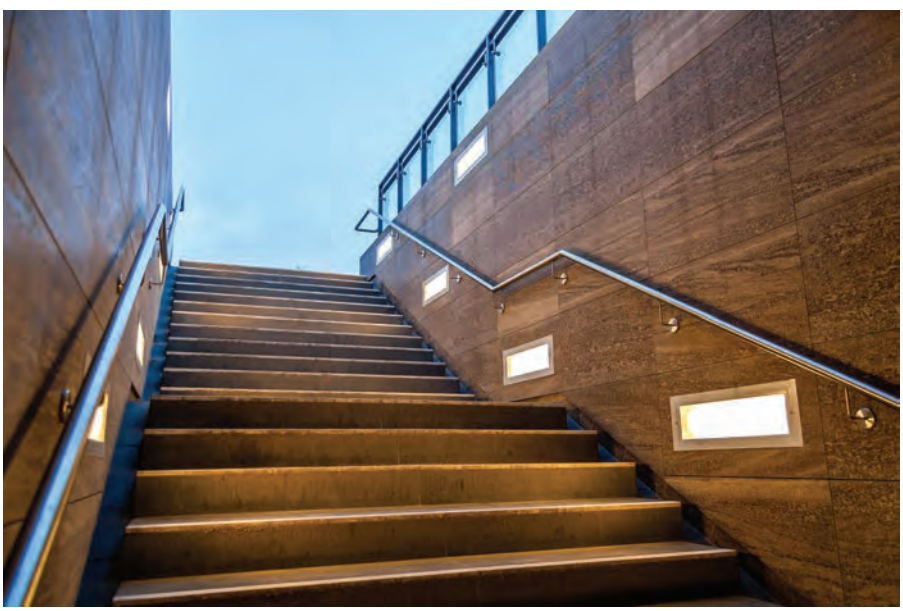


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Increased illumination required on stairway.

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of the steps and level changes on the stairways. The 10 foot-candle level has been recognized as an illumination minimum in the ICC A117.1 standard since the 2003 edition. By placing this requirement directly within the IBC, the application of the higher illumination provisions has been expanded.

It is important to note the scoping of the revised provisions:

a. The minimum illumination of 10 foot-candles does not apply to stairs or steps located in the exit discharge due to being limited to "exit access" and "exit" stairways.

b. The stairways are not expected to be continuously illuminated to the 10 foot-candle level, as the increased illumination is only applicable "when the stairway is in use", thus allowing for occupant sensor controls, daylight-responsive controls or other energy saving techniques.

c. The exception for lower lighting levels during performances in assembly occupancies is still applicable.

The general means of egress will continue to use the 1 foot-candle minimum as only the stairways within the exit and exit access portion of the egress path must be illuminated to this higher level "when the stairway is in use."

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1009.2.1

Accessible Elevators to Occupied Roofs

CHANGE TYPE: Modification

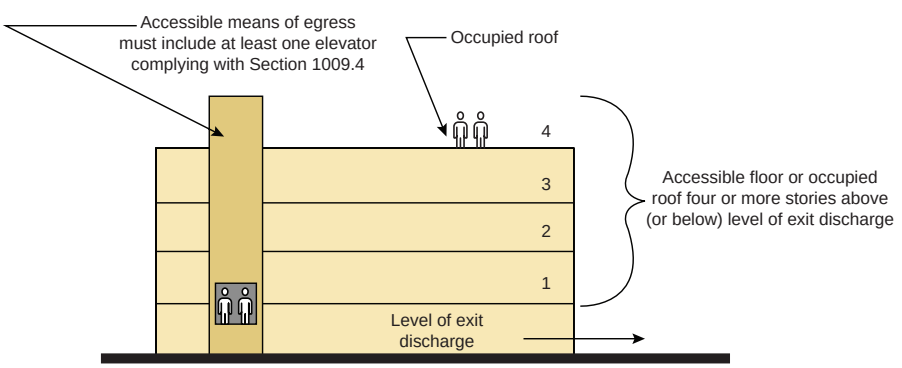
CHANGE SUMMARY: An elevator serving an occupied roof must now be considered as one of the required accessible means of egress where the roof is located directly above the third story above the level of exit discharge.

2021 CODE TEXT: **1009.2.1 Elevators required.** In buildings where a required accessible floor or occupied roof is four or more stories above or below a level of exit discharge, not less than one required accessible means of egress shall be an elevator complying with Section 1009.4.

Exceptions:

1. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, the elevator shall not be required on floors provided with a horizontal exit and located at or above the levels of exit discharge.
2. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, the elevator shall not be required on floors provided with a ramp conforming to the provisions of Section 1012.

CHANGE SIGNIFICANCE: In the 2018 edition, IBC Section 1104.4 was modified to specifically include occupied roofs as also needing to be served by an accessible route similar to how accessible stories in a multiple-story building are addressed. However, even though an accessible route was required to the occupied roof, there was some debate as to how the Accessible Means of Egress (AMOE) provisions applied. The AMOE was clearly applicable to the occupied roof because it is an accessible space and based on the requirements in IBC Section 1009.1. Whether an elevator was required as one of the AMOE was arguable because the provisions of Section 1009.2.1 applied where an accessible floor was four or more stories above a level of exit discharge. For example, if there was an occupied roof on a four-story building, that roof level had only three "stories" between it and the level of exit discharge, and the roof itself did



Accessible means of egress from occupied roof.

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not qualify as a story under the definition of the code. Therefore, there were not "four or more stories" above the level of exit discharge and it seemingly would allow stairways or other components to be used for the AMOE. This issue was generally viewed as being adequately addressed since the code had required occupied roofs to be provided with exits as required for stories (see Section 1021.1 in 2009 IBC), but with occupied roofs becoming more common and there being some confusion, it was deemed important to clarify the code's intent.

An occupied roof on a four-story or taller building will now typically impose the requirements of Section 1009.2.1 that an elevator provide "not less than one" of the required accessible means of egress. Having the elevator available for independent or possibly assisted rescue will help emergency responders who would help people from the occupied roof. This will also limit the number of floor levels where people must be carried or assisted down the stairways, as well as generally ensure that people who use wheelchairs will be able to be brought down from above with their chair. Addressing the occupied roof level, even though it is not a "story," should lead to greater consistency when applying the elevator requirement.

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1009.6.2
Areas of Refuge

CHANGE TYPE: Modification

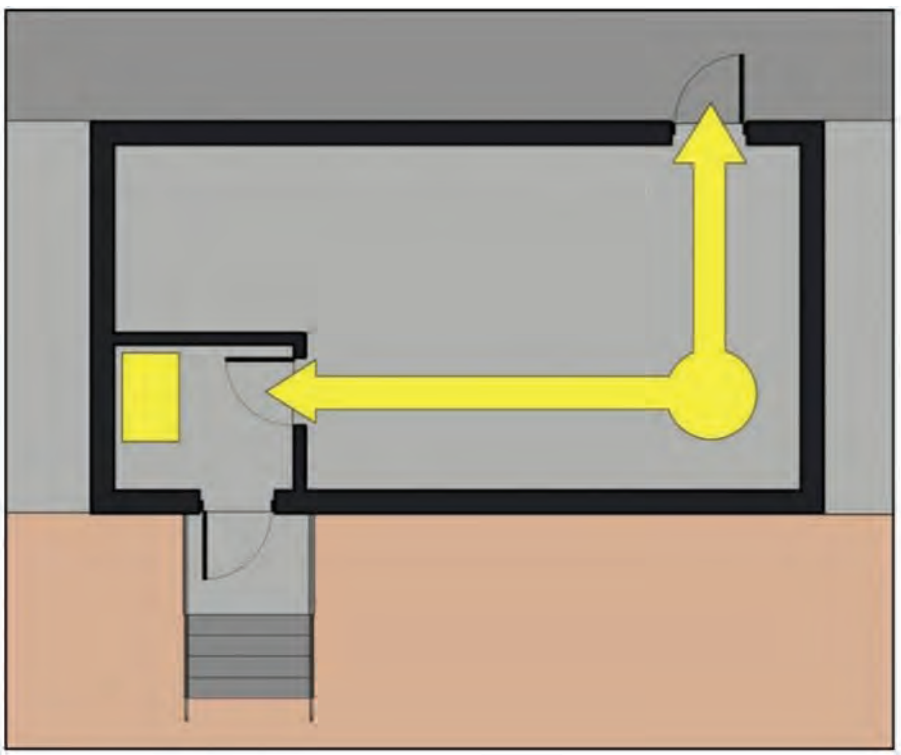
CHANGE SUMMARY: The use of an interior area of refuge at the level of exit discharge instead of an exterior area for assisted rescue is now permitted.

2021 CODE TEXT: **1009.6.2 Stairway or elevator access.** Every required area of refuge shall have direct access to a stairway complying with Sections 1009.3 and 1023 or an elevator complying with Section 1009.4.

> **Exception:** An interior area of refuge at the level of exit discharge that provides direct access to an exterior exit door.

CHANGE SIGNIFICANCE: In general, to consider an area of refuge as a safe location for awaiting assistance, the area of refuge needs to have access to a stairway that is compliant with IBC Section 1009.3 and runs between stories or to an exit stairway complying with Section 1023. In situations like single-story buildings, the safe location was typically put on the exterior of the building in compliance with the provisions for exterior areas for assisted rescue in Section 1009.7. In some situations, due to either location, climate or other factors, an exterior area for assisted rescue may not be possible or desirable.

An example would be a building with different grade elevations on the front and the back of the building. While the front of the building provides for one accessible means of egress at grade level, the second route out the rear of the building is at a level approximately loading dock height with a stairway to grade. With no ability to provide an exterior area for



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Interior area of refuge on level of exit discharge.

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assisted rescue at the rear of the building that meant either 1) doing without any protection, ignoring the need for a second accessible means of egress, or 2) locating a second means of egress along the front with what was considered as an inadequate spatial separation. Providing an interior area of refuge was considered to be a reasonable alternative even though it was not technically permitted due to the limitations in Section 1009.3 and 1023.

Although there were concerns regarding the perceived reduction in safety of having a less obvious interior area of refuge instead of an exterior area for assisted rescue at the rear exit, it was recognized that the area of refuge would need to comply with all the applicable provisions and would be permitted on other levels. When using this option for an area of refuge, it is important to remember that many other provisions will still apply. The area of refuge must comply with all the requirements of Section 1009.6, including the need for adequate separation (1009.6.4) and two-way communication (1009.6.5). Signage and instructions as regulated by Sections 1009.9, 1009.10, 1009.11, 1112.1 Item 8 and 1112.4 Items 2 and 3 would be required, making the occupants aware of this area of refuge and its features. In addition, where fire safety or evacuation plans are required by the International Fire Code Section 403, the provisions of Item 4 in IFC Section 404.2.1 and Items 2.3 and 4.4.1 in IFC Section 404.2.2 will ensure the fire department knows the location of these areas of refuge and will check them for people who may need assistance. The applicable IFC requirements along with the two-way communication requirements for all areas of refuge will ensure that people who use these areas of refuge will have a means of requesting and expecting assistance.

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1009.6.3, 3008.6.4

Area of Refuge Floor Space

CHANGE TYPE: Modification

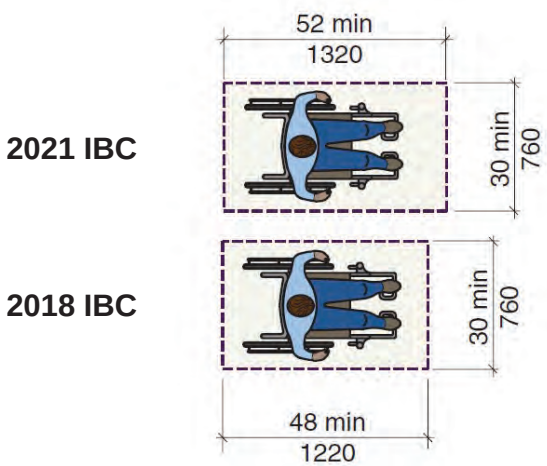
CHANGE SUMMARY: The minimum required size of the clear floor space for a wheelchair has been increased to 30 inches in width by 52 inches in length to coordinate with the 2017 edition of the ICC A117.1 Standard.

2021 CODE TEXT: **1009.6.3 Size.** Each area of refuge shall be sized to accommodate one wheelchair space of 30 inches by ~~48~~ 52 inches (762 mm by ~~1219~~ 1320 mm) for each 200 occupants or portion thereof, based on the occupant load of the area of refuge and areas served by the area of refuge. Such wheelchair spaces shall not reduce the means of egress minimum width or required capacity. Access to any of the required wheelchair spaces in an area of refuge shall not be obstructed by more than one adjoining wheelchair space.

3008.6.4 Lobby size. Each occupant evacuation elevator lobby shall have minimum floor area as follows:

1. The occupant evacuation elevator lobby floor area shall accommodate, at 3 square feet (0.28 m^2) per person, not less than 25 percent of the occupant load of the floor area served by the lobby.
2. The occupant evacuation elevator lobby floor area shall accommodate one wheelchair space of 30 inches by ~~48~~ 52 inches (760 mm by ~~1220~~ 1320 mm) for each 50 persons, or portion thereof, of the occupant load of the floor area served by the lobby.

Exception: The size of lobbies serving multiple banks of elevators shall have the minimum floor area approved on an individual basis and shall be consistent with the building's fire safety and evacuation plan.



Increased size of clear floor space.

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CHANGE SIGNIFICANCE: In the 2017 edition of the ICC A117.1 Standard, the minimum required length of a clear floor space for a wheelchair was increased from 48 inches to 52 inches. The standard was revised due to research focusing on "wheeled mobility devices" including manual and power wheelchairs as well as scooters that are used for accessibility. The research indicated that the previous 48-inch length would accommodate the occupied length of approximately 75 percent of the manual chair users and about 50 percent of the occupied powered chair and scooter users. By increasing the length of the clear floor space to at least 52 inches, it is expected that the new length will accommodate approximately 95 percent of the occupied manual chair users and 90 percent of powered chair users.

Although this change to the clear floor space occurred in the 2017 edition of ICC A117.1, it is important to note that the standard will only impose this increased size requirement in new construction. Existing buildings will continue to be regulated based on the previous 48-inch length. When dealing with the accessible means of egress, the IBC provides the scoping and many of the details that are needed for areas of refuge including the construction protection and size requirements for areas of refuge. Therefore, it is important that the minimum required size of the wheelchair clear floor space be increased in locations where building occupants in wheeled mobility devices are expected to wait for assistance, such as in an area of refuge (IBC Section 1009.6) or in a lobby serving an occupant evacuation elevator (IBC Section 3008.6.4). Because many users of power-operated wheelchairs are also the people with the greatest accessibility challenges and a more vulnerable part of the population, it was important that the spaces where they are expected to await assistance would be adequately sized to allow them to enter into the protected space and wait.

Additional information related to this size increase is available in the ICC publication *Significant Changes to the ICC A117.1 Accessibility Standard*, as well as at the University of Buffalo's Center for Inclusive Design and Environmental Access website at http://idea.ap.buffalo.edu/projects/anthropometry/. It is important to recognize that although the recommendations of the report suggest even larger clear floor spaces, the A117.1 standard committee elected to modify the recommendations. As the Americans with Disabilities Act (ADA) references the IBC for accessible means of egress, these increased size clear floor spaces are to be applied within an area of refuge.

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1010.1.1
Door Widths

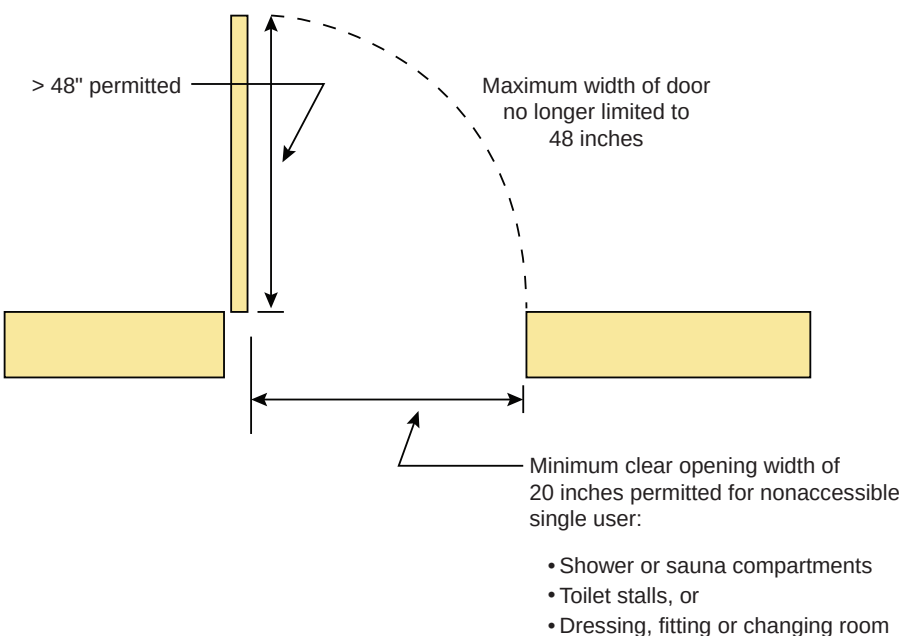
CHANGE TYPE: Modification

CHANGE SUMMARY: The maximum width for a swinging door is no longer regulated and a consolidated exception now allows for reduced door sizes where serving single-user showers, saunas and toilet compartments, as well as dressing, fitting and changing rooms.

2021 CODE TEXT: **1010.1.1 Size of doors.** The required capacity of each door opening shall be sufficient for the occupant load thereof and shall provide a minimum clear opening width of 32 inches (813 mm). The clear opening width of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees (1.57 rad). Where this section requires a minimum clear opening width of 32 inches (813 mm) and a door opening includes two door leaves without a mullion, one leaf shall provide a minimum clear opening width of 32 inches (813 mm). In Group I-2, doors serving as means of egress doors where used for the movement of beds shall provide a minimum clear opening width of $41^1/_2$ inches (1054 mm). ~~The maximum width of a swinging door leaf shall be 48 inches (1219 mm) nominal.~~ The minimum clear opening height of doors shall be not less than 80 inches (2032 mm).

Exceptions:

1. In Group R-2 and R-3 dwelling and sleeping units that are not required to be an Accessible unit, Type A unit or Type B unit, the minimum ~~and maximum~~ width shall not apply to door openings that are not part of the required means of egress.
2. *(No change)*
3. *(No change)*



Door width.

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4. The maximum width of door leaves in revolving doors that comply with Section ~~1010.1.4.1~~ 1010.3.1 shall not be limited.
5. The maximum width of door leaves in power-operated doors that comply with Section ~~1010.1.4.2~~ 1010.3.2 shall not be limited
6. *(No change)*
7. *(No change)*
8. *(No change)*
9. *(No change)*
10. *(No change)*
11. Doors serving nonaccessible single-user shower or sauna compartments, toilet stalls or dressing, fitting or changing rooms shall have a minimum clear opening width of 20 inches (508 mm). ~~The minimum clear opening width shall not apply to doors for nonaccessible shower or sauna compartments.~~

~~12. The minimum clear opening width shall not apply to the doors for nonaccessible toilet stalls.~~

CHANGE SIGNIFICANCE: Historically, the maximum allowable width of a swinging door used for egress has been limited to 48 inches. The limitation was based principally on the weight of the door and tendency for wider/heavier doors to require greater maintenance to assure proper functioning and reasonable opening effort. The elimination of the width limitation is based on several factors, including 1) Section 1010.1.3 will continue to limit the door opening force regardless of the height, width or weight of the door; and 2) the need for wider doors in locations such as hospitals and other occupancies where the movement of patient beds, merchandise or equipment may create the need for a wider door. Although a pair of doors has been the typical solution, that approach was not always effective as it could require the person moving through the door or moving the equipment through the door to operate both doors at the same time to gain passage. Exceptions 1 and 4 were also revised to coordinate with the deletion of the maximum door width requirement.

Exceptions 11 and 12 were recently added to address nonaccessible shower, sauna or toilet compartments. Unfortunately, once a list of exceptions is created, it begins to make the items that are not on the list more apparent. For example, small dressing, fitting and changing rooms at many retail stores were required to provide 32-inch minimum width doors simply because there was no specific exception. From a format perspective, these two previous exceptions were also consolidated as Exception 11.

A minimum door width of 20 inches was also included in the revised exception. The width of 20 inches was selected to maintain compliance with historical door widths of 24 inches for most single-user toilet compartments and individual saunas, 32 inches for fitting rooms, and 22 inches for commercial showers. As such, the 20-inch minimum width selection continues to allow all of these commonly accepted door sizes.

One possible issue of interpretation is the application to only "single-user" elements. This phrasing intends to coordinate with the fact that these spaces, which are nonaccessible, are typically clustered with, or adjacent to, a similar accessible element. See Section 1110.2, Exception 3, and

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Sections 1110.7 or 1110.14 as examples. Another issue is the recognition that the intent of the "single-user" wording is not to prohibit situations such as where a parent enters the changing room with their child or a friend goes into the room with someone to offer their opinion. The purpose is to ensure that spaces that are required to be accessible or that are intended for common use by multiple people will be provided with a 32-inch minimum clear door width. For example, a changing room for a bridal party at a wedding venue or for a sports team or group of referees at a gymnasium would not be viewed as being intended for a "single user." However, a toilet stall or the typical changing or fitting room in a retail space would generally be considered as a "single-user" space even if there might be more than one person in the space on some occasions.

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1010.1.1.1

Projections into Door Openings

CHANGE TYPE: Modification

CHANGE SUMMARY: Additional components are now specifically permitted to project into the minimum required door opening height.

2021 CODE TEXT: **1010.1.1.1 Projections into clear ~~width~~ opening.** There shall not be projections into the required clear opening width lower than 34 inches (864 mm) above the floor or ground. Projections into the clear opening width between 34 inches (864 mm) and 80 inches (2032 mm) above the floor or ground shall not exceed 4 inches (102 mm).

> **Exception:** Door closers, overhead door stops, power door operators, and electromagnetic door ~~stops~~ locks shall be permitted to be 78 inches (1980 mm) minimum above the floor.

CHANGE SIGNIFICANCE: Previously, the only items that were specifically permitted to project into the minimum required clear door height were a door closer and a door stop. Power door operators and electromagnetic locks are now also permitted to extend down into the clear opening height. It has also been clarified that the door stops that were previously addressed are the overhead stops that are a part of the door frame and not some other type of device mounted on the wall, ceiling or other part of the egress path that in some manner restricts how far the door can open.



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Door closer and electromagnetic lock projecting into door height.

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1010.1.3
Door Opening Forces

CHANGE TYPE: Modification

CHANGE SUMMARY: The requirements for releasing the latching hardware and the force to open the door have been divided into separate subsections to provide coordination with the 2017 edition of the ICC A117.1.

2021 CODE TEXT: ~~**1010.1.3 Door opening force.** The force for pushing or pulling open interior swinging egress doors, other than fire doors, shall not exceed 5 pounds (22 N). These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. For other swinging doors, as well as sliding and folding doors, the door latch shall release when subjected to a 15-pound (67 N) force. The door shall be set in motion when subjected to a 30-pound (133 N) force. The door shall swing to a full-open position when subjected to a 15-pound (67 N) force.~~

1010.1.3 Forces to unlatch and open doors. The forces to unlatch doors shall comply with the following:

1. Where door hardware operates by push or pull, the operational force to unlatch the door shall not exceed 15 pounds (67 N).
2. Where door hardware operates by rotation, the operational force to unlatch the door shall not exceed 28 inch-pounds (315 N-cm).



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Operational force for door hardware.

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The force to open doors shall comply with the following:

1. For interior swinging egress doors that are manually operated, other than doors required to be fire rated, the force for pushing or pulling open the door shall not exceed 5 pounds (22 N).
2. For other swinging doors, sliding doors, or folding doors, and doors required to be fire rated, the door shall require not more than a 30-pound (133 N) force to be set in motion and shall move to a full-open position when subjected to not more than a 15-pound (67 N) force.

CHANGE SIGNIFICANCE: Door opening force provisions have been modified to 1) coordinate with the requirements found in ICC A117.1, and 2) help clarify the intent by dividing the requirements into separate areas. As divided, one provision now addresses the operating force to release the door latching hardware and the second addresses the force needed to move the door leaf to an open position. Previously, misapplication occurred where efforts were made to apply the limits to both the door itself and to the operating hardware.

A technical revision recognizes that the door hardware provisions now address "rotation" and establishes a 28 inch-pound force instead of the 15-pound force that is referenced for pushing or pulling the hardware. This coordinates with Section 404.2.6 of the ICC A117.1 standard. Depending on the type of hardware involved (pushing, pulling, rotational), appropriate force levels have been established so compliance may be determined. Providing these values and distinctions helps to clarify how the forces are applied and determined, leading to more consistent interpretations related to the forces that are appropriate for each type of operation. As an example, where the operational force for the hardware relies on a rotational movement, a maximum of 28 inch-pounds is specified. Because this is essentially the torque, a rotational force, it was considered inappropriate to simply specify a force such as 5 pounds. The amount of force required to operate the hardware will be dependent on the length of the lever arm to which the force is applied. The amount of force would differ greatly depending on the distance from the pivot point where the force is applied.

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1010.2.4
Locks and Latches

CHANGE TYPE: Modification

CHANGE SUMMARY: The general locking provisions have been expanded to allow locked doors in the egress system when desired due to the clinical needs of care recipients or where exterior areas egress back through the building.

2021 CODE TEXT: ~~**1010.1.9.4**~~ **1010.2.4 Locks and latches.** Locks and latches shall be permitted to prevent operation of doors where any of the following exist:

1. *(No change)*
2. In Group I-1, Condition 2 and Group I-2 occupancies where the clinical needs of persons receiving care require containment or where persons receiving care pose a security threat, provided that all clinical staff can readily unlock doors at all times, and all such locks are keyed to keys carried by all clinical staff at all times or all clinical staff have the codes or other means necessary to operate the locks at all times.

~~2.~~3. *(No change)*

~~3.~~4. *(No change)*

~~4.~~5. *(No change)*

~~5.~~6. *(No change)*

~~6.~~7. *(No change)*

8. Other than egress courts, where occupants must egress from an exterior space through the building for means of egress, exit access doors shall be permitted to be equipped with an approved locking device where installed and operated in accordance with all of the following:



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Courtyard egressing through building.

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8.1. The maximum occupant load shall be posted where required by Section 1004.9. Such sign shall be permanently affixed inside the building and shall be posted in a conspicuous space near all the exit access doorways.

8.2. A weatherproof telephone or two-way communication system installed in accordance with Sections 1009.8.1 and 1009.8.2 shall be located adjacent to not less than one required exit access door on the exterior side.

8.3. The egress door locking device is readily distinguishable as locked and shall be a key-operated locking device.

8.4. A clear window or glazed door opening, not less than 5 square feet (0.46 m^2) in area, shall be provided at each exit access door to determine if there are occupants using the outdoor area.

8.5. A readily visible, durable sign shall be posted on the interior side on or adjacent to each locked required exit access door serving the exterior area stating, "THIS DOOR TO REMAIN UNLOCKED WHEN THE OUTDOOR AREA IS OCCUPIED." The letters on the sign shall be not less than 1 inch (25.4 mm) high on a contrasting background.

8.6. The occupant load of the occupied exterior area shall not exceed 300 occupants in accordance with Section 1004.

9. Locking devices are permitted on doors to balconies, decks or other exterior spaces serving individual dwelling or sleeping units.

10. Locking devices are permitted on doors to balconies, decks or other exterior spaces of 250 square feet (23.23 m^2) or less serving a private office space.

CHANGE SIGNIFICANCE: Although four new items have been added to the general locking provisions, they fundamentally address two basic situations. Item 2 will address certain institutional occupancies where the needs of the care recipients are better addressed by containment. Items 8, 9 and 10 address exterior areas that must enter back into the building as a portion of their required egress path.

Item 2 now coordinates with provisions that are accepted by the federal regulations used for healthcare facilities. This exception will allow locked egress doors, and thus restricted movement, for the safety of the patient and/or public in certain assisted living facilities, hospitals and nursing facilities. This type of restricted egress is often used where additional security, elopement prevention or dementia wandering need to be addressed. While Section 1010.2.14 can be used to address electric locking systems, this new exemption can be applied where the use of manual locking systems having keys or codes may not be addressed. An important aspect of this requirement is that all clinical staff are capable of unlocking these egress doors should a need arise.

Items 8, 9 and 10 try to strike a balance between egress safety and building security that has been left unaddressed in previous editions of the code. Section 1004.7 mandates an unobstructed path of egress—including the prohibition of locking devices on means of egress doors—where egress travel from exterior spaces is required to pass back through the building. However, for security purposes, building owners and tenants want to

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install locks on these doors to prevent people from being able to enter the building through these doors. Building owners and building officials have long recognized this conflict between security and safety and generally had to accept locks being installed by using either the modification or alternative allowances of Chapter 1. The new exemptions will provide guidance to directly address how these exterior doors can be provided with locking devices and still be considered for required egress purposes from the exterior spaces.

While Items 9 and 10 will be somewhat self-limiting due to the occupancy involved, a maximum occupant load limit of 300 was established in Item 8 for consistency with Item 3, which has allowed a lockable main egress door in assembly uses under somewhat similar restrictions.

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1010.2.8

Locking Arrangements in Group I-4

CHANGE TYPE: Modification

CHANGE SUMMARY: Group I-4 occupancies are now regulated under the special locking arrangements allowed for other "educational occupancies."

2021 CODE TEXT: ~~**1010.1.4.4**~~ **1010.2.8 Locking arrangements in educational occupancies.** In Group E ~~and~~ occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors from classrooms, offices and other occupied rooms ~~shall be permitted to be provided~~ with locking arrangements designed to keep intruders from entering the room ~~where~~ shall comply with all of the following conditions ~~are met~~:

1. The door shall be capable of being unlocked from outside the room with a key or other approved means.
2. The door shall be openable from within the room in accordance with Section ~~1010.1.9~~ 1010.2.
3. Modifications shall not be made to listed panic hardware, fire door hardware or door closers.
4. Modifications to fire door assemblies shall be in accordance with NFPA 80.

~~**1010.1.4.4.1 Remote operation of locks.** Remote operation of locks complying with Section 1010.1.4.4 shall be permitted.~~

Remote locking or unlocking of doors from an approved location shall be permitted in addition to the unlocking operation in Item 1.



Photo courtesy of Schlage Lock Co., LLC (Part of Allegion plc)

Door security hardware.

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CHANGE SIGNIFICANCE: Facilities used for day care operations are often classified as Group I-4 occupancies. Such occupancies provide custodial care for fewer than 24 hours per day and include both adult day care and child day care. Although Group E day care facilities and other similar uses have previously been addressed, Group I-4 occupancies have not been included in the IBC but have previously been addressed in the IFC for existing buildings. The need for lockdown plans in day care facilities, both Group E and Group I-4, is important, and as such has been included with the other educational related occupies covered by this provision.

The remote operation requirement has also been relocated and clarified to recognize that it can be used for both locking and/or unlocking operations. It is important to note that this remote operation provision must be in addition to the outside the room unlocking option addressed by Item 1. In addition, it does not modify or remove the egress capabilities established in Items 2 and 3. These remote locking/unlocking operations can be set up to occur from locations including the main office or a security office, or even by a remote fob given to school staff or emergency responders. The intent of Item 1 and the remote operation requirement is to ensure that authorized entry can be made into the room and to prohibit the installation of slide bolts or dead bolts that would only be openable from within the room, limiting the ability of emergency responders to enter a room from outside the space.

It should be noted that the code does not require the installation of these locking arrangements to keep people from entering a room. However, if that type of security is desired, then compliance with the four items is required.

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1011.6
Stairway Landings

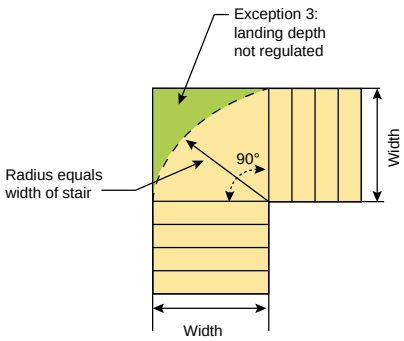
CHANGE TYPE: Modification

CHANGE SUMMARY: Requirements addressing the layout and configuration of landings, both curved and those that exceed the minimum size, have been revised.

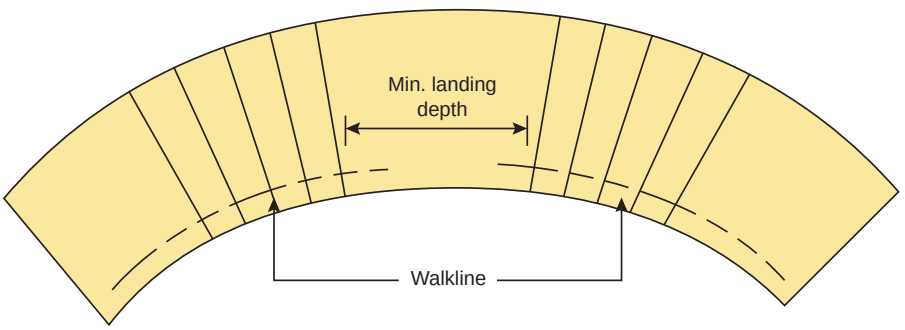
2021 CODE TEXT: **1011.6 Stairway landings.** There shall be a floor or landing at the top and bottom of each stairway. The width of landings, measured perpendicularly to the direction of travel, shall be not less than the width of stairways served. Every landing shall have a minimum depth, measured parallel to the direction of travel, equal to the width of the stairway or 48 inches (1219 mm), whichever is less. Doors opening onto a landing shall not reduce the landing to less than one-half the required width. When fully open, the door shall not project more than 7 inches (178 mm) into the required width of a landing. Where wheelchair spaces are required on the stairway landing in accordance with Section 1009.6.3, the wheelchair space shall not be located in the required width of the landing and doors shall not swing over the wheelchair spaces.

~~Exception~~ Exceptions:

1. Where stairways connect stepped aisles to cross aisles or concourses, stairway landings are not required at the transition between stairways and stepped aisles constructed in accordance with Section ~~1029~~ 1030.
2. Where curved stairways of constant radius have intermediate landings, the landing depth shall be measured horizontally between the intersection of the walkline of the lower flight at the landing nosing and the intersection of the walkline of the upper flight at the nosing of the lowest tread of the upper flight.
3. Where a landing turns 90 degrees (1.57 rad) or more, the minimum landing depth in accordance with this section shall not be required where the landing provided is not less than that described by an arc with a radius equal to the width of the flight served.



Landing at 90-degree turn.



Landing depth at curved stairway.

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CHANGE SIGNIFICANCE: Doors protruding into the width of the landing more than 7 inches should only be considered a problem when that projection is into the required width. While doors projecting into egress elements and over landings are generally handled in a similar manner – both at any point in their swing and when fully opened – the provisions for landings did differ from those in Section 1005.7.1 that were directly related to the required width. This caused some confusion on the application due to the provisions of Section 102.1 dealing with specific versus general provisions. As the scope of the provision is now the required width, confusion should be eliminated and the door swing projection requirements will be consistent.

The new Exception 2 provides specific guidance as to how the measurement of the landing depth is to be made when the landing and adjacent stair runs are curved. For those curved stairways with a constant and consistent radius, the measurement of the landing depth is to be taken at the walkline, which is established in Section 1011.4. Because the measurement of the tread depth of the adjacent stairs is measured at the walkline of those flights, it made sense to regulate the depth of the landing in a similar manner.

The intent of Exception 3 is to maintain the minimum width and required capacity of the stairway as it turns at the landing between adjacent flights. By swinging an arc that uses the stairway width as the radius, it will establish the area of the landing that is required to maintain the minimum egress width without mandating a square or rectangular landing. This methodology has been generally accepted for years and has been common where semicircular landings were designed or to allow for standpipes to be placed in these corners. It should be noted that Exception 3 does not apply where the stairway's turn at the landing is less than 90 degrees.

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1016.2

Egress Through Intervening Spaces

CHANGE TYPE: Modification

CHANGE SUMMARY: Egress through an enclosed elevator lobby area is now permitted for spaces requiring only one means of egress.

2021 CODE TEXT: **1016.2 Egress through intervening spaces.** Egress through intervening spaces shall comply with this section.

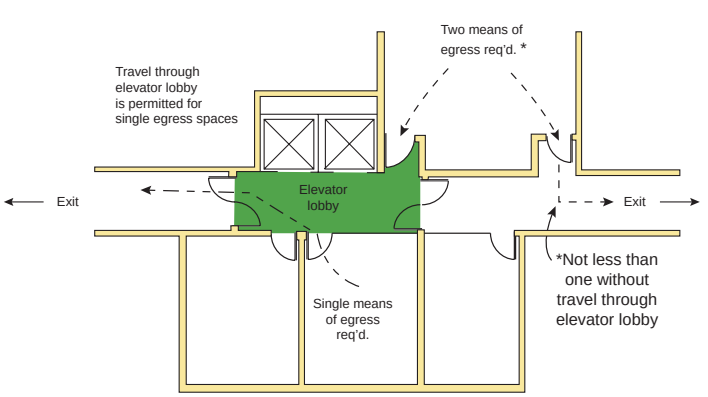
1. Exit access through an enclosed elevator lobby is permitted. Where access to two or more exits or exit access doorways is required in Section 1006.2.1, access ~~Access~~ to not less than one of the required exits shall be provided without travel through the enclosed elevator lobbies required by Section 3006. Where the path of exit access travel passes through an enclosed elevator lobby, the level of protection required for the enclosed elevator lobby is not required to be extended to the exit unless direct access to an exit is required by other sections of this code.
2. *(No change)*
3. *(No change)*
4. *(No change)*
5. *(No change)*

Exceptions:

1. *(No change)*
2. *(No change)*

CHANGE SIGNIFICANCE: Egress travel through intervening spaces, including enclosed elevator lobbies, is permitted where specific conditions are met. Historically, all spaces required access to at least one of the required exits without passing through an enclosed elevator lobby. Therefore, if a space had only a single means of egress, such egress was not permitted to go directly through an elevator lobby before travel to an exit. Only when an area had multiple egress paths available could one pass through the elevator lobby to reach an exit.

Although spaces that required two means of egress could have one path go through the elevator lobby—because there was one option available that did not require travel through the lobby—a small space without an available secondary option was not permitted to go through the lobby.



Egress through elevator lobby.

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1019.3
Exit Access Stairways

CHANGE TYPE: Clarification

CHANGE SUMMARY: The allowance exempting the enclosure of exit access stairways that only serve two stories has been clarified by mandating that the stories be adjacent.

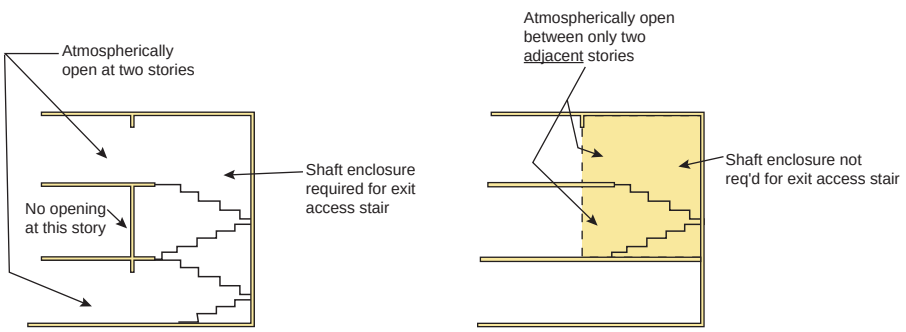
2021 CODE TEXT: **1019.3 Occupancies other than Groups I-2 and I-3.** In other than Group I-2 and I-3 occupancies, floor openings containing exit access stairways or ramps ~~that do not comply with one of the conditions listed in this section~~ shall be enclosed with a shaft enclosure constructed in accordance with Section 713.

Exceptions:

1. Exit access stairways and ramps that serve or atmospherically communicate between only two adjacent stories. Such interconnected stories shall not be open to other stories.
2. *(No change)*
3. *(No change)*
4. *(No change)*
5. *(No change)*
6. *(No change)*
7. Exit access stairways and ramps serving smoke-protected or open-air assembly seating complying with the exit access travel distance requirements of Section ~~1029~~ 1030.7.
8. *(No change)*
9. Exterior exit access stairways or ramps between occupied roofs.

CHANGE SIGNIFICANCE: In a format revision, the charging paragraph of Section 1019.3 has been revised such that the conditions that previously existed are now exceptions rather than conditions. As revised, the general scoping will mandate that exit access stairways are required to be enclosed within a compliant shaft, and the various exceptions will provide exemptions to that shaft enclosure requirement.

Exception 1 has also been modified so the term "adjacent" has been inserted, limiting the two atmospherically connected levels to being two adjacent stories. Limiting the exception to adjacent stories is intended to clarify the exception and to prohibit the possibility of using an enclosure



Exit access stair connecting stories.

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to skip intermediate levels and interconnect two remote floors. For example, if the stairway was left open to the first story and perhaps the third story, but partitioned off from the second story, it would still potentially allow smoke or a fire to spread greater distances through the building. Even in buildings where floors are nonrated, they provide a level of separation and the code has traditionally only allowed two adjacent floors to be interconnected. However, the previous code language was not clear enough to limit the exception to being "adjacent" stories.

When applying the new Exception 9, exterior exit access stairways between different levels of occupied roofs are also permitted to be exempt from the shaft enclosure requirement. This allowance is applicable to the stairway between an elevated deck that is on the roof itself, or a condition where a stairway connects the roofs on different levels of the building.

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1020.5
Dead-End Corridors

CHANGE TYPE: Modification

CHANGE SUMMARY: In hospitals, a corridor that does not serve patient rooms or treatment spaces is now allowed a maximum 30-foot dead end.

2021 CODE TEXT: ~~**1020.4**~~ **1020.5 Dead ends.** Where more than one exit or exit access doorway is required, the exit access shall be arranged such that dead-end corridors do not exceed 20 feet (6096 mm) in length.

Exceptions:

1. In Group I-3, Condition 2, 3 or 4, occupancies, the dead end in a corridor shall not exceed 50 feet (15 240 mm).
2. In occupancies in Groups B, E, F, I-1, M, R-1, R-2, S and U, where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the length of the dead-end corridors shall not exceed 50 feet (15 240 mm).
3. A dead-end corridor shall not be limited in length where the length of the dead-end corridor is less than 2.5 times the least width of the dead-end corridor.
4. In Group I-2, Condition 2 occupancies, the length of dead-end corridors that do not serve patient rooms or patient treatment spaces shall not exceed 30 feet (9144 mm).

CHANGE SIGNIFICANCE: To keep egress travel direct and efficient, the length of a dead-end corridor is typically limited to a maximum of 20 feet. While several exceptions allow for longer dead-ends, the increase



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Corridor serving patient treatment space.

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did not apply to Group I-2 occupancies such as hospitals. Maintaining the dead end limit in hospitals was generally viewed as being appropriate for areas where patients might not be easily or rapidly moved. Although the IBC has previously placed a 20-foot maximum limit on such dead-end corridors, the National Fire Protection Association in NFPA 101 permits a 30-foot maximum limit for healthcare occupancies.

Because most hospitals are regulated by the federal Centers for Medicare and Medicaid Services (CMS), the difference between the IBC and NFPA 101 has caused confusion and resulted in the more restrictive 20-foot limitation being applied throughout the area of the hospital classified as a Group I-2 occupancy. Many areas within a hospital, such as staff areas, waiting areas or other non-patient areas are functionally similar to Group B occupancies where a longer dead end has been deemed to be reasonable and appropriate. Balance has been achieved by now permitting a 30-foot limit in dead-end corridors "that do not serve patient rooms or patient treatment spaces" while still maintaining the general 20-foot limitation where patients would be served. Because the 30-foot limitation aligns with the requirements established by CMS and NFPA 101, it was viewed as being reasonable and safe to change the limit in the IBC.

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1030.16

Handrails at Social Stairs

CHANGE TYPE: Modification

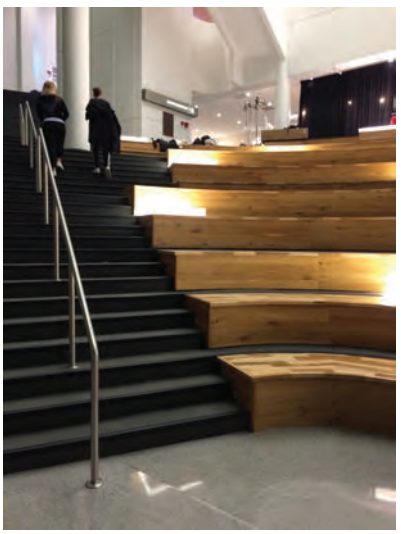
CHANGE SUMMARY: Guidance is now provided to address what are often called "social stairs," which are regulated by a combination of the general stairway provisions and those for assembly seating.

2021 CODE TEXT: ~~**1029.16**~~ **1030.16 Handrails.** Ramped aisles having a slope exceeding one unit vertical in 15 units horizontal (6.7-percent slope) and stepped aisles shall be provided with handrails in compliance with Section 1014 located either at one or both sides of the aisle or within the aisle width. Where stepped aisles have seating on one side and the aisle width is 74 inches (1880 mm) or greater, two handrails are required. Where two handrails are required, one of the handrails shall be within 30 inches (762 mm) horizontally of the stepped aisle.

Exceptions:

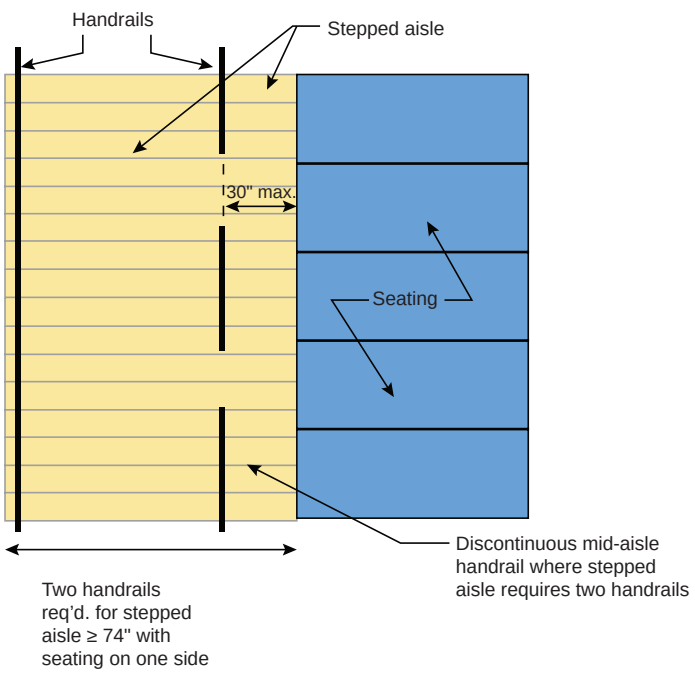
1. Handrails are not required for ramped aisles with seating on both sides.
2. Handrails are not required where, at the side of the aisle, there is a guard with a top surface that complies with the graspability requirements of handrails in accordance with Section 1014.3.
3. Handrail extensions are not required at the top and bottom of stepped aisles and ramped aisles to permit crossovers within the aisles.

~~**1029.16.1**~~ **1030.16.1 Discontinuous mid-aisle handrails.** Where there is seating on both sides of the aisle, the mid-aisle handrails shall be discontinuous. ~~with~~ Where a stepped aisle is required to have two handrails,



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Social stairway.



Handrail requirements for social stairway.

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the mid-aisle handrails shall be discontinuous. Gaps or breaks shall be provided at intervals not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of not less than 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the mid-aisle handrail shall have rounded terminations or bends.

CHANGE SIGNIFICANCE: Social stairs have become common as gathering areas, especially in educational and assembly occupancies. In the meantime, they have not been clearly classified or regulated by the code. Because of the different designs and the lack of any clear means of regulation, it has led to inconsistent regulation. Depending on the design and jurisdiction, the provisions for bleachers, stairways, stepped aisles, or some other alternate system have been applied. In some cases, the effort to make them comply with the IBC's existing provisions have made some of them seemingly less safe by locating handrails where the users must either climb over or under the rail to reach the seating platforms.

The new regulations are a variation of the assembly stepped aisle provisions of Section 1030. The rationale is based on essentially having an assembly seating area with the seating platforms, without seats, located to the side of the stepped aisle. This approach will help guide the aisle width requirements (per Section 1030.9.1) as well as address the placement of handrails serving the adjacent stepped aisle or, if also included, a stairway adjacent to the stepped aisle.

Section 1030.16 requires handrails either at one or both sides of the aisle or allows a handrail to be in the middle of the aisle. In situations where there is seating to one side, Section 1030.16 now requires two handrails where the aisle width exceeds 74 inches. The 74-inch width was selected to create a width that will keep the steps usable. In this case, that dimension was selected by the 30-inch measurement from the seating platform, which also ensures the handrail is within the 30-inch reach dimension addressed in Section 1014.9, plus the normal 44-inch stairway width required by Section 1011.2. Using these two dimensions to establish the 74-inch requirement and the need for having two handrails ensures that the handrails will be provided where needed and not be required on narrower stepped aisles where the second handrail may impede movement in the aisle.

Where two handrails are required, Section 1030.16.1 requires any handrail located other than at the side of the aisle to be a discontinuous handrail. The discontinuous handrail provisions are consistent with what historically has been required for center aisle handrails in assembly seating. Using these discontinuous handrails will allow for a stepped aisle adjacent to the seating platforms but also allow people to move from that aisle to any adjacent stepped aisle without having to climb over or under the rail or needing to go to the top or bottom to get to the other side. This will allow people to use an actual stepped aisle to access the platforms of the social stairway instead of requiring them to walk on the platforms that may have larger riser heights and varying depths.

Several good examples of both acceptable and unacceptable designs can be found in a review of code change submittal E106-18.

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1031

Emergency Escape and Rescue Openings

CHANGE TYPE: Modification

CHANGE SUMMARY: Although predominately a reorganization of the emergency escape and rescue opening provisions to coordinate the IBC and the *International Residential Code* (IRC) provisions have also been added to address the size of steps from an area well and the use of a door.

2021 CODE TEXT: **202 EMERGENCY ESCAPE AND RESCUE OPENING.** An operable exterior window, door or other similar device that provides for a means of escape and access for rescue in the event of an emergency.

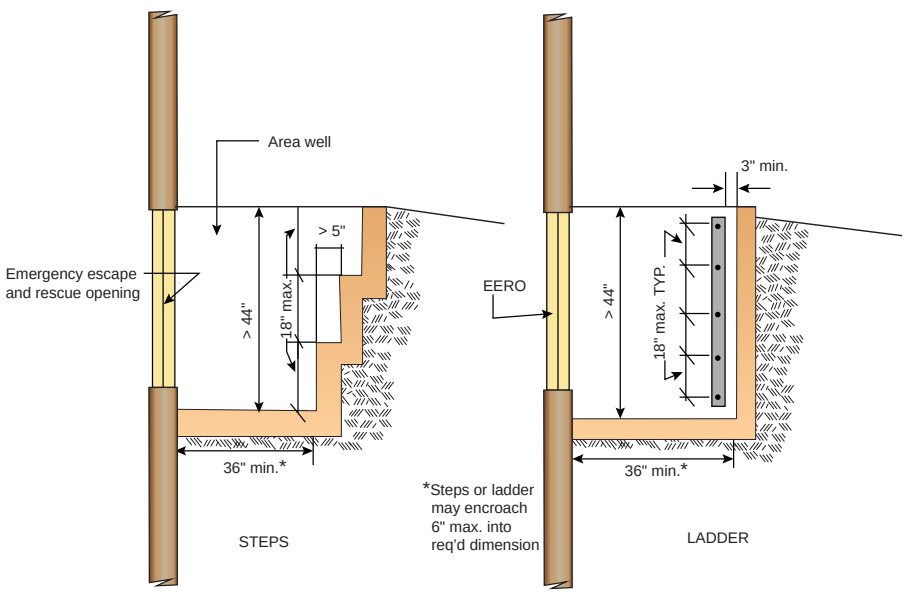
SECTION ~~1030~~ 1031
EMERGENCY ESCAPE AND RESCUE

1031.1 General. Emergency escape and rescue openings shall comply with the requirements of this section.

~~1030.1~~ 1031.2 ~~General~~ Where required. In addition to the means of egress required by this chapter, emergency escape and rescue openings shall be provided in the following occupancies:

1. Group R-2 occupancies located in stories with only one exit or access to only one exit as permitted by Tables ~~1006.3.3~~ 1006.3.4 (1) and ~~1006.3.3~~ 1006.3.4 (2).
2. Group R-3 and R-4 occupancies.

Basements and sleeping rooms below the fourth story above grade plane shall have not fewer than one ~~exterior~~ emergency escape and rescue opening in accordance with this section. Where basements contain one or



Area well requirement for EERO.

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more sleeping rooms, an emergency escape and rescue ~~openings~~ opening shall be required in each sleeping room, but shall not be required in adjoining areas of the basement. Such openings shall open directly into a public way or to a yard or court that opens to a public way.

Exceptions:

1. Basements with a ceiling height of less than 80 inches (2032 mm) shall not be required to have emergency escape and rescue openings.
2. Emergency escape and rescue openings are not required from basements or sleeping rooms that have an exit door or exit access door that opens directly into a public way or to a yard, court or exterior ~~exit~~ egress balcony that opens to a public way.
3. Basements without habitable spaces and having not more than 200 square feet (18.6 m^2) in floor area shall not be required to have emergency escape and rescue openings.
4. Storm shelters are not required to comply with this section where the shelter is constructed in accordance with ICC 500.

~~4~~5. Within individual dwelling and sleeping units in Groups R-2 and R-3, where the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1, 903.3.1.2 or 903.3.1.3, sleeping rooms in basements shall not be required to have emergency escape and rescue openings provided that the basement has one of the following:

   ~~4.1~~5.1. One means of egress and one emergency escape and rescue opening.

   ~~4.2~~5.2. Two means of egress.

~~1030.1.1~~ 1031.2.1 Operational constraints and opening control devices. *(No changes)*

1031.3 Emergency escape and rescue openings. Emergency escape and rescue openings shall comply with Sections 1031.3.1 through 103.3.3.

~~1030.2~~ 1031.3.1 Minimum size. *(No changes)*

~~1030.2.1~~ 1031.3.2 Minimum dimensions. *(No changes)*

~~1030.3~~ 1031.3.3 Maximum height from floor. *(No changes)*

~~1030.3~~ 1031.4 Emergency escape and rescue doors. Where a door is provided as the required emergency escape and rescue opening, it shall be a swinging door or a sliding door.

~~1030.4~~ 1031.5 ~~Window~~ Area wells. An emergency escape and rescue opening with ~~a finished sill height~~ the bottom of the clear

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opening below the adjacent grade ~~ground level~~ shall be provided with ~~a window~~ an area well in accordance with Sections ~~1030.4.1 and 1030.4.2~~ 1031.5.1 through 1031.5.3.

~~1030.4.1~~ 1031.5.1 Minimum size. The minimum horizontal area of the ~~window~~ area well shall be 9 square feet (0.84 m^2), with a ~~minimum dimension of~~ horizontal projection and width of not less than 36 inches (914 mm). The area ~~of the window~~ well shall allow the emergency escape and rescue opening to be fully opened.

> **Exception:** The ladder or steps required by Section 1031.5.2 shall be permitted to encroach not more than 6 inches (152 mm) into the required dimensions of the area well.

~~1030.4.2~~ 1031.5.2 Ladders or steps. ~~Window~~ Area wells with a vertical depth of more than 44 inches (1118 mm) shall be equipped with an approved permanently affixed ladder or steps. ~~Ladders or rungs shall have an inside width of not less than 12 inches (305 mm), shall project not less than 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center (o.c.) vertically for the full height of the window well. The ladder or steps shall not encroach into the required dimensions of the window well by more than 6 inches (152 mm).~~ The ladder or steps shall not be obstructed by the emergency escape and rescue opening when the window or door is in the open position. Ladders or steps required by this section ~~are exempt from the stairway requirements of~~ shall not be required to comply with Section 1011.

~~1030.4.2.1~~ 1031.5.2.1 Ladders. Ladders or rungs shall have an inside width of at least 12 inches (305 mm), shall project at least 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center (o.c.) vertically for the full height of the area well.

~~1030.4.2.2~~ 1031.5.2.2 Steps. Steps shall have an inside width of not less than 12 inches (305 mm), shall have treads greater than 5 inches (127 mm) in depth and a riser height not greater than 18 inches (457 mm) for the full height of the area well.

1031.5.3 Drainage. Area wells shall be designed for proper drainage by connecting to the building's foundation drainage system required by Section 1805.

> **Exception:** A drainage system for area wells is not required where the foundation is on well-drained soil or sand-gravel mixture soils in accordance with the United Soil Classification System, Group I Soils, in accordance with Section 1803.5.1.

~~1030.5~~ 1031.6 Bars, grilles, covers and screens. ~~Bars~~ Where bars, grilles, covers, screens or similar devices are ~~permitted to be~~ placed over emergency escape and rescue openings~~, bulkhead enclosures~~ or ~~window~~ area wells that serve such openings, ~~provided that~~ the minimum net clear opening size ~~complies~~ shall comply with Sections 1031.3 and 1031.5 ~~1030.1.1 through 1030.4.2 and such~~. Such devices shall be

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releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the emergency escape and rescue opening. ~~Where such bars, grilles, covers, screens or similar devices are installed in existing buildings, they shall not reduce the net clear opening of the emergency escape and rescue opening and smoke alarms shall be installed in accordance with Section 907.2.10 regardless of the valuation of the alteration~~.

CHANGE SIGNIFICANCE: On the whole, the revisions to the provisions addressing emergency escape and rescue openings (EEROs) result in relatively few technical changes but do provide more coordination between the IRC and the IBC regarding the requirements for EEROs. For example, the ladder requirements that are shown as new text in Section 1031.5.2.1 are merely being relocated from Section 1031.5.2. This will allow Section 1031.5.2 to serve as a base paragraph dealing with the way that ladders or steps impact an area well, while the specific ladder and step provisions are addressed in the subsections of 1031.5.2.1 and 1031.5.2.2, respectively. The following is a list of the more important technical changes found within this section.

- **Section 1031.2:** The word "exterior" has been deleted because it is now included in the definition. A new Exception 4 references the ICC 500 standard for storm shelters. Although many of the dimensional requirements are consistent, Section 501.4 of that standard contains requirements for an emergency opening in spaces that have only a single means of egress. Since the ICC 500 standard contains specific requirements for the emergency opening, it is appropriate to use those requirements for storm shelters instead of those found in the IBC.
- **Section 1031.4:** The new EERO text intends to use substantially the same criteria for both doors and windows rather than separate requirements for each. This new requirement will be a bit more restrictive than before by limiting EERO doors to a swinging door or a sliding door.
- **Section 1031.5:** The primary changes in the area well provisions are editorial revisions to provide clearer language and wording that is consistent with other sections. For example, the term is changed from "window wells" since doors are also allowed to serve as the EERO. The term "finished sill height" is changed to "the bottom of the clear opening" to coordinate with the location the measurement in Section 1031.3.3 is made to.
- **Section 1031.5.2:** A significant change provides technical guidelines for steps from an area well. While the code previously excluded these steps from needing to comply with the stairway requirements of Section 1011, it provided no details regarding what sizing or spacing was appropriate. The established dimensions allow the width and spacing between the steps to be 18 inches as is currently allowed for the ladder and a 5-inch

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minimum tread depth that is currently allowed for alternating tread devices and ships' ladders in Sections 1011.14 and 1011.15. Having a specific set of requirements will provide consistency where steps are installed.

- **Section 1031.5.3:** Provisions regarding drainage have been added consistent with the provisions from the IRC to address the concern of water accumulation in the area well.
- **Section 1031.6:** The requirements related to alterations of existing buildings have been relocated to the *International Existing Building Code* (IEBC) since that is the appropriate document for such buildings.

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PART 5

Accessibility

Chapter 11

■ **Chapter 11** Accessibility

Chapter 11 is intended to address the accessibility and usability of buildings and their elements for people with physical disabilities. The provisions within the chapter are generally considered as scoping requirements that state what and where accessibility is required or how many accessible features or elements must be provided. The technical requirements, addressing how accessibility is to be accomplished, are found in ICC A117.1, as referenced by Chapter 11. The concept of the code is to initially mandate that all buildings and building elements be accessible, then to reduce the required accessibility where logical and reasonable. ■

1102
Accessible Design Compliance

1104.4
Accessible Multistory Buildings

1105.1.1
Automatic Doors at Public Entrances

1107.2
Vehicle Charging Stations

1108.5, 1110.2
Assisted Toileting and Bathing

1110.6
Bottle Filling Stations

1110.13.2
Service Windows

1110.15
Operable Parts

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1102

Accessible Design Compliance

CHANGE TYPE: Modification

CHANGE SUMMARY: The ICC A117.1 standard that is referenced by the *International Building Code* (IBC) for the design and construction of accessible buildings and facilities has been updated from the 2009 edition to the 2017 edition and includes several new and revised technical requirements.

2021 CODE TEXT:

SECTION 1102
COMPLIANCE

1102.1 Design. Buildings and facilities shall be designed and constructed to be accessible in accordance with this code and ICC A117.1.

CHAPTER 35
REFERENCED STANDARDS

ICC A117.1 – ~~09~~ 17: Accessible and Usable Buildings and Facilities

CHANGE SIGNIFICANCE: The recognition of the 2017 edition of the ICC A117.1 standard as the referenced standard for accessible design provides a number of significant changes. As with all referenced standards, it is important to identify the scoping limitations that IBC Section 102.4 places on referenced standards. It is important to note that the requirements of any standard are applicable "to the prescribe extent of each such reference." As a result, the standard includes some provisions that are never scoped or required by the IBC. For example, the 2017 edition of the ICC A117.1 contains requirements related to improving



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ICC A117.1 2017 edition.

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communication for persons using sign language (see A117.1, Sections 704.7 and 802.11), but neither of these provisions are scoped or referenced by the IBC. While such provisions may be used to provide design guidance and help improve communication, they are not required to be applied unless a jurisdiction has amended the adopting ordinances.

Several substantial changes can be found within the 2017 edition of the ICC A117.1 standard, with many of the major revisions highlighted and discussed in the ICC publication *Significant Changes to the ICC A117.1 Accessibility Standard*, 2017 Edition. One of the changes that may have the most impact is the enhanced dimensions for clear floor spaces and turning spaces. The increased dimensions were in response to technical data regarding the space needed by persons using scooters and certain types of motorized wheelchairs. It should be noted that the enhanced provisions only apply to new buildings and facilities.

Other technical modifications address exterior routes, curb cuts, blended transitions, clarity for detectable warnings, passenger drop-offs and parking requirements that coordinate with the federal Public Rights of Way Accessibility Guidelines (PROWAG), provisions for electrical vehicle charging stations, and acoustic standards for classrooms. While these revisions will improve access and usability for persons with disabilities, it is important that users recognize that the ICC A117.1 provisions will in some situations be more restrictive than those found in the federal Americans with Disabilities Act (ADA).

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CHANGE TYPE: Clarification

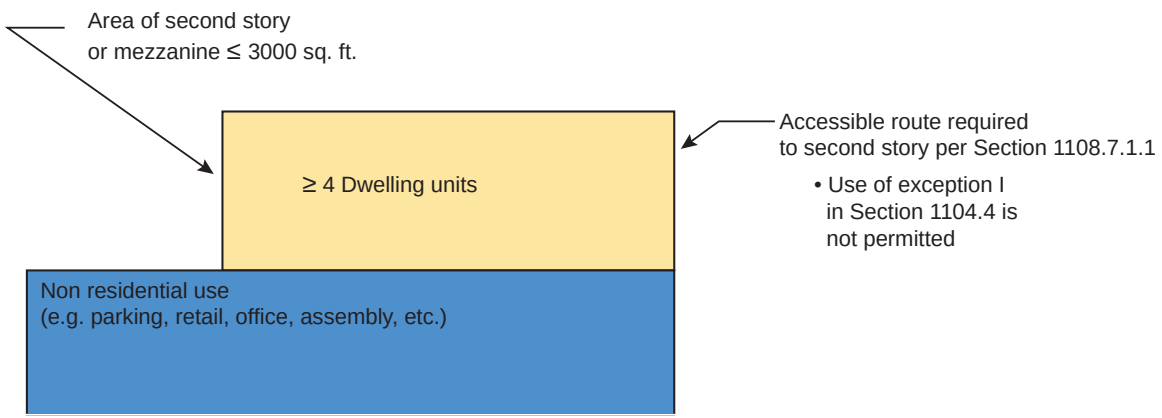
CHANGE SUMMARY: The application of the 3,000 square-foot exclusion for a vertical accessible route in buildings having four or more dwelling units is now prohibited.

1104.4 Accessible Multistory Buildings

2021 CODE TEXT: **1104.4 Multistory buildings and facilities.** At least one accessible route shall connect each accessible story, mezzanine and occupied roofs in multilevel buildings and facilities.

Exceptions:

1. An accessible route is not required to stories, mezzanines and occupied roofs that have an aggregate area of not more than 3,000 square feet (278.7 m^2) and are located above and below accessible levels. This exception shall not apply to:
   - **1.1.** Multiple tenant facilities of Group M occupancies containing five or more tenant spaces used for the sales or rental of goods and where at least one such tenant space is located on a floor level above or below the accessible levels.
   - **1.2.** Stories or mezzanines containing offices of health care providers (Group B or I).
   - **1.3.** Passenger transportation facilities and airports (Group A-3 or B).
   - **1.4.** Government buildings.
   - **1.5.** Structures with 4 or more dwelling units.
2. Stories, mezzanines or occupied roofs that do not contain accessible elements or other spaces as determined by Section ~~1107~~ 1108 or ~~1108~~ 1109 are not required to be served by an accessible route from an accessible level.
3. In air traffic control towers, an accessible route is not required to serve the cab and the floor immediately below the cab.



Multistory building with dwelling units.

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4. Where a two-story building or facility has one story or mezzanine with an occupant load of five or fewer persons that does not contain public use space, that story or mezzanine shall not be required to be connected by an accessible route to the story above or below.

CHANGE SIGNIFICANCE: As a general rule, an accessible route must be provided to each accessible story, mezzanine and occupied roof. Exception 1 waives the requirement for an accessible route to floors above and below any accessible level under specified conditions. A new exclusion for applying Exception 1 has been provided to maintain coordination with the requirements of the Fair Housing Act. The restriction will generally ensure that smaller efficiency type dwellings do not conflict with the Fair Housing accessibility requirements and are consistent with the provisions addressing Type B units in the IBC.

Since the requirements of the Fair Housing Act and those for Type B units in the IBC apply when there are "four or more dwelling units . . . intended to be occupied as a residence," it would be unlikely that in a typical apartment building that you could have four units as well as the common space and stay beneath the 3,000 square-foot limitation that Exception 1 sets. However, with the trend towards smaller units in some jurisdictions and for certain projects, it could be possible. Therefore, the exclusion in the new Item 1.5 is necessary to prevent units being constructed in violation of the Fair Housing Act and without the proper accessible route to reach the units.

For example, a small two-story building with four or more apartments is being constructed on the second story over another use such as retail sales. Because there are no compliant units on the first story, Section 1108.7.1.1 requires compliant accessible units to be constructed on the second story and would require an accessible route to that story. If the area of the second story is less than 3,000 square feet in size, and it was possible to apply Exception 1 to eliminate the accessible route to the upper level, it would create a conflict with the Fair Housing Act and the intent of the IBC as addressed by Section 1108.7.1.1.

If the arrangement of the apartment building was modified so a compliant Type B unit is provided on the first story, then the structure could use Exception 2 in Section 1104.4 whether the floor area of the second story is above or below the 3,000 square-foot limitation listed in Exception 1. Apartment buildings with four or more dwelling units will be regulated by Exception 2 rather than Exception 1.

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1105.1.1

Automatic Doors at Public Entrances

CHANGE TYPE: Addition

CHANGE SUMMARY: In certain occupancies, the accessible public entrances of buildings with larger occupant loads must now be provided with an automatic door.

2021 CODE TEXT: **1105.1 Public entrances.** In addition to accessible entrances required by Sections ~~1105.1.1~~ 1105.1.2 through ~~1105.1.7~~ 1105.1.8, at least 60 percent of all public entrances shall be accessible.

Exceptions:

1. An accessible entrance is not required to areas not required to be accessible.
2. Loading and service entrances that are not the only entrance to a tenant space.

1105.1.1 Automatic doors. In facilities with the occupancies and building occupant loads indicated in Table 1105.1.1, public entrances that are required to be accessible shall have one door be either a full power-operated door or a low-energy power-operated door. Where the public entrance includes a vestibule, at least one door into and one door out of the vestibule shall meet the requirements of this section.



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Automatic door at entrance.

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TABLE 1105.1.1 Public Entrance with Power-Operated Door[a]

Occupancy	Building Occupant Load Greater Than
A-1, A-2, A-3, A-4	300
B, M, R-1	500

a. In mixed-use facilities where the total sum of the building occupant load is greater than those listed, the most restrictive building occupant load shall apply.

1105.1.2 ~~1105.1.1~~ Parking garage entrances. *(No changes)*

1105.1.3 ~~1105.1.2~~ Entrances from tunnels or elevated walkways. *(No changes)*

1105.1.4 ~~1105.1.3~~ Restricted entrances. *(No changes)*

1105.1.5 ~~1105.1.4~~ Entrances for inmates or detainees. *(No changes)*

1105.1.6 ~~1105.1.5~~ Service entrances. *(No changes)*

1105.1.7 ~~1105.1.6~~ Tenant spaces. *(No changes)*

1105.1.8 ~~1105.1.7~~ Dwelling units and sleeping units. *(No changes)*

CHANGE SIGNIFICANCE: Automatic door openers are now required at public entrances serving specific occupancies and occupant loads. The occupancies selected are those where the occupants are typically more transient and serve people who frequently use those entries. The thresholds chosen are consistent with those for Risk Category III of Table 1604.5 when addressing Assembly occupancies, and the need for a third exit (Table 1006.3.3) when serving the other occupancies. Both of these conditions were viewed as being thresholds where a critical mass of people are present.

The scoping of this requirement addresses all accessible public entrances, resulting in automatic doors being required where they previously had not been required by the IBC, and expands the number of entries that have typically been regulated by other accessibility provisions.

Scoping of the new requirements is limited to public entrances that are required to be accessible in the occupancies and for the occupant loads listed in Table 1105.1.1. The term "public entrances" is defined as any entrance "that is not a service entrance or a restricted entrance." Therefore, the defined terms of public entrance, service entrance and restricted entrance must all be reviewed and understood to properly apply this provision. When reviewing the entrances regulated under Section 1105, the application is not limited to only the public entrances that are included in the base paragraph of Section 1105.1, but also includes any other entrance serving pedestrians from parking garages (1105.1.2), tunnel or elevated walkway entrances (1105.1.3), or any of the other entrances listed that are required to be accessible and meet the definition for a public entrance. Ultimately, it is only the entrances listed in Sections 1105.1.4, 1105.1.5 and 1105.1.6 (because they are classified as restricted entrances or service entrances) and those not meeting the occupancy or occupant load thresholds of Table 1105.1.1 that would be exempt from the automatic door requirement.

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Section 1105.1.1 provides additional guidance that must not be overlooked to properly apply the new requirement. First, if the public entrance consists of multiple doors at that entrance, only one door at that entrance is regulated. For example, where the entrance has four doors, only one of the four doors must be equipped with the automatic opener. Second, the automatic door must be either a full power-operated or low-energy power-operated door, providing for coordination with Section 404.3.1 of the ICC A117.1 standard and excluding the use of power-assist doors. Third, where the entry door is served by a vestibule, at least one door into and one door out of the vestibule is required to comply. This coordinates with the provisions of ICC A117.1, Section 404.3.2 that will also require that the two regulated vestibule doors have the same type of automatic door opener. Therefore, both would either need to be full power-operated or both must be low-energy power-operated. Having one full power-operated and one low-energy power-operated opener serving the two vestibule doors would not be permitted.

When determining if Table 1105.1.1 is applicable, it is important to review Footnote (a) where a mixed occupancy is involved. Mixed occupancy buildings are regulated based on the total sum of the building occupant load. For example, a Group B office building with an occupant load of 300 that also includes a Group A-3 conference room area with an additional 100 occupants would total 400 occupants and thus would need to provide a power-operated door at any public entrance, because it would exceed the 300 occupant load limit that is shown in the table for the Group A-3 occupancy. Another example would be a Group B office building that has an occupant load of 450 but also includes a Group E day care facility serving 60 kids. In this situation, where the building contains more than 500 occupants, the power-operated door requirements from the table related to Group B occupancies will apply.

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1107.2

Vehicle Charging Stations

CHANGE TYPE: Addition

CHANGE SUMMARY: Scoping provisions have been provided to make electrical vehicle charging stations accessible.

2021 CODE TEXT:

SECTION 1107
MOTOR-VEHICLE-RELATED FACILITIES

1107.1 General. Electrical vehicle charging stations shall comply with Section 1107.2. Fuel-dispensing systems shall comply with Section 1107.3.

1107.2 Electrical vehicle charging stations. Electrical vehicle charging stations shall comply with Sections 1107.2.1 and 1107.2.2.

> **Exception:** Electrical vehicle charging stations provided to serve Group R-2, R-3 and R-4 occupancies are not required to comply with this section.

1107.2.1 Number of accessible vehicle spaces. Not less than 5 percent of vehicle spaces on the site served by electrical vehicle charging systems, but not fewer than one for each type of electric vehicle charging system, shall be accessible.

1107.2.2 Vehicle space size. Accessible vehicle spaces shall comply with the requirements for a van accessible parking space that is 132 inches (3350 mm) minimum in width with an adjoining access aisle that is 60 inches (1525 mm) minimum in width.



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Electrical vehicle charging station.

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~~**1109.14**~~ **1107.3 Fuel-dispensing systems.** Fuel-dispensing systems shall be accessible.

CHANGE SIGNIFICANCE: Limited scoping provisions now reference the ICC A117.1 technical requirements addressing accessible electric vehicle charging stations (EVCS). Set forth in Section 502.11 of the standard, the technical criteria are limited to the regulation of operable parts, obstructions, and an accessible route from the vehicle space access aisle to the clear floor space adjacent to the vehicle charging station.

It is important to note that neither the IBC nor ICC A117.1 will require the installation of these charging stations. But, once they are provided, they will be regulated and required to be accessible. Section 1107 does not mandate these systems and Section 406.2.7 begins with the statement "where provided." Once an EVCS is provided, a certain number (see Section 1107.2.1) will be expected to be accessible unless they are serving Group R-2, R-3 or R-4 occupancies. These residential occupancies were exempted because of their non-transient nature and the assumption that if a person has an electric vehicle and elects to install an EVCSs at their designated parking space, it should not trigger compliance with the other requirements for an EVCS.

The details in the scoping language of Section 1107.2.1 are important and should not be overlooked. The first aspect is that the five-percent requirement applies based on the total number of EVCSs that are provided on the site. As such, an accessible charging station is not necessarily required at each cluster of EVCS spaces. For example, if a retail store had four EVCS parking spots provided at two separate locations, they would be able to provide a single EVCS at either one of the two locations. In addition, "not fewer than one for each type" of charging system must be accessible. This is an important feature since there currently are multiple types of charging methods and vehicle charging connectors. This ensures that at least one of each type of charging system is accessible so that all users have access to an accessible charger. The number of accessible charging stations required by this aspect of the scoping will be dependent on the charging stations themselves. If the station can only serve one type of charging system or connector, then "not fewer than one for each type" must be made accessible and multiple stations would be needed and regulated. Conversely, if a single charging station can be used for all charging types and connectors, then that single charging station would be able to satisfy the requirement that each type be accessible.

Section 1107.2.2 requires that the EVCS parking space comply with the van accessible provisions, having a minimum width of 132 inches with an adjoining access aisle at least 60 inches minimum in width. This size requirement coordinates with that specified in Section 502.2 of the ICC A117.1 standard for van accessible spaces.

It is also important to consider the signage provisions of Section 1112.1 when dealing with these EVCSs. Because the new provisions were not included with those for parking in Section 1106, it is appropriate to consider EVCSs as a service similar to the use of gas pumps rather than a parking space. This will also allow for coordination with the signage requirements of Section 1112.1 that do not require these spaces to be identified by a sign with the International Symbol of Accessibility. The EVCS provisions of Section 1107 are not referenced in the signage provisions and are not parking spaces required by Section 1106.

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1108.5, 1110.2

Assisted Toileting and Bathing

CHANGE TYPE: Addition

CHANGE SUMMARY: A series of changes were made to the assisted living and nursing home provisions to allow some units to have toilet and bathing facilities designed for assisted use instead of the independent use generally intended by the ICC A117.1 Accessible unit provisions.

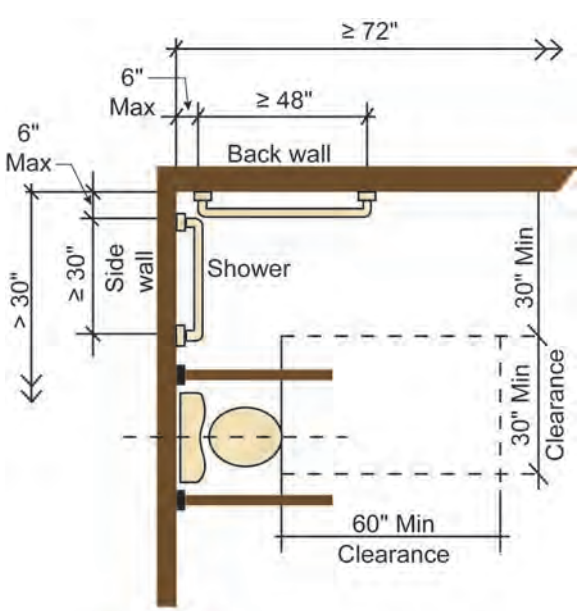
2021 CODE TEXT: ~~**1107.5.1**~~ **1108.5.1 Group I-1.** Accessible units and Type B units shall be provided in Group I-1 occupancies in accordance with Sections ~~1107.5.1.1~~ 1108.5.1.1 and ~~1107.5.1.2~~ 1108.5.1.3.

~~**1107.5.1.1**~~ **1108.5.1.1 Accessible units.** In Group I-1, Condition 1, at least 4 percent, but not less than one, of the dwelling units and sleeping units shall be Accessible units. ~~In Group I-1, Condition 2, at least 10 percent, but not less than one, of the dwelling units and sleeping units shall be Accessible units.~~ Accessible dwelling units and sleeping units shall be dispersed among the various classes of units.

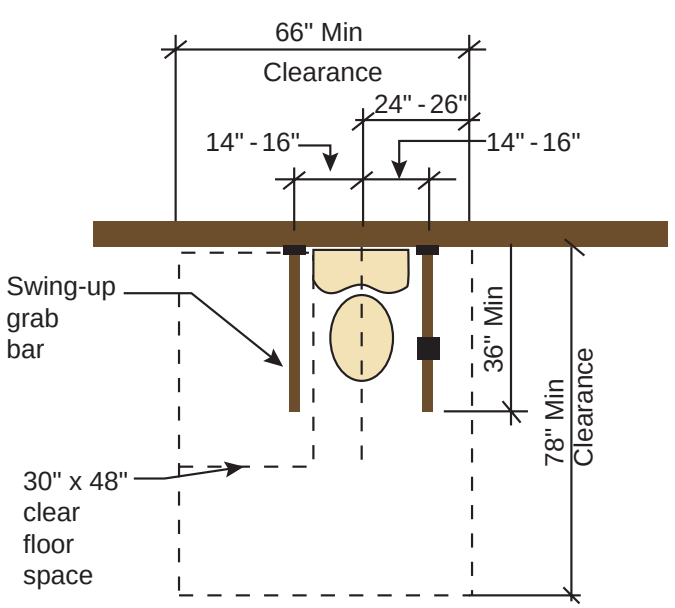
Exceptions:

1. Water closets shall not be required to comply with ICC A117.1 where such water closets comply with Section 1110.2.2, in not more than 50 percent of the Accessible units.
2. Roll-in-type showers shall not be required to comply with ICC A117.1 where roll-in-type showers comply with Section 1110.2.3, in not more than 50 percent of the Accessible units.

1108.5.1.2 Accessible units in Group I-1, Condition 2. In Group I-1, Condition 2, at least 10 percent, but not less than one, of the dwelling units and sleeping units shall be Accessible units. Accessible dwelling units and sleeping units shall be dispersed among the various classes of units.



Assisted bathing using roll-in shower.



Clearances for assisted toileting.

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Exceptions:

1. Water closets shall not be required to comply with ICC A117.1 where such water closets comply with Section 1110.2.2, in not more than 50 percent of the Accessible units.
2. Roll-in-type showers shall not be required to comply with ICC A117.1 where roll-in-type showers comply with Section 1110.2.3, in not more than 50 percent of the Accessible units.

~~**1107.5.2**~~ **1108.5.2 Group I-2 nursing homes.** Accessible units and Type B units shall be provided in nursing homes of Group I-2, Condition 1 occupancies in accordance with Sections ~~1107.5.2.1~~ 1108.5.2.1 and ~~1107.5.2.2~~ 1108.5.2.2.

~~**1107.5.2.1**~~ **1108.5.2.1 Accessible units.** At least 50 percent but not less than one of each type of the dwelling units and sleeping units shall be Accessible units.

Exceptions:

1. Water closets shall not be required to comply with ICC A117.1 where such water closets comply with Section 1110.2.2, in not more than 90 percent of the Accessible units.
2. Roll-in-type showers shall not be required to comply with ICC A117.1 where roll-in-type showers comply with Section 1110.2.3, in not more than 90 percent of the Accessible units,

~~**1107.5.4**~~ **1108.5.4 Group I-2 rehabilitation facilities.** In hospitals and rehabilitation facilities of Group I-2 occupancies that specialize in treating conditions that affect mobility, or units within either that specialize in treating conditions that affect mobility, 100 percent of the dwelling units and sleeping units shall be Accessible units.

Exceptions:

1. Water closets shall not be required to comply with ICC A117.1 where such water closets comply with Section 1110.2.2, in not more than 50 percent of Accessible units.
2. Roll-in-type showers shall not be required to comply with ICC A117.1 where roll-in-type showers comply with Section 1110.2.3, in not more than 50 percent of Accessible units.

~~**1109.2**~~ **1110.2 Toilet and bathing facilities.** Each toilet room and bathing room shall be accessible. Where a floor level is not required to be connected by an accessible route, the only toilet rooms or bathing rooms provided within the facility shall not be located on the inaccessible floor. Except as provided for in Sections ~~1109.2.2~~ 1110.2.4 and ~~1109.2.3~~ 1110.2.5, at least one of each type of fixture, element, control or dispenser in each accessible toilet room and bathing room shall be accessible.

Exceptions:

1. *(No changes)*
2. *(No changes)*
3. *(No changes)*

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4. *(No changes)*
5. *(No changes)*
6. *(No changes)*
7. Where permitted in Section 1108, in toilet rooms or bathrooms serving Accessible units, water closets designed for assisted toileting shall comply with Section 1110.2.2.
8. Where permitted in Section 1108, in bathrooms serving Accessible units, showers designed for assisted bathing shall comply with Section 1110.2.3.

9.~~7.~~ *(No changes)*

1110.2.2 Water closets designed for assisted toileting. Water closets designed for assisted toileting shall comply with Section 1110.2.2.1 through 1110.2.2.6.

1110.2.2.1 Location. The centerline of the water closet shall be not less than 24 inches (610 mm) and not greater than 26 inches (660 mm) from one side of the required clearance.

1110.2.2.2 Clearance. Clearance around the water closet shall comply with Section 1110.2.2.2.1 through 1110.2.2.2.3.

1110.2.2.2.1 Clearance width. Clearance around a water closet shall be not less than 66 inches (1675 mm) in width, measured perpendicularly from the side of the clearance that is not less than 24 inches (610 mm) and not greater than 26 inches (660 mm) from the water closet centerline.

1110.2.2.2.2 Clearance depth. Clearance around the water closet shall be not less than 78 inches (1980 mm) in depth, measured perpendicularly from the rear wall.

1110.2.2.2.3 Clearance overlap. The required clearance around the water closet shall permit overlaps per ICC A117.1, Section 604.3.3.

1110.2.2.3 Height. The height of the water closet seats shall comply with ICC A117.1, Section 604.4.

1110.2.2.4 Swing–up grab bars. Swing-up grab bars shall comply with ICC A117.1, Sections 609.2 and 609.8. Swing-up grab bars shall be provided on both sides of the water closet and shall comply with all of the following:

1. The centerline of the grab bar shall be not less than 14 inches (356 mm) and not greater than 16 inches (405 mm) from the centerline of the water closet.
2. The length of the grab bar is not less than 36 inches (915 mm) in length, measured from the rear wall to the end of the grab bar.
3. The top of the grab bar in the down position is not less than 30 inches (760 mm) and not greater than 34 inches (865 mm) above the floor.

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1110.2.2.5 Flush controls. Flush controls shall comply with ICC A117.1, Section 604.6.

1110.2.2.6 Dispensers. Toilet paper dispensers shall be mounted on at least one of the swing-up grab bars and the outlet of the dispenser shall be located not less than 24 inches (610 mm) and not greater than 36 inches (915 mm) from the rear wall.

1110.2.3 Standard roll-in-type shower compartment designed for assisted bathing. Standard roll-in-type shower compartments designed for assisted bathing shall comply with Section 1110.2.3.1 through 1110.2.3.9.

1110.2.3.1 Size. Standard roll-in-type shower compartments shall have a clear inside dimension of not less than 60 inches (1525 mm) in width and 30 inches (760 mm) in depth, measured at the center point of opposing sides. An entry not less than 60 inches (1525 mm) in width shall be provided.

1110.2.3.2 Clearance. A clearance of not less than 60 inches (1525 mm) in length adjacent to the 60-inch (1525 mm) width of the open face of the shower compartment, and not less than 30 inches (760 mm) in depth, shall be provided.

Exceptions:

1. A lavatory complying with ICC A117.1, Section 606 shall be permitted at one end of the clearance.
2. Where the shower compartment exceeds minimum sizes, the clear floor space shall be placed adjacent to the grab bars and not less than 30 inches from the back wall.

1110.2.3.3 Grab bars. Grab bars shall comply with ICC A117.1, Section 609 and shall be provided in accordance with Section 1110.2.3.3.1 and 1110.2.3.3.2. In standard roll-in-type shower compartments, grab bars shall be provided on three walls. Where multiple grab bars are used, required horizontal grab bars shall be installed at the same height above the floor. Grab bars can be separate bars or one continuous bar.

1110.2.3.3.1 Back-wall grab bar. The back-wall grab bar shall extend the length of the back wall and extend within 6 inches (150 mm) maximum from the two adjacent sidewalls.

Exception: The back-wall grab bar shall not be required to exceed 48 inches (1220 mm) in length. The rear grab bar shall be located with one end within 6 inches maximum of a sidewall with a grab bar complying with Section 110.2.3.3.2.

1110.2.3.3.2 Sidewall grab bars. The sidewall grab bars shall extend the length of the wall and extend within 6 inches (150 mm) of the adjacent back wall.

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Exceptions:

1. The sidewall grab bar shall not be required to exceed 30 inches (760 mm) in length. The side grab bar shall be located with one end within 6 inches (152 mm) of the back wall with a grab bar complying with Section 1110.2.3.3.1.
2. Where the sidewalls are located 72 inches (1830 mm) or greater apart, a grab bar is not required on one of the sidewalls.

1110.2.3.4 Seats. Wall-mounted folding seats shall not be installed.

1110.2.3.5 Controls and hand showers. In standard roll-in-type showers, the controls and hand shower shall be located not less than 38 inches (965 mm) and not greater than 48 inches (1220 mm) above the shower floor. Controls shall be located to facilitate caregiver access.

1110.2.3.6 Hand showers. Hand showers shall comply with ICC A117.1, Section 608.5.

1110.2.3.7 Thresholds. Thresholds shall comply with ICC A117.1, Section 608.6.

1110.2.3.8 Shower enclosures. Shower compartment enclosures for shower compartments shall comply with ICC A117.1, Section 608.7.

1110.2.3.9 Water temperature. Water temperature shall comply with ICC A117.1, Section 608.8.

CHANGE SIGNIFICANCE: Allowances for assisted toileting and bathing are now established where occupants in care facilities may require assistance instead of being able to independently perform these functions. Of special note is that the new technical provisions are addressed in the IBC rather than the ICC A117.1 standard as is typically done. The new provisions are intended to allow for assisted toileting and bathing requirements to be applied as a design option where they better serve the intended population of the care recipients.

For the purposes of application, Sections 1108.5.1, 1108.5.2 and 1108.5.4 provide the scoping requirements that indicate the type of accessible housing units that are required for Group I-1 and I-2 assisted living facilities, nursing homes and rehabilitation facilities. Generally, the Accessible units that are required in these facilities are to be designed to allow independent access to the toilet and bathing facilities as is established in the Accessible dwelling unit provisions of Section 1102 of the ICC A117.1 standard. Exceptions to Sections 1108.5.1, 1108.5.2 and 1108.5.4 now modify the percentage of units that must be constructed to the Accessible unit requirements and allow a specified percentage of those units to comply with the modified toileting and bathing provisions so assistance with those tasks can be more easily performed. Therefore, the scoping in Sections 1108.5.1, 1108.5.2 and 1108.5.4 will indicate how many of the Accessible units may be modified, while Sections 1110.2.2 and 1110.2.3 will provide the technical criteria necessary to make the water closet and roll-in shower usable by the care

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recipient and care provider. The two new exceptions in Section 1110.2 simply coordinate with the previously mentioned scoping sections and allow for the assisted toileting and bathing facilities to comply with the new provisions in Section 1110.2.2 and 1110.2.3 instead of the basic Accessible unit requirements.

Under normal circumstances, the IBC provides the scoping requirements (what, where and how many) while the ICC A117.1 standard provides the technical requirements (how things are made accessible). Because the research regarding assisted toileting and bathing was only recently completed, and the differing and overlapping code change cycles between the IBC and the A117.1, both scoping and technical provisions were included in the IBC.

One key aspect is that the provisions are optional. As the scoping provisions in Sections 1108.5.1, 1108.5.2 and 1108.5.4 indicate, these are exceptions and can be applied if desired by the designer. In addition, the exceptions allow the designer to modify a limited number of the Accessible units for assisted toileting and bathing depending on the needs of the clients. By providing separate exceptions for the toileting provision and the bathing provision, the designs may modify either one or both of those functions for assistance as needed. A unit will not need to be modified for both toileting and bathing simply because they elect to modify one of the uses.

The primary technical changes to Section 1110.2 include the following: (a) the increased clearance width around the water closet of 66 inches with the clearance being measured 24 to 26 inches from the centerline of the fixture, (b) an increased clearance depth of 78 inches to allow additional approach options, (c) the allowance for swing-up grab bars that typically are only permitted in Type B units, and (d) a toilet paper dispenser to be installed on at least one of the swing-up grab bars. The increased space and clearance to the sides of the water closet along with the swing-up grab bars will allow either additional room for the staff to get along side the fixture and assist the user or provide the user grab bars and a clear floor space to accomplish a traditional side transfer. The use of the swing-up grab bars is allowed since the wall opposite the transfer is greater than the usual 16-inch to 18-inch distance from the centerline of the water closet.

The primary technical change regarding the shower is the elimination of the requirement for a folding seat to be installed. In the permitted care facilities, the seat is being eliminated because if residents cannot stand for their shower, a portable rolling shower chair will typically be used. Eliminating the folding seat and using a rolling chair gives a caregiver additional space to maneuver around to assist the patient and bathe their back and sides. With the elimination of the seat, the side-wall and back-wall grab bars will also differ, with a side-wall bar being required on what would have generally been the seat wall, and both grab bars starting in the corner.

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1110.6

Bottle Filling Stations

CHANGE TYPE: Addition

CHANGE SUMMARY: Where provided, bottle filling stations must now be accessible.

2021 CODE TEXT: **1110.6 Bottle-filling stations.** Where bottle-filling stations are provided, they shall be accessible.

> **Exception:** Bottle-filling stations over drinking fountains for standing persons are not required to be accessible, provided that bottle-filling stations are also located over the drinking fountains for persons using wheelchairs.

CHANGE SIGNIFICANCE: Water bottle-filling stations are becoming a common feature in an effort to reduce the use of disposable bottles. While some of the bottle-filling stations are installed independently, the majority of them are typically located in conjunction with drinking fountains. It is important to note that this new requirement will not require the bottle filling stations to be installed but will ensure they are made accessible "where . . . provided."

Section 602.4 of the ICC A117.1 standard contains the technical requirements to make the bottle-filling stations accessible, addressing the need for a clear floor space for either a forward or side approach and controls that comply with the general operable parts requirements of ICC A117.1, Section 309.

Where bottle-filling stations are located over a drinking fountain, the accessible element will need to be located over the drinking fountain in a manner that meets the required reach ranges for persons using a wheelchair (A117.1, Section 602.2). Where bottle fillers are provided over both the high and the low drinking fountains, the bottle-filling station over the drinking fountain installed for standing persons is not required to be accessible. Bottle fillers over both drinking fountains creates a redundant condition and therefore, it reasonably does not need to be made accessible.



International Code Council

Bottle-filling stations at drinking fountains.

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1110.13.2
Service Windows

CHANGE TYPE: Clarification

CHANGE SUMMARY: Sales and service counters now specifically address windows, and such elements are to be accessible whether or not a counter is provided at that location.

2021 CODE TEXT: ~~**1109.12.3**~~ **1110.13.2** ~~**Point of sale**~~ **Sales and service counters and windows.** Where counters or windows are provided for ~~sales~~ sale or distribution of goods or services, at least one of each type of counter and window provided shall be accessible. Where such counters or windows are dispersed throughout the building or facility, accessible counters or windows shall also be dispersed.

CHANGE SIGNIFICANCE: In the ICC A117.1, Section 904.3 was modified to provide clearer technical criteria for sales and service counters and windows. As a result, IBC 1110.13.2 was clarified to make such elements accessible. While the majority of technical revisions distinguished the requirements between the employee and customer side of the counters, additional changes included the line of sight requirements needed between the customer and the employee as well as addressing the application to sales or service windows where no customer counter is provided.

The addition of the term "windows" into this section clarifies that sales and service windows are required to be accessible whether a counter is provided at that location or not. An example would be a ticket window at a movie theater or a window at an information/security desk located in a building's entry lobby.



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Sales/service windows.

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While sales and service windows are expected to be accessible—whether there is a counter associated with the window or not—having the term "window" prominent in the code text may also help to remind users of the visual connection requirement that Section 904.3.1 of the A117.1 expects to exist between the customer and the sales or service staff.

Additional information related to the sales and service counter and window requirements of the A117.1 standard can be found in both the *ICC A117.1-2017 Commentary* and the *Significant Changes to the ICC A117.1 Accessibility Standard*.



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Sales/service windows.

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1110.15
Operable Parts

CHANGE TYPE: Modification

CHANGE SUMMARY: A new reference to the operable parts provisions of ICC A117.1 allows the removal of like exceptions from the IBC.

2021 CODE TEXT: ~~**1109.13**~~ **1110.15 Controls, operating mechanisms and hardware.** Controls, operating mechanisms and hardware intended for operation by the occupant, including switches that control lighting and ventilation and electrical convenience outlets, in accessible spaces, along accessible routes or as parts of accessible elements shall be accessible.

Exceptions:

1. Operable parts that are intended for use only by service or maintenance personnel shall not be required to be accessible.
2. ~~Electrical or communication receptacles serving a dedicated use shall not be required to be accessible.~~
3. ~~Where two or more outlets are provided in a kitchen above a length of counter top that is uninterrupted by a sink or appliance, one outlet shall not be required to be accessible.~~
4. ~~Floor electrical receptacles shall not be required to be accessible.~~
5. ~~HVAC diffusers shall not be required to be accessible.~~
6. ~~Except for light switches, where redundant controls are provided for a single element, one control in each space shall not be required to be accessible.~~

2.~~7.~~ Access doors or gates in barrier walls and fences protecting pools, spas and hot tubs shall be permitted to comply with Section 1010.2.3.

3. Operable parts exempted in accordance with ICC A117.1 are not required to be accessible.



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Accessible operable control.

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CHANGE SIGNIFICANCE: For coordination purposes, five exceptions have been deleted from the IBC as they are listed in Section 309.1 of the ICC A117.1 standard. The deletion of these items from the IBC will not only eliminate redundancy and confusion but will also help keep the two documents coordinated over time. Because the deleted exceptions are found in ICC A117.1, there is no change in the IBC's application.

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PART 6

Building Envelope, Structural Systems and Construction Materials

Chapters 12 through 26



- **Chapter 12** Interior Environment
- **Chapter 13** Energy Efficiency
  No changes addressed
- **Chapter 14** Exterior Walls
- **Chapter 15** Roof Assemblies and Rooftop Structures
- **Chapter 16** Structural Design
- **Chapter 17** Special Inspections and Tests
- **Chapter 18** Soils and Foundations
- **Chapter 19** Concrete
- **Chapter 20** Aluminum
  No changes addressed
- **Chapter 21** Masonry
- **Chapter 22** Steel
- **Chapter 23** Wood
- **Chapter 24** Glass and Glazing
  No changes addressed
- **Chapter 25** Gypsum Board, Gypsum Panel Products, and Plaster
- **Chapter 26** Plastic
  No changes addressed

The interior environment provisions of Chapter 12 include requirements for lighting, ventilation and sound transmission. Chapter 13 provides a reference to the *International Energy Conservation Code* for provisions governing energy efficiency. Regulations governing the building envelope are located in Chapters 14 and 15, addressing exterior wall coverings and roof coverings, respectively. Structural systems are regulated through the structural design provisions of Chapter 16, while structural testing and special inspections are addressed in Chapter 17. The provisions of Chapter 18 apply to soils and foundation systems. The requirements for materials of construction, both structural and non-structural, are located in Chapters 19 through 26. Structural materials regulated by the code include concrete, lightweight metals, masonry, steel and wood. Glass and glazing, gypsum board, plaster and plastics are included as regulated non-structural materials. ■

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1202.3

Insulation of Unvented Attics

CHANGE TYPE: Modification

CHANGE SUMMARY: A new option is available for the regulation of unvented attics with air-permeable insulation and vapor diffusion ports in warmer climates.

2021 CODE TEXT: **1202.3 Unvented attic and unvented enclosed rafter assemblies.** Unvented attics and unvented enclosed roof framing assemblies created by ceilings applied directly to the underside of the roof framing members/rafters and the structural roof sheathing at the top of the roof framing members shall be permitted where all of the following conditions are met:

1-4. *(no changes)*

5. Insulation shall ~~be located in accordance with the following~~: comply with either Item 5.1 or 5.2, and additionally Item 5.3.

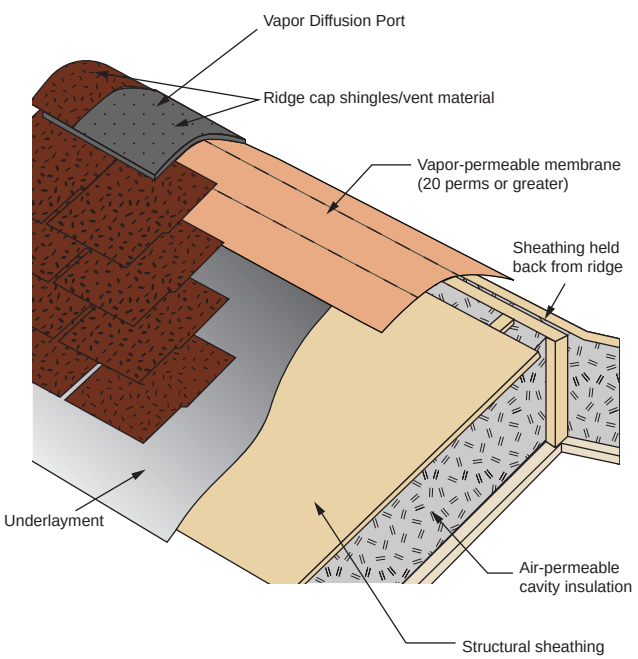
5.1 *(no changes)*

5.2. In Climate Zones 1, 2 and 3, air-permeable insulation installed in unvented attics shall meet the following requirements:

5.2.1. A vapor diffusion port shall be installed not more than 12 inches (305mm) from the highest point of the roof, measured vertically from the highest point of the roof to the lower edge of the port.

5.2.2. The port area shall be greater than or equal to 1/600 of the ceiling area. Where there are multiple ports in the attic, the sum of the port areas shall be greater than or equal to the area requirement.

5.2.3. The vapor-permeable membrane in the vapor diffusion port shall have a vapor permeance rating of greater than or equal to 20 perms when tested in accordance with Procedure A of ASTM E96.



Vapor diffusion ports above an unvented attic.

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5.2.4. The vapor diffusion port shall serve as an air barrier between the attic and the exterior of the building.

5.2.5. The vapor diffusion port shall protect the attic against the entrance of rain and snow.

5.2.6. Framing members and blocking shall not block the free flow of water vapor to the port. Not less than a 2-inch (50 mm) space shall be provided between any blocking and the roof sheathing. Air-permeable insulation shall be permitted within that space.

5.2.7. The roof slope shall be greater than or equal to 3 units vertical in 12 units horizontal (3:12).

5.2.8. Where only air-permeable insulation is used, it shall be installed directly below the structural roof sheathing, on top of the attic floor, or on top of the ceiling.

5.2.9. Where only air-permeable insulation is used and is installed directly below the structural roof sheathing, air shall be supplied at a flow rate greater than or equal to 50 cubic feet per minute (23.6 L/s) per 1000 square feet (93 m^2) of ceiling.

~~**5.2**~~ **5.3.** The air shall be supplied from ductwork providing supply air to the occupiable space when the conditioning system is operating. Alternatively, the air shall be supplied by a supply fan when the conditioning system is operating. Where preformed insulation board is used as the air-impermeable insulation layer, it shall be sealed at the perimeter of each individual sheet interior surface to form a continuous layer.

202 VAPOR DIFFUSION PORT. An assembly constructed or installed within a roof assembly at an opening in the roof deck to convey water vapor from an unvented attic to the outside atmosphere.

CHANGE SIGNIFICANCE: To assist with energy efficiency, unvented attic assemblies are an alternative to ventilated attic spaces. The assemblies are typically constructed with spray polyurethane foam applied directly to the underside of the roof deck, or they may be insulated over the top of the roof deck with rigid insulation boards. In regions at risk from wildfires, the elimination of eave vents and air sealing of the vents at ridges reduces the entry of embers into the attic. The elimination of roof vents in hurricane-prone regions reduces the entry of rainwater during hurricanes.

Blown cellulose, fiberglass batts and blown fiberglass have been added as options for insulating unvented attic assemblies. This new assembly is limited to warmer areas, specifically Climate Zones 1, 2 and 3, and requires a vapor diffusion port. The port acts as a moisture control measure, allowing moisture in the attic to be removed by vapor diffusion rather than by air change. Moisture laden air is more buoyant than dry air and accumulates at the ridge, then exits via the vapor diffusion ports, allowing the attic assembly to remain airtight while providing a path for moisture reduction.

The use of this method also allows insulation to be installed directly to the underside of the roof deck or at the floor/ceiling level of the attic assembly. Section 1202.3 provides guidance on the location of vapor diffusion ports within the roof assembly and clarifies that the vapor diffusion port contains a membrane material that is both vapor-permeable and water-resistive. The definition of a vapor diffusion port has also been added to Chapter 2 to clarify that the port is an element of the attic space and installed within the roof deck.

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1207

Enhanced Classroom Acoustics

CHANGE TYPE: Addition

CHANGE SUMMARY: Educational occupancies are now required to meet the enhanced classroom acoustic requirements of Section 808 of ICC A117.1.

2021 CODE TEXT:

SECTION 1207 ENHANCED CLASSROOM ACOUSTICS

1207.1 General. Enhanced classroom acoustics, where required in this section, shall comply with Section 808 of ICC A117.1.

1207.2 Where required. In Group E occupancies, enhanced classroom acoustics shall be provided in all classrooms with a volume of 20,000 cubic feet (566 m^3) or less.

CHANGE SIGNIFICANCE: Good classroom acoustics are essential to support language acquisition and learning for all children, particularly younger children. There are three primary styles of learning in a classroom: visual, auditory and kinesthetic or tactile. Visual learning is a teaching and learning style in which ideas, concepts, data and other information are associated with images. This style highlights the importance of good lighting in classrooms, so students can read or see different images.

Auditory learning is a learning style in which a person learns through listening. An auditory learner depends on hearing and speaking. In the instruction of auditory learners, teachers use techniques such as verbal direction, group discussions, verbal reinforcement, group activities, reading aloud and putting information into a rhythmic pattern such as a rap, poem or song. The third style, kinesthetic or tactile learning, is learning while carrying out a physical activity, such as physical manipulation or experiments. Learning modality strengths can occur independently or in combination, they can change over time and they become ingrained with age. It is estimated that auditory learners make up about 30 percent of the population.



Photo courtesy of skynesher

Classroom acoustics are based on ceiling, wall and floor materials.

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For children who have hearing loss and those who use cochlear implants, there is no substitute for a good acoustic environment. Assistive technologies typically only amplify the teacher and do not amplify discussions among children or between the teacher and individual child. Additionally, children with disabilities not related to hearing, such as autism and learning disabilities, may be adversely affected by high ambient-noise levels, while students learning English also benefit from clear speech and low background noise.

The new enhanced acoustic requirements only apply to those rooms where the volume doesn't exceed 20,000 cubic feet. Assuming a 10-foot ceiling height, classrooms of up to 2000 square feet are required to meet these requirements. The criteria in ICC A117.1, Section 808 are intended to be applicable to standard-sized self-contained classrooms, while not including larger spaces used for activities such as band and choir. The criteria are not intended to apply to ancillary learning spaces, such as individual tutoring spaces, corridors or a cafeteria.

A classroom is limited to a maximum reverberation time for classroom acoustics, determined through the measurement of room performance or by a calculation based on materials on the floor, ceiling and walls. Performance in a fully furnished, unoccupied classroom should include a maximum reverberation time of 0.6-0.7 seconds, depending upon the size of the classroom, and a maximum background noise of either 35 dBA (A-weighted sound pressure level) or 55 dBC (C-weighted sound pressure level). The ambient sound levels must be measured in both dBA and dBC. The dBA filter measures mid-range frequencies, while the dBC filter measures low and high frequencies.

Reverberation time measures how quickly sound decays in a room. The volume of the space and the surfaces in the room will affect the reverberation time. The intent of the 0.6 to 0.7 second reverberation time is to increase the sound level from the teacher throughout the room while maintaining clarity. ASTM E2235, *Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods*, is used for testing sound decay rates.

The prescriptive calculation requires noise reduction coefficient (NRC) ratings for every surface finish, including finishes on the floor, ceiling and all walls. Ratings range from zero to one, with one indicating the surface absorbs most of the speech sound energy and zero indicating the surface reflects most of the speech sound energy. The NRC for each material is multiplied by the square footage of that material. The surface area of these materials are to be subtracted from the area of the mounting surface – for example, if a wall is 10 feet in length by 10 feet in height, and two 2-foot by 10-foot panels are attached to the wall, the calculation would be based on 60 square feet of uncovered wall and 40 square feet of panels.

The ICC A117.1 criterion also considers other sound sources including ambient sound sources outside the classrooms. These sources may include playground noises, airplane or traffic sources and student movement in hallways. There are multiple ways to mitigate these issues. Some outdoor environment sources can be addressed by careful placement of the classrooms on the site or through the choice of the exterior materials for walls and roofs. Building noises can be mitigated by the proper selection of wall systems, location of doors and placement of mechanical systems.

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1208.4

Efficiency Dwelling Units

CHANGE TYPE: Modification

CHANGE SUMMARY: The minimum required floor area of an efficiency dwelling unit has been reduced to 190 square feet, and a definition of an efficiency dwelling unit has been added.

2021 CODE TEXT: ~~**1207.4**~~ **1208.4 Efficiency dwelling units.** ~~An efficiency living unit~~ Efficiency dwelling units shall conform to the requirements of the code except as modified herein:

1. The unit shall have a living room of not less than ~~220~~ 190 square feet (~~20.4 m^2~~ 17.7m^2) of floor area. ~~An additional 100 square feet (9.3 m^2) of floor area shall be provided for each occupant of such unit in excess of two.~~
2. The unit shall be provided with a separate closet.
3. ~~The~~ For other than Accessible, Type A and Type B dwelling units, the unit shall be provided with a kitchen sink, cooking appliance and ~~refrigeration facilities~~ refrigerator, each having a clear working space of not less than 30 inches (762 mm) in front. Light and ventilation conforming to this code shall be provided.
4. The unit shall be provided with a separate bathroom containing a water closet, lavatory and bathtub or shower

Dwelling unit, efficiency. A dwelling unit where all permanent provisions for living, sleeping, eating and cooking are contained in a single room.



Photo courtesy of Paul Vinten

Studio apartment with a single primary living space.

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CHANGE SIGNIFICANCE: Efficiency dwelling units are better known as studio apartments, where a single room is utilized for all living, sleeping, dining and cooking activities. A new definition reflects this single-space concept. It has also been clarified that an efficiency unit is a specific type of dwelling unit and would be regulated as such where scoped throughout the IBC. In prior codes, it was represented as an undefined living unit.

Previously, the approach to occupant load determination was inconsistent with the general method established in Chapter 10 "Means of Egress." Rather than basing the design occupant load on the floor area of the unit, the size of the unit varied based on the actual occupant load. No code path was available for an occupant load exceeding two occupants unless the gross square footage of the efficiency dwelling unit exceeded 320 square feet. This methodology has been deleted, based in part on the assumption that no more than two people occupy the unit. The minimum required living room floor area for an efficiency dwelling unit has been decreased from 220 square feet to 190 square feet of floor area, aligned and consistent with Section 1208.3 for a dwelling unit's minimum required floor area (equal to two rooms, one of 120 square feet and a second of 70 square feet).

Comparison of Dwelling Units

Dwelling Unit	Standard	Efficiency
Primary Room – Minimum Size	120 ft^2	190 ft^2
Other Rooms – Minimum Size	70 ft^2	Not Applicable
Cooking Facilities?	Yes	Yes
Sanitation Facilities?	Yes	Yes
Closet?	Not required in primary room	Yes

Note that a standard dwelling unit assumes multiple rooms within the unit.

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1210.3

Restroom Privacy

CHANGE TYPE: Addition

CHANGE SUMMARY: Concerns regarding privacy within public restrooms have been addressed by requiring a screening element at the entry to the restroom.

2021 CODE TEXT: ~~**1209.3**~~ **1210.3 Privacy.** Public restrooms shall be visually screened from outside entry or exit doorways to ensure user privacy within the restroom. This provision shall also apply where mirrors would compromise personal privacy. Privacy at water closets and urinals shall be provided in accordance with Sections 1210.3.1 and 1210.3.2.

> **Exception:** Visual screening shall not be required for single-occupant toilet rooms with a lockable door.

CHANGE SIGNIFICANCE: For some time, Section 1210.3 has required sidewall or partition urinal privacy in restrooms but has not previously addressed privacy from passersby outside restroom facilities. A requirement for a screening wall or other obscuring measure in the entry to the facilities has been added. The placement of mirrors within the facility has also been addressed to deal with reflections from within the room to the outside area.

See Chapter 29 of the 2021 IBC for additional changes to public restrooms addressing installation of fixtures and water closets.



Photo courtesy of baona

Screen at restroom entry.

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1404.3 Vapor Retarders

CHANGE TYPE: Modification

CHANGE SUMMARY: Vapor retarder provisions have been reorganized and thresholds clarified for when a vapor retarder is required and which retarder is required as well as location and climate zone requirements.

2021 CODE TEXT: **1404.3 Vapor retarders.** Vapor retarder materials shall be classified in accordance with Table 1404.3(1). A vapor retarder shall be provided on the interior side of frame walls in accordance with Tables 1404.3(2) and 1404.3(3), or an approved design using accepted engineering practice for hygrothermal analysis. The appropriate climate zone shall be selected in accordance with Chapter 3 of the *International Energy Conservation Code*. ~~Vapor retarders as described in Section 1404.3.3 shall be provided in accordance with Sections 1404.3.1 and 1404.3.2, or an approved design using accepted engineering practice for hygrothermal analysis.~~

TABLE 1404.3(1) Vapor Retarder Materials and Classes

Vapor Retarder Class	Acceptable Materials
I	Sheet polyethylene, nonperforated aluminum foil, or other approved materials with a perm rating of less than or equal to 0.1
II	Kraft-faced fiberglass batts or vapor retarder paint or other approved materials, applied in accordance with the manufacturer's instructions for a perm rating greater than 0.1 and less than or equal to 1.0
III	Latex paint, enamel paint, or other approved materials, applied in accordance with the manufacturer's instructions for a perm rating of greater than 1.0 and less than or equal to 10

TABLE 1404.3(2) Vapor Retarder Options

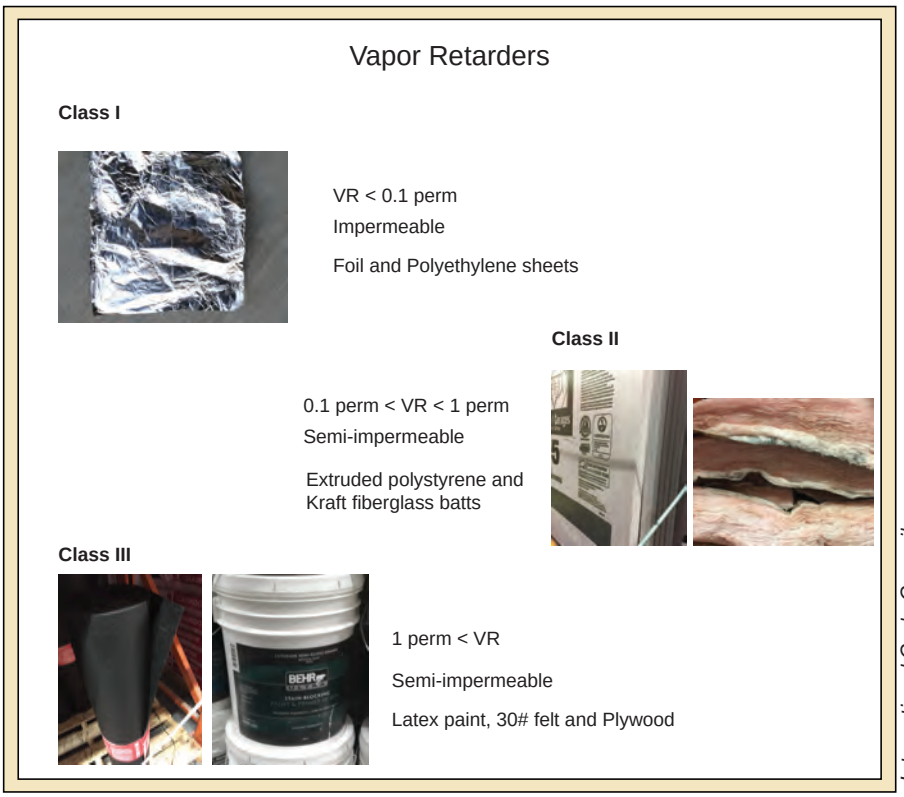
	Vapor Retarder Class		
Climate Zone	I	II	III[a]
1, 2	Not permitted	Not permitted	Permitted
3, 4 (except Marine 4)	Not permitted	Permitted	Permitted
Marine 4, 5, 6, 7, 8	Permitted	Permitted	See Table 1404.3(3)

a. See also Section 1404.3.2

CHANGE SIGNIFICANCE: Vapor retarder provisions have been reorganized to make them more user-friendly, utilizing new tables and text to assist the designer in selecting appropriate vapor retarders for the climatic conditions and desired vapor retarder class.

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Class I, II and III vapor retarders.

Some vapor retarders do not fit neatly into categories defined by vapor permeability measurements alone. Prohibition of certain vapor retarder classes in specific climate zones is based on the need to provide assemblies the ability to dry to the interior. However, if a vapor retarder has vapor permeability that increases with relative humidity to a Class III level, it will allow drying and should not be prohibited.

While there is adequate experience in cold climates in the U.S. and Canada to justify the use of a Class I interior vapor retarder, for example, a 4-mil polyethylene, with foam plastic insulating sheathing on the exterior side of an assembly, a design for the double vapor barrier assembly must be submitted for approval. Due to concerns with a low drying potential, walls using a double vapor barrier, in other words, a Class I vapor retarder on both sides, must be accompanied by air sealing details and a drainage plane to minimize the potential for water leakage or moisture accumulation. Thus, the use of a double vapor barrier assembly may require some additional considerations to ensure performance.

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CHANGE TYPE: Modification

CHANGE SUMMARY: New Table 1404.3.1 assigns minimum continuous insulation *R*-values where Class II vapor retarders are installed.

2021 CODE TEXT: **1404.3.1 Class I and II vapor retarders.** ~~Class I and II vapor retarders shall not be provided on the interior side of frame walls in Zones 1 and 2. Class I vapor retarders shall not be provided on the interior side of frame walls in Zones 3 and 4 other than Marine 4. Class I or II vapor retarders shall be provided on the interior side of frame walls in Zones 5, 6, 7, 8 and Marine 4. The appropriate zone shall be selected in accordance with Chapter 3 [CE] of the *International Energy Conservation Code*-Commercial Provisions.~~ Where a Class II vapor retarder is used in combination with foam plastic insulating sheathing installed as continuous insulation on the exterior side of frame walls, the continuous insulation shall comply with Table 1404.3.1 and the Class II vapor retarder shall have a vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B). Use of a Class I interior vapor retarder in frame walls with a Class I vapor retarder on the exterior side shall require an approved design.

Exceptions:

1. Basement walls.
2. Below-grade portion of any wall.
3. Construction where accumulation, condensation or freezing of moisture will not damage the materials.
4. ~~Conditions where Class III vapor retarders are required in Section 1404.3.2.~~
4. Class I and II vapor retarders with vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B) shall be allowed on the interior side of any frame wall in all climate zones.

TABLE 1404.3.1 Continuous Insulation with Class II Vapor Retarder

Climate Zone	Permitted Conditions[a]
3	Continuous insulation with *R*-value ≥ *R*-2
4, 5, and 6	Continuous insulation with *R*-value ≥ *R*-3 over 2 × 4 wall Continuous insulation with *R*-value ≥ *R*-5 over 2 × 6 wall
7	Continuous insulation with *R*-value ≥ *R*-5 over 2 × 4 wall Continuous insulation with *R*-value ≥ *R*-7.5 over 2 × 6 wall
8	Continuous insulation with *R*-value ≥ *R*-7.5 over 2 × 4 wall Continuous insulation with *R*-value ≥ *R*-10 over 2 × 6 wall

a. In addition to the vapor retarder, spray foam with a maximum permeance of 1.5 perms at the installed thickness, applied to the interior cavity side of wood structural panels, fiberboard, insulating sheathing or gypsum is deemed to comply with the continuous insulation requirement only for the moisture control purposes of this table where the spray foam *R*-value plus any continuous insulation *R*-value provided equals or exceeds the specified continuous insulation *R*-value.

Table 1404.3.1

Class II Vapor Retarders



International Code Council

Kraft-paper-backed fiberglass. insulation is a Class II vapor retarder.

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CHANGE SIGNIFICANCE: Section 1404.3 now allows the use of a Class II interior vapor retarder where foam plastic insulating sheathing is used as continuous insulation on the exterior of buildings where appropriate for climate and use. This modified provision coordinates requirements for vapor retarders with typical insulation requirements found in the *International Energy Conservation Code* for wood-framed wall assemblies, assuring that an adequate amount of continuous insulation is used together with a Class II interior vapor retarder to keep wall interiors sufficiently warm to control condensation and moisture accumulation.

The use of a Class II interior vapor retarder with foam sheathing on the exterior provides a stable and dry wall assembly. Using Class II vapor retarders, research has found stable moisture content levels, and their use does not seem to alter the ability of walls with exterior foam sheathing to dry out. Consequently, a combination of exterior insulation and a Class II vapor retarder is allowed, increasing the *R*-value with minimal changes in construction practice. Spray foam used to satisfy continuous insulation requirements is intended to be used for moisture control.

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1404.3.2

Class III Vapor Retarders

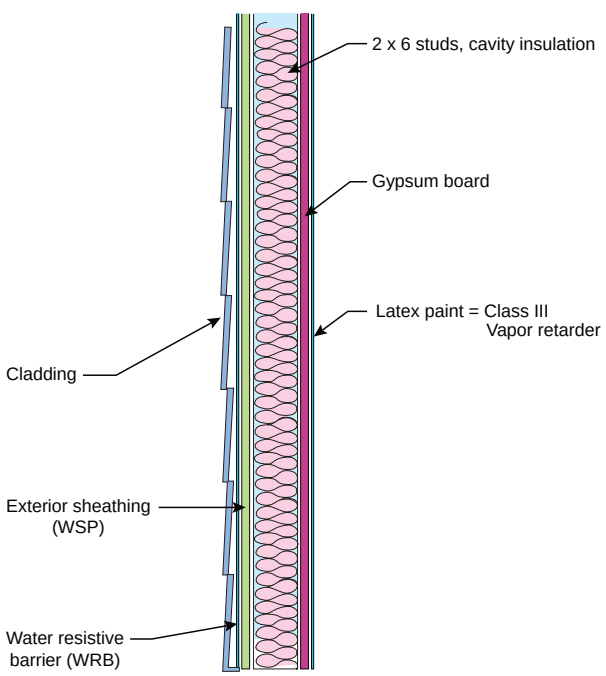
CHANGE TYPE: Modification

CHANGE SUMMARY: The appropriate use of Class III vapor retarders with spray foam insulation has been clarified.

2021 CODE TEXT: **1404.3.2 Class III vapor retarders.** ~~Class III vapor retarders shall be permitted where for any one of the conditions in Table 1404.3.2 is met.~~ Only Class III vapor retarders shall be used on the interior side of frame walls where foam plastic insulating sheathing with a perm rating of less than 1 is applied in accordance with Table ~~1404.3.2~~ 1404.3(3) on the exterior side of the frame wall.

1404.3.2.1 Spray foam plastic insulation for moisture control with Class III vapor retarders. For purposes of compliance with Table 1404.3(3), spray foam with a maximum permeance of 1.5 perms at the installed thickness applied to the interior cavity side of wood structural panels, fiberboard, insulating sheathing or gypsum shall be deemed to meet the continuous insulation *R*-value requirement where the spray foam *R*-value meets or exceeds the specified continuous insulation *R*-value.

1404.3.2.1.1 Hybrid insulation for moisture control with Class III vapor retarders. For the purposes of compliance with Table 1404.3(3), the combined *R*-values of spray foam plastic insulation and continuous insulation shall be permitted to be counted towards the continuous *R*-value requirement.



Wall with Class III vapor retarder.

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TABLE ~~1404.3.2~~ 1404.3(3) Class III Vapor Retarders

Zone	Class III Vapor Retarders Permitted for:[a,b]
~~Marine~~ 4	Vented cladding over wood structural panels
	Vented cladding over fiberboard
	Vented cladding over gypsum
	Continuous insulation with *R*-value ≥ *R*-2.5 over 2 × 4 wall
	Continuous insulation with *R*-value ≥ *R*-3.75 over 2 × 6 wall
7 ~~and 8~~	Continuous insulation with *R*-value ≥ *R*-10 over 2 × 4 wall
	Continuous insulation with *R*-value ≥ *R*-15 over 2 × 6 wall
8	Continuous insulation with *R*-value ≥ *R*-12.5 over 2 × 4 wall
	Continuous insulation with *R*-value ≥ *R*-20 over 2 × 6 wall

a. ~~Spray foam with a maximum permanence of 1.5 perms at the installed thickness applied to the interior cavity side of wood structural panels, fiberboard, insulating sheathing or gypsum is deemed to meet the continuous insulation requirement where the spray foam *R*-value meets or exceeds the specified insulating sheathing *R*-value.~~ Vented cladding shall include vinyl lap siding, polypropylene, or horizontal aluminum siding, brick veneer with airspace as specified in this code, and other approved vented claddings.

b. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class III vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of the *International Energy Conservation Code.*

(No changes to portions of table not shown)

CHANGE SIGNIFICANCE: A revised table and new text are provided to assist designers in selecting appropriate vapor retarders for the climatic conditions and desired vapor retarder class. Class III vapor retarders with foam sheathing are now addressed in a manner consistent with provisions in the *International Residential Code*. Table 1404.3(3) mandates continuous insulation for moisture control but provides an exception for spray foam in the cavity. The *International Energy Conservation Code* includes hybrid insulation systems with a combination of cavity and continuous insulation. Charging language has been added for the combination of insulating methods to provide moisture control where the total required *R*-value is achieved by continuous, cavity or a combination of insulation strategies.

Modifications to Table 1404.3(3) include the use of Zone 4, rather than Marine 4, for the first category. The Marine 4 climate zone is a warmer-in-winter climate zone than the rest of Climate Zone 4. When conditions are necessary to control water vapor in Marine 4, they should also be required in all of Climate Zone 4, especially in the moist (A) regions of Climate Zone 4. Climate Zone 8 was not intended to be included with Climate Zone 7. Climate Zone 8 is a colder climate and requires additional continuous insulation to maintain proper moisture control and equivalent performance. Climate Zone 8 now requires a higher degree of insulation.

Class III vapor retarders are also permitted in Climate Zones 1-3 without necessary compliance with the conditions in Table 1404.3(3) intended for colder climates. Latex paint often complies as a Class III vapor retarder and is commonly used in all climate zones for an interior finish,

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even if not declared to be a Class III vapor retarder. Where paints are used as vapor retarders, they must be applied in accordance with the manufacturer's instructions to achieve the required perm rating for the vapor retarder class. Misuse or misapplication of paints that are not specifically recommended for use as vapor retarders has been shown to increase the risk of moisture problems in walls requiring Class III vapor retarders. Some paint applications may have a water vapor permeance of more than three times the maximum limit for Class III vapor retarders. As a result, walls designed with Class III vapor retarders can experience an increased risk of moisture accumulation problems. Paints should be verified to be acceptable Class III barriers when intended to be used as a vapor barrier.

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1406.10

Metal Composite Material Cladding

CHANGE TYPE: Modification

CHANGE SUMMARY: From an application perspective, requirements for metal composite materials installed on exterior walls of buildings of Type I, II, III and IV construction have been significantly simplified and limited by the deletion of the alternate conditions previously set forth in Section 1406.11.

2021 CODE TEXT: **1406.10 Type I, II, III and IV construction.** Where installed on buildings of Type I, II, III and IV construction, metal composite material (MCM) ~~MCM systems~~ shall comply with Sections 1406.10.1 and ~~1406.10.4, or Section 1406.11.~~ 1406.10.2 for installations up to 40 feet (12 192 mm) above grade plane. Where installed on buildings of Type I, II, III and IV construction, MCMs and MCM systems shall comply with Sections 1406.10.1 through 1406.10.3, for installations greater than 40 feet (12 192 mm) above grade plane.

1406.10.1 Surface-burning characteristics. MCM shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 450 when tested ~~as an assembly~~ in the maximum thickness intended for use in accordance with ASTM E84 or UL 723.

1406.10.2 Thermal barriers. MCM shall be separated from the interior of a building by an approved thermal barrier consisting of ½-inch (12.7 mm) gypsum wallboard or material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.



International Code Council

MCM use for cladding of an urban building.

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~~**1406.10.3 Thermal barrier not required.**~~

Exceptions:

1. The MCM system is specifically approved based on tests conducted in accordance with NFPA 286 and with the acceptance criteria of Section 803.1.1.1, UL 1040 or UL 1715. Such testing shall be performed with the MCM in the maximum thickness intended for use. The MCM system shall include seams, joints and other typical details used in the installation and shall be tested in the manner intended for use.
2. The MCM is used as elements of balconies and similar projections, architectural trim or embellishments.

~~**1406.10.4**~~ **1406.10.3 Full-scale tests.** The MCM system shall be tested in accordance with, and comply with, the acceptance criteria of NFPA 285. Such testing shall be performed on the MCM system with the MCM in the maximum thickness intended for use.

(The deleted text of Section 1406.11 providing for alternate conditions is not included for clarity.)

CHANGE SIGNIFICANCE: A metal composite material (MCM) is a factory manufactured panel consisting of metal skins bonded to both sides of a solid plastic core. Recent global fire events have raised multiple questions regarding the use of MCM panels on exterior walls of Type I, II, III and IV construction. Although many, if not all, of the fires have involved wall assemblies that did not comply with provisions of the IBC, it was deemed necessary to evaluate the current regulation of such assemblies and revise the provisions to address current thinking. From an application perspective, the requirements have been significantly simplified and limited by the deletion of alternate conditions previously set forth in Section 1406.11. In other than Type V construction, the installation of MCM panels and MCM systems are now regulated based on one of two thresholds: 1) those applications where MCMs are installed no more than 40 feet above grade plane, and 2) those conditions where MCM panels and systems are installed at heights more than 40 feet above grade plane.

Where the MCM or MCM systems are installed at a height greater than 40 feet above grade plane, the three previous criteria continue to be applicable regarding surface-burning characteristics, thermal barriers and full-scale tests based on NFPA 285. Where the installation height is 40 feet or less, full-scale testing is not mandated. Testing for flame spread of the MCM when installed in buildings of Type I, II, III and IV construction needs to be of the MCM itself, in other words, of the sandwich panel alone and not of the system that includes a series of other components.

The recognition of alternate conditions dealing with fire separation distance, self-ignition temperature, panel size, occupancy limitations and automatic sprinkler system protection has been deleted. MCMs were the only system in Chapter 14 where the presence of sprinklers inside the building was the reason to eliminate height and coverage limitations associated with fires along the exterior wall envelope. However, interior sprinkler systems for high-rise buildings are not intended to control outside exposure fires. The presence of sprinklers inside the building should not provide a full exception from testing to NFPA 285 or from height limitations considered necessary to ensure a minimum level of safety.

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1503.3

Parapet Walls

CHANGE TYPE: Modification

CHANGE SUMMARY: Parapet walls now require moisture resistance in a manner similar to the remainder of the building.

2021 CODE TEXT: **1503.3 ~~Coping.~~ Parapet walls.** Parapet walls shall be ~~properly coped with noncombustible, weatherproof materials of a width not less than the thickness of the parapet wall.~~ coped or covered in accordance with Sections 1503.3.1 and 1503.3.2. The top surface of the parapet wall shall provide positive drainage.

1503.3.1 Fire-resistance-rated parapet walls. Parapet walls required by Section 705.11 shall be coped or covered with weatherproof materials of a width not less than the thickness of the parapet wall such that the fire-resistance rating of the wall is not decreased.

1503.3.2 Other parapet walls. Parapet walls meeting one of the exceptions in Section 705.11 shall be coped or covered with weatherproof materials of a width not less than the thickness of the parapet wall.

CHANGE SIGNIFICANCE: By definition, a parapet wall is the part of any wall entirely above the roof line. Depending on the type of roofing system designed, traditional metal or masonry copings may not cap or cover a parapet wall. Section 1503.3 now provides requirements for when and how parapet walls are to be properly coped or covered by having requirements for two different types of parapet walls. Additionally, the mandate that parapet walls be coped with noncombustible materials has been deleted.

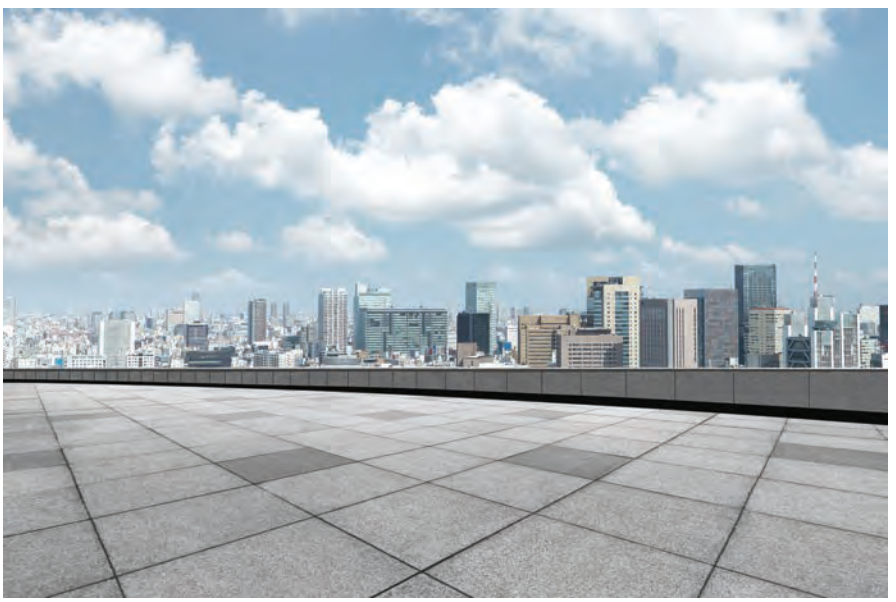


Photo courtesy of Patrick Wong

Short parapet wall on roof.

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Section 1503.3.1 is applicable to parapet walls required to comply with Section 705.11 regulating the fire resistance and related features of such walls. Parapet walls shall be coped or covered with materials that are both weatherproof and maintain the required fire-resistance rating. Section 1503.3.2 addresses parapet walls that are exempt from the parapet wall requirements of Section 705.11, such as those parapets intended to conceal the roof slope or rooftop equipment. With no fire resistance mandated, the only requirement is that parapet walls be coped or covered with weatherproof materials. In both cases, coping materials are to extend the full thickness of the parapet wall.

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1504.5
Ballasted Roofs

CHANGE TYPE: Modification

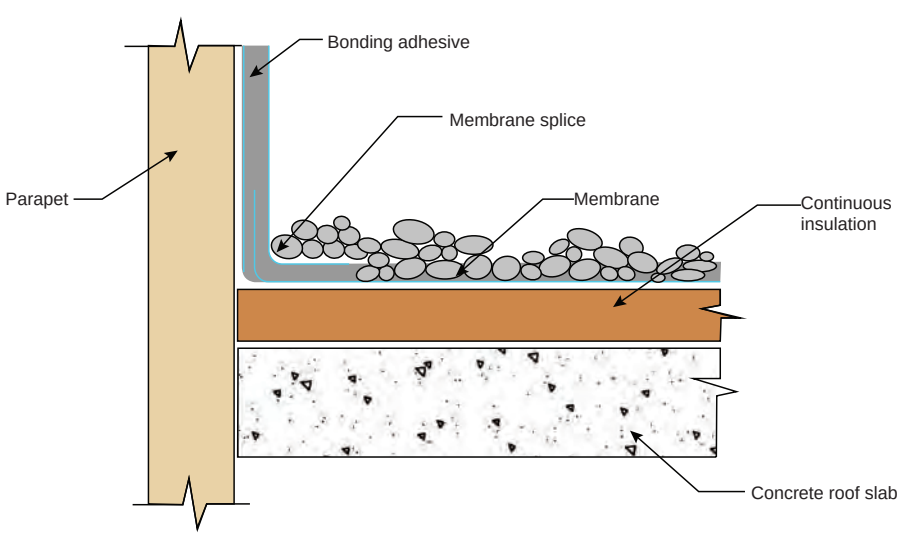
CHANGE SUMMARY: All requirements applicable to the design and construction of ballasted low-slope roofs are now contained in the ANSI/SPRI RP-4 standard.

2021 CODE TEXT: ~~**1504.4**~~ **1504.5 Ballasted low-slope single-ply roof systems.** Ballasted low-slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Sections~~s~~ 1507.12 ~~and 1507.13~~ shall be designed in accordance with ~~Section 1504.8 and~~ ANSI/SPRI RP-4.

CHANGE SIGNIFICANCE: Ballasted roofs must now solely comply with American National Standards Institute (ANSI)/Single Ply Roofing Industry (SPRI) RP-4, *Wind Design Standard for Ballasted Single-ply Roofing Systems*, and as such are no longer regulated by Section 1504.9. Requirements in the SPRI RP-4 standard were developed for ballasted roofs with the intent to prevent ballast scour for this single-ply ballasted system. The scour wind speed is below the wind speed at which blow-off occurs. Therefore, rock does not become airborne and damage glazing in adjacent buildings.

SPRI RP-4 requires stone ballast sized according to ASTM D7655, *Standard Classification for Size of Stone Used as Ballast for Membrane Roof Systems*. Stone is sized into one of four categories. No. 4 ballast, the smallest diameter stone, must be at least 1¼ inches in diameter. In comparison, No. 2 ballast must be at least 2½ inches in diameter. Alternatively, stone pavers may be used as ballast. A No. 4 paver must weigh at least 18 pounds per square foot. This ballast stone is much larger than stone used for aggregate surfaced roofing, as described in IBC Section 1504.9.

The requirements in SPRI RP-4 are based on a complete set of wind tunnel tests. In this test series, variables that impact the wind performance of ballasted single-ply roof assemblies were evaluated, including



Ballasted single-ply roof with large aggregate.

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stone size and distribution as specified in ASTM D7655. In the series of tests, three critical wind speeds were identified for each condition of parapet height and stone size:

Wind speed 1 - speed at which stone first begins to move

Wind speed 2 - speed, if maintained, that results in stone scouring

Wind speed 3 - speed at which stone blow-off occurs

Requirements in the design tables of SPRI RP-4 are based on Wind speed 2, the wind speed at which stone scour occurs. The requirements of the standard have recently been updated based on field performance of ballasted single-ply roofs. The most recent edition's design tables reflect the current methodology for the interpretation of wind tunnel data.

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1504.9

Aggregate-Surfaced Roofs

CHANGE TYPE: Modification

CHANGE SUMMARY: Parapets of a minimum height are now required for aggregate-surfaced roofs to prevent blow-off.

2021 CODE TEXT: **1504.9 Wind resistance of aggregate-surfaced roofs.** Parapets shall be provided for aggregate-surfaced roofs and shall comply with Table 1504.9.

~~**1504.8 Surfacing and ballast materials in hurricane-prone regions.** For a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site, the following materials shall not be used on the roof:~~

~~1. Aggregate used as surfacing for roof coverings.~~

~~2. Aggregate, gravel or stone used as ballast.~~

~~**TABLE 1504.8 Maximum Allowable Mean Roof Height Permitted for Buildings with Aggregate on the Roof in Areas Outside A Hurricane-Prone Region**~~

TABLE 1504.9 Minimum Required Parapet Height (inches) for Aggregate Surfaced Roofs[a,b,c]

Aggregate Size	Mean Roof Height (ft)	Wind Exposure and Basic Design Wind Speed (mph)																	
		Exposure B									Exposure C[d]								
		≤95	100	105	110	115	120	130	140	150	≤95	100	105	110	115	120	130	140	150
ASTM D1863 (No.7 or No.67)	15	2	2	2	2	12	12	16	20	24	2	13	15	18	20	23	27	32	37
	20	2	2	2	2	12	14	18	22	26	12	15	17	19	22	24	29	34	39
	30	2	2	2	13	15	17	21	25	30	14	17	19	22	24	27	32	37	42
	50	12	12	14	16	18	21	25	30	35	17	19	22	25	28	30	36	41	47
	100	14	16	19	21	24	27	32	37	42	21	24	26	29	32	35	41	47	53
	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56
ASTM D1863 (No.6)	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39
	100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45
	150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

a. Interpolation shall be permitted for mean roof height and parapet height.

b. Basic design wind speed, *V*, and wind exposure shall be determined in accordance with Section 1609.

c. Where the minimum required parapet height is indicated to be 2 inches (51 mm), a gravel stop shall be permitted and shall extend not less than 2 inches (51 mm) from the roof surface and not less than the height of the aggregate.

d. For Exposure D, add 8 inches (203 mm) to the parapet height required for Exposure C and the parapet height shall not be less than 12 inches (305 mm).

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Photo courtesy of Baloncici

Aggregate-surfaced roof with parapet.

CHANGE SIGNIFICANCE: Past provisions regulating aggregate blow-off from aggregate-surfaced roofs were not based on a quantitative analysis of observed roofing system performances in real wind events. Rather, the requirements were based on variations in surface pressure with building height, which is known to be an inaccurate predictor of aggregate blow-off due to pressure equalization effects.

Fully revised Section 1504.9 is now based on wind speeds for blow-off and only deals with smaller aggregate used for the surfacing of built-up roofs (BUR) and sprayed polyurethane foam (SPUF) roofs, both of which are different systems than ballasted roofs.

Table 1504.9 considers aggregate size, roof height and wind speed to determine the minimum required parapet height. The table provides an engineering and scientific basis for roof design to prevent aggregate blow-off that is based on wind tunnel tests and subsequent field studies of hurricane damage. Unsafe conditions where no parapets are provided to retain aggregates are no longer allowed.

Critical parameters, such as aggregate size and parapet height, will now govern performance. The use of aggregate-surfaced roofing systems is a viable option in high-wind areas with appropriate aggregate sizing and parapet height.

Note: ASTM D1863 maintains an aggregate size No. 67 that is sized between aggregates No. 7 and No. 6.

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1603.1.4

Construction Document Wind Zones

CHANGE TYPE: Modification

CHANGE SUMMARY: Component and cladding wind zones must now be identified in the construction documents.

2021 CODE TEXT: **1603.1.4 Wind design data.** The following information related to wind loads shall be shown, regardless of whether wind loads govern the design of the lateral force-resisting system of the structure:

1. Basic design wind speed, V, miles per hour and allowable stress design wind speed, V_{asd}, as determined in accordance with Section 1609.3.1.
2. Risk category.
3. Wind exposure. Applicable wind direction if more than one wind exposure is utilized.
4. Applicable internal pressure coefficient.
5. Design wind pressures and their applicable zones with dimensions to be used for exterior component and cladding materials not specifically designed by the registered design professional responsible for the design of the structure, pounds per square foot (kN/m^2).

CHANGE SIGNIFICANCE: There has been some confusion as to how the 2016 edition of the American Society of Civil Engineers (ASCE) standard ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures,* component and cladding (C&C) wind pressure zones are to be applied—specifically, what dimensions various zones should be for individual buildings. A description of C&C pressure zones in the construction documents should assist in correctly applying requirements for roof and wall assemblies and covering applications.

Adding the zones to the submittal information is intended to improve guidance for locating tighter nailing zones and other changes in construction requirements on a roof or wall surface. As ASCE 7-16 updated C&C roof zones, changing the shape, length and wind intensity of the zones, notice of changing nailing patterns in designs, especially along roof edges and ridges, is important. C&C wall pressures did not change in ASCE 7-16.

To provide a sense of how these changes affect building nailing patterns, consider Figure 16-1 where four examples of a flat roof on low- and mid-rise buildings are outlined. Note that corner areas have higher wind pressures than edge areas, while interior areas have the lowest wind pressures. Therefore, the tightest nailing patterns occur in corner zones and more widely-spaced nail patterns occur in the center of a roof.

For the low-rise building in Layout 1, the large footprint means the high-pressure corner areas look small. The length and depth of a corner area are determined by the building height. When a building's length (L) and width (W) are much larger than its height, in a warehouse, for example, the higher-pressure corner areas (Zone 3) become a very small portion of the total roof area. Edge areas typically fall into the Zone 2 category, unless Zone 3 extends around the perimeter as shown in Layout 4. The width of these Zone 2 areas is 60 percent of the building height. For a

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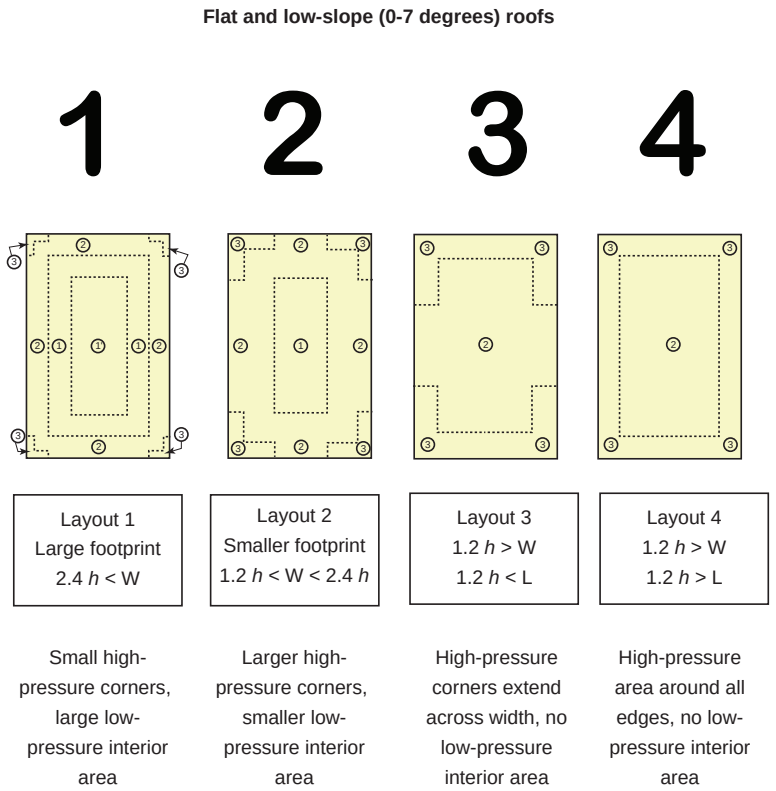


Figure 16-1 Component and cladding wind zone sizes may change significantly with building shape.

warehouse, this is a narrow strip along the four sides of the building. This area will have increased nailing requirements compared to ASCE 7-10, but only in a relatively narrow strip. The interior is divided into Zone 1 and Zone 1′. Wind pressures in Zone 1 are lower than the edge and corner zones. Zone 1′ has a further reduced wind pressure. This zone only exists for buildings with a large footprint and low height. A building with a smaller footprint, such as Layout 2 or Layout 3, does not have a Zone 1′.

Layout 2 is an example of a typical low-rise 1- to 3-story building potentially used for office or mercantile space. Its footprint is significantly smaller than the warehouse. The edge areas extend further into the center of the roof. More of this roof will have tight nailing patterns. Zone 1 does still occur in the center of the roof along with its less restrictive nailing patterns.

Layout 3 is a mid-rise building with a height approximately equal to its width. In this example, the corner areas extend across the width of the building creating tighter nail spacing along the entire edge. Along the length of the building, the corner nailing ends and the edge nailing begins near the center of the building length. The entire center of the roof requires edge (Zone 2) nailing rather than a reduction to interior (Zone 1) nail spacing.

Layout 4 is a mid-rise building where the building is taller than it is long. In this case, the entire edge of the roof requires corner (Zone 3) nailing and the interior requires edge (Zone 2) nailing, creating a much tighter nail schedule for the entire roof.

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A more detailed example of the nailing patterns:

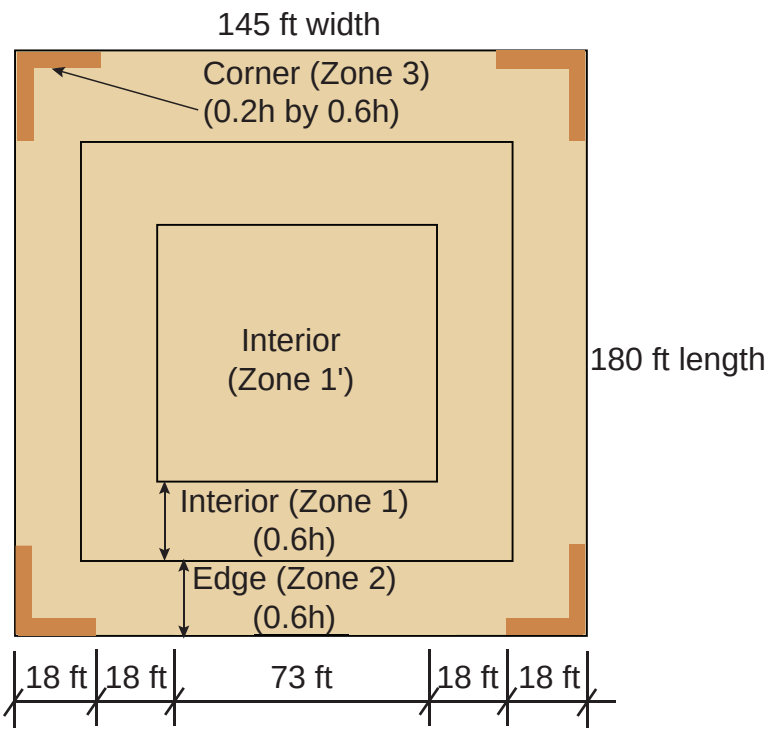
In the following examples, the roof C&C zones using the simplified method for low-rise buildings (ASCE 7-16, Chapter 30, Part 2) are shown for (1) a flat roof and (2) a 10:12 hip roof. Both have significant changes to nail spacing due to increased loads compared to ASCE 7-10, which was referenced by the 2012 and 2015 editions of the *International Building Code* (IBC).

Example 1: Flat Roof

Building Height ~ Mean Roof Height = 30 ft

0.2h = 0.2 × 30 ft = 6 ft (corner zone depth)

0.6h = 0.6 × 30 ft = 18 ft (corner zone length, edge zone depth)



Example 2: High-Slope Hip Roof

4-story building

10:12 pitch roof

Mean Roof Height = 55 ft

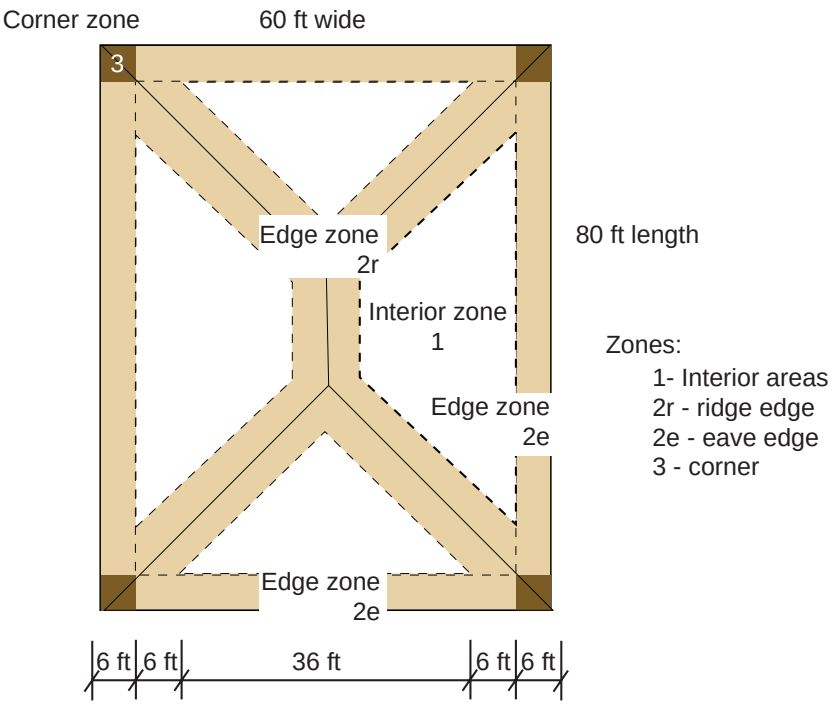
a = 10% of the least roof dimension or 0.4h

0.1w = 0.1 × 60 ft = 6 ft 6 ft < 22 ft, a = 6 ft

0.4h = 0.4 × 55 ft = 22 ft

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When designing hip roofs, the use of the variable *a* to determine the length and depth of corner, ridge and eave edge zones continues. The value is either 10 percent of the roof width or 40 percent of the building height, whichever is smaller.

Roof Pressures

In addition to larger corner and edge areas on roofs, ASCE 7-16 also includes increased roof pressures for low-rise (simplified) buildings with h ≤ 60 ft and buildings taller than 60 feet with hip, gable or flat roofs. In the case of a flat roof on a low-rise building using the simplified method, pressures for corner, edge and interior areas increased from 13 percent to 81 percent with an average increase of over 40 percent. For other roof slopes, Table 16-1 shows a comparison of C&C loads for ASCE 7-16 versus ASCE 7-10. Between the increase of roof area assigned to corner and edge regions and the increase in roof pressures, nail schedules are likely to change across the entire roof with nail spacing cut in half in some cases.

TABLE 16-1 Comparison of Component and Cladding Coefficients in ASCE 7[a]

	Ratio of ASCE 7–16/ASCE 7–10											
	Roof $GC_p - GC_{pi}$						Roof Overhang $GC_p - GC_{pi}$					
Roof Slope	3r	3e	2r	2n	2e	1	3r	3e	2r	2n	2e	1
$7 < \Theta \leq 20$	1.36	1.14	1.69	1.69	1.16	2.02	1.27	1.11	1.59	1.59	1.14	–
$20 < \Theta \leq 27$	1.36	0.96	1.43	1.43	0.89	1.56	1.27	0.97	1.36	1.36	0.91	–
$27 < \Theta \leq 45$	1.58	2.45	1.43	1.58	1.43	1.68	1.40	2.00	1.30	140	1.30	–

a. Low-rise building (simplified) Part 2 method for gable roofs.

(Courtesy of American Wood Council.)

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Table 1604.5

Risk Categories of Assembly Spaces

CHANGE TYPE: Modification

CHANGE SUMMARY: Mixed occupancy buildings with assembly spaces are now designated as Risk Category III when the total public assembly occupant load is greater than 2,500 people.

2021 CODE TEXT:

TABLE 1604.5 Risk Category of Buildings and Other Structures

Risk Category	Nature of Occupancy
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing one or more public assembly spaces, each having an occupant load greater than 300 and a cumulative occupant load of the public assembly spaces of greater than 2,500. • Buildings and other structures containing Group E or Group I-4 occupancies or combination thereof, with an occupant load greater than 250. *(Other Risk Category III criteria remain unchanged)*

CHANGE SIGNIFICANCE: Group R-1 hotels often have convention center facilities with multiple large ballrooms and other assembly spaces, but public assembly is not the primary occupancy of the building. These



Photo courtesy of Mad Circles

A movie theater is an example of an assembly occupancy.

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buildings have historically been classified as Risk Category II. Conversely, there are smaller buildings consisting solely of one or more assembly rooms where the primary occupancy is public assembly with a cumulative occupant load of over 300 that must be designed to the higher Risk Category III requirements although the total assembly occupant load is much lower when compared to a hotel.

To deal with this imbalance, Table 1604.5 includes a new condition under Risk Category III for those buildings containing at least one assembly space with an occupant load greater than 300 while also having a cumulative occupant load for all assembly spaces of more than 2,500. Buildings that meet these criteria are now assigned to Risk Category III rather than Risk Category II.

To illustrate the revised provisions, the following example is based on a hotel with an adjoining convention area. The primary use of the building is considered to be Group R-1; however, there are also a number of assembly spaces having a significant occupant load. The building housing the hotel and convention facilities is now considered to be Risk Category III due to the new criteria.

Example: Hotel Conference Center



Photo courtesy of mustafagull

5-story hotel with conference center

440 guest rooms

2 ballrooms with 1,200 occupants each

3 meeting rooms with 90 occupants each

Total assembly occupants: 2,670 people **Risk Category III**

The new threshold requires the existence of two conditions for the establishment of a Risk Category III classification. First, at least one of the assembly spaces must have an occupant load that exceeds 300, and second, the cumulative occupant load of all assembly spaces must exceed 2,500. In the example shown, both conditions have been met, and the building is to be assigned to Risk Category III.

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An additional revision addresses day care facilities classified as Group I-4 occupancies. These occupancies have not previously been specifically identified in Table 1604.5; however, the threshold at which a Risk Category III is to be assigned to such day care facilities has now been established. Consistent with the application for when a Group E occupancy is present, a building used for day care purposes is considered Risk Category III when the total occupant load for the Group I-4 occupancy, or the combination of Group E and Group I-4 occupancies, exceeds 250.



Photo courtesy of kievith

Group I-4 in an apartment complex.

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1605
Load Combinations

CHANGE TYPE: Modification

CHANGE SUMMARY: The strength design and allowable stress design load combinations have been deleted while direct reference to Chapter 2 of ASCE 7 has been added to Section 1605.

2021 CODE TEXT: **1605.1 General.** Buildings and other structures and portions thereof shall be designed to resist the strength load combinations specified in ASCE 7, Section 2.3, the allowable stress design load combinations specified in ASCE 7, Section 2.4, or the alternative allowable stress design load combinations of Section 1605.2.

Exceptions:

1. The modifications to load combinations of ASCE 7 Section 2.3, ASCE 7 Section 2.4, and Section 1605.2 specified in ASCE 7 Chapters 18 and 19 shall apply.
2. Where the allowable stress design load combinations of ASCE 7 Section 2.4 are used, flat roof snow loads of 30 pounds per square foot (1.44 kN/m^2) and roof live loads of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic load. Where flat roof snow loads exceed 30 pounds per square foot (1.44 kN/m^2), 20 percent shall be combined with seismic loads.
3. Where the allowable stress design load combinations of ASCE 7 Section 2.4 are used, crane hook loads need not be combined with roof live loads or with more than three-fourths of the snow load or one-half of the wind loads.



2021 IBC directly references ASCE 7-16 for load combinations.

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~~1605.3.2~~ 1605.2 Alternative allowable stress design load combinations. In lieu of the ~~basic load combinations specified in Section 1605.3.1~~ load combinations in ASCE 7, Section 2.4, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. Where using these alternative allowable stress load combinations that include wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced where permitted by the material chapter of this code or the referenced standards. For load combinations that include the counteracting effects of dead and wind loads, only two-thirds of the minimum dead load likely to be in place during a design wind event shall be used. Where using these alternative load combinations to evaluate sliding, overturning and soil bearing at the soil-structure interface, the reduction of foundation overturning from Section 12.13.4 in ASCE 7 shall not be used. Where using these alternative basic load combinations for proportioning foundations for loadings, which include seismic loads, the vertical seismic load effect, E_v, in Equation 12.4-4 of ASCE 7 is permitted to be taken equal to zero. Where required by ASCE 7, Chapters 12, 13, and 15, the load combinations including overstrength of ASCE 7, Sections 2.3.6 shall be used.

$$D + L + (L_r \text{ or } S \text{ or } R) \qquad \textbf{(Equation ~~16-17~~ 16-1)}$$

$$~~D + L + 0.6\omega W~~ \; D + L + 0.6W \qquad \textbf{(Equation ~~16-18~~ 16-2)}$$

$$~~D + L + 0.6\omega W + S/2~~ \; D + L + 0.6W + S/2 \qquad \textbf{(Equation ~~16-19~~ 16-3)}$$

$$~~D + L + S + 0.6\omega W/2~~ \; D + L + S + 0.6W/2 \qquad \textbf{(Equation ~~16-20~~ 16-4)}$$

$$D + L + S + E/1.4 \qquad \textbf{(Equation ~~16-21~~ 16-5)}$$

$$0.9D + E/1.4 \qquad \textbf{(Equation ~~16-22~~ 16-6)}$$

Exceptions:

1. Crane hook loads need not be combined with roof live loads or with more than three-fourths of the snow load or one-half of the wind load.
2. Flat roof snow loads of 30 pounds per square foot (1.44 kN/m^2) or less and roof live loads of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 pounds per square foot (1.44 kN/m^2), 20 percent shall be combined with seismic loads.

(Additional deleted text not shown for brevity and clarity)

CHANGE SIGNIFICANCE: For seven editions, the IBC has contained three separate groups of load combinations:

1. Strength (Section 1605.2)
2. Basic Allowable Stress (Section 1605.3.1)
3. Alternative Allowable Stress (Section 1605.3.2)

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Two combinations, the strength load combinations and basic allowable stress load combinations, are replicated directly from ASCE 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. Deletion of the IBC load combinations removes minor variations in the requirements between the IBC and ASCE 7 by eliminating the duplication of the equations.

The third set of load combinations are a legacy set from the codes that predate the IBC. In the 2000 IBC through the 2018 IBC, the alternative allowable stress design load combinations permitted the use of a 1/3 increase in allowable stresses when evaluating load combinations containing short-term transient loads including wind and seismic loads. The basic allowable stress combinations did not permit the reduction in loads, but applied a factor of 0.75 to transient loads, including live, snow, wind and seismic loads, when more than one of these loads was considered simultaneously.

The ASCE 7 load combinations have further permitted an increase in allowable stresses when the material, such as wood, has increased available strength under short-term loading, i.e. loads due to snow, rain, wind or earthquakes. This increase is not intended to be used for the design of masonry, concrete or steel structures, because the strength of these materials does not vary significantly with the duration of the load. Unfortunately, the one-third stress increase has routinely been applied incorrectly. To limit misuse of the stress increase, the omega factor, ω, has been deleted from the alternative allowable stress design load combinations.

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1606
Dead Loads

CHANGE TYPE: Modification

CHANGE SUMMARY: Dead loads at the roof level have been clarified as well as fixed service equipment concentrated loads.

2021 CODE TEXT: **1606.2 ~~Design dead load.~~ Weights of materials of construction.** For purposes of design, the actual weights of materials of construction ~~and fixed service equipment~~ shall be used. In the absence of definite information, values used shall be subject to the approval of the building official.

1606.3 Weight of fixed service equipment. In determining dead loads for purposes of design, the weight of fixed service equipment, including the maximum weight of the contents of fixed service equipment, shall be included. The components of fixed service equipment that are variable, such as liquid contents and movable trays, shall not be used to counteract forces causing overturning, sliding, and uplift conditions in accordance with Section 1.3.6 of ASCE 7.

Exceptions:

1. Where force effects are the result of the presence of the variable components, the components are permitted to be used to counter those load effects. In such cases, the structure shall be designed for force effects with the variable components present and with them absent.
2. For the calculation of seismic force effects, the components of fixed service equipment that are variable, such as liquid contents and movable trays, need not exceed those expected during normal operation.

1606.4 Photovoltaic panel systems. The weight of photovoltaic panel systems, their support system, and ballast shall be considered as dead load.

1606.5 Vegetative and landscaped roofs. The weight of all landscaping and hardscaping materials for vegetative and landscaped roofs shall be considered as dead load. The weight shall be computed considering



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Examples of roof dead loads – HVAC equipment, solar panels and vegetative roofs.

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both fully saturated soil and drainage layer materials and fully dry soil and drainage layer materials to determine the most severe load effects on the structure.

CHANGE SIGNIFICANCE: Historically, the code has not addressed variable content weight in dead loads nor explicitly described certain loads. The weights of vegetative roofs, solar panels and fixed service equipment have been clarified to provide consistency between the IBC and ASCE 7. A dead load, as defined in Section 202, has two parts: the weight of materials that constitute the building and the weight of fixed service equipment. The weight of fixed service equipment includes both the empty weight of the equipment and the maximum weight of the contents. For example, the weight of liquids is to be included in the dead load of piping and tanks, and the weight of conduit and wiring is to be included in the dead load of cable trays. In addition, as content weight may be variable, it cannot be counted upon to counteract the effects of overturning, sliding and uplift forces. Exceptions in Section 1606 specifically address the calculation of variable loads for liquids and moveable equipment.

Exception 1 indicates that when the variable content weight is the source of the force causing overturning, sliding or uplift, it can be used to counteract the force. For example, in a tank, a liquid is the primary source of the seismic mass for the tank and, therefore, can be used to resist seismic uplift. However, the liquid cannot be used to resist overturning, sliding and uplift forces from wind loads.

Exception 2 indicates that the maximum weight of the contents does not have to be used when calculating seismic forces, but rather the weight that typically exists during normal operation. This is consistent with methodologies for the determination of seismic weight when including components that may not be in place during an earthquake.

The worst-case design load is used for each aspect of seismic design. If a fully loaded tank is the worst design load case for drift calculations or forces on tank anchorage, then a fully loaded tank is assumed in design. If an empty tank is the worst potential load case for determining uplift or walking of a tank during an earthquake, then that loading scheme is to be used for design.

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1607.11.4

Rope Descent Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: Rope descent system anchorage has been added to the section on fall arrest and lifeline anchorage.

2021 CODE TEXT: ~~**1607.10.4**~~ **1607.11.4 Fall arrest, ~~and~~ lifeline, and rope descent system anchorages.** In addition to any other applicable live loads, fall arrest, ~~and~~ lifeline, and rope descent system anchorages and structural elements that support these anchorages shall be designed for a live load of not less than 3,100 pounds (13.8 kN) for each attached ~~lifeline~~ line, in ~~every~~ any direction that ~~a fall arrest~~ the load can be applied.

Anchorages of horizontal lifelines and the structural elements that support these anchorages shall be designed for the maximum tension that develops in the horizontal lifeline from these live loads.

CHANGE SIGNIFICANCE: In 2017, the Occupational Safety and Health Administration (OSHA) adopted new regulations in Section 1910.27 that specifically require all anchorages of rope descent systems (such as boatswain's chairs) to be able to support 5,000 pounds in any direction for each attached worker. Since OSHA has added specific language addressing rope descent systems, and because the systems and loads are basically identical to those for other fall arrest lines, Section 1607.11.4 has been updated to mirror OSHA's requirements and includes minimum design loads for rope descent systems.

Requirements for the design of a horizontal lifeline anchorage and its support have been added to ensure that the anchorage design correctly considers increases in forces associated with the horizontal lifeline geometry.

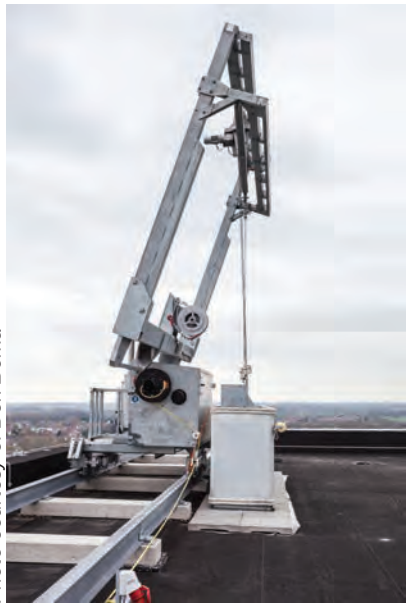


Photo courtesy of Den Boma

Fall arrest and lifeline cables must be designed to stop falls.



Photo courtesy of cat-scape

Rope descent systems.

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1607.17
Fixed Ladder Live Load

CHANGE TYPE: Addition

CHANGE SUMMARY: Live loads for fixed and ship's ladders have been added to the IBC.

2021 CODE TEXT: **1607.17 Fixed ladders.** Fixed ladders with rungs shall be designed to resist a single concentrated load of 300 pounds (1.33 kN) in accordance with Section 4.5.4 of ASCE 7. Where rails of fixed ladders extend above a floor or platform at the top of the ladder, each side rail extension shall be designed to resist a single concentrated load of 100 pounds (0.445 kN) in accordance with Section 4.5.4 of ASCE 7. Ship's ladders shall be designed to resist the stair loads given in Table 1607.1.

CHANGE SIGNIFICANCE: Live loads to be used in the design of ladders have not previously been specified in the IBC; however, requirements for fixed ladders are now coordinated between the IBC and ASCE 7. Ladder live loads contained in ASCE 7 have been added to the IBC. The addition of live load values provides the necessary load values in the IBC but maintains the accompanying design information within ASCE 7.

Ship's ladder live loads are listed by a reference to stair loads set forth in Table 1607.1. The table requires a uniform live load for stairs of 100 pounds per square foot and a concentrated live load of 300 pounds. One- and two-family dwellings may use a lower uniform live load for stairs, which also applies to ship's ladders.

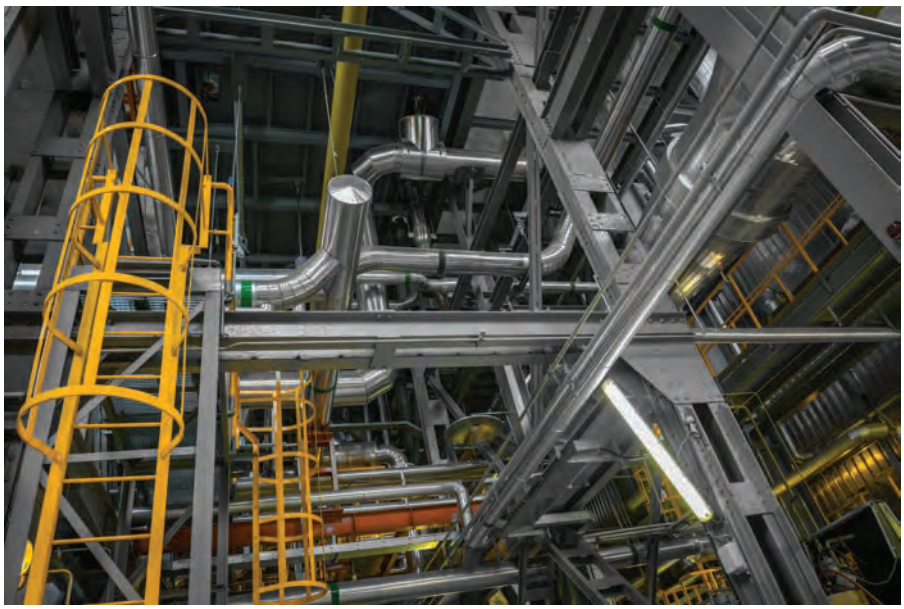


Photo courtesy of svedoliver

Fixed ladder loads are assigned by ASCE 7.

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1608.2

Snow Maps

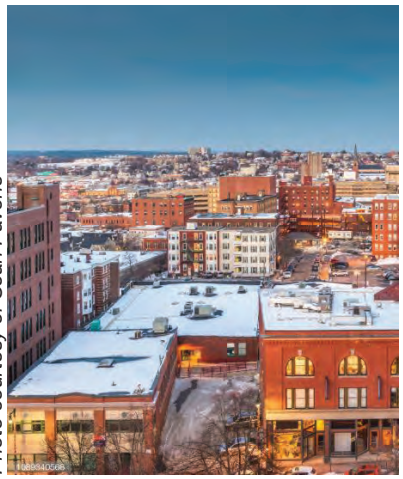


Photo courtesy of Sean Pavone

Many western towns have snow loads updated in the 2021 IBC.

CHANGE TYPE: Modification

CHANGE SUMMARY: The ground snow load map has been updated to provide consistency with ASCE 7-16 snow maps by adding a reference to ASCE 7 snow tables in states with large case study areas.

2021 CODE TEXT: **1608.2 Ground snow loads.** The ground snow loads to be used in determining the design snow loads for roofs shall be determined in accordance with ASCE 7 or Figures 1608.2(1) and 1608.2(2) for the contiguous United States and Table 1608.2 for Alaska.

(Additional text in section not shown for brevity.)

CHANGE SIGNIFICANCE: Updating Section 1608 harmonizes snow load provisions with the 2016 edition of ASCE 7, which is the reference standard for snow loads used in building design.

ASCE 7 has a ground snow map that contains new ground-snow load tables; these include tables for seven states: Colorado, Idaho, Montana, Washington, New Mexico, Oregon and New Hampshire. The state tables list ground snow loads and maximum elevations for major cities and towns in each region of a given state. The tables are based on state ground snow reports by regional experts and include specialized knowledge of local climatic conditions. Table 7.2-5, Ground Snow Loads for Selected Locations in Washington [State] is an excerpt from ASCE 7-16.

IBC Figures 1608.2(1) and 1608.2(2) indicate which states have supplemental data within the ASCE 7 standard.

ASCE 7 TABLE 7.2-5 Ground Snow Loads for Selected Locations in Washington excerpt

City/Town	County	Ground Snow Load (psf)	Elevation (ft)
Arlington	Snohomish	17	120
Auburn	King	20	85
Bainbridge Island	Kitsap	15	100
Bellevue	King	20	100
Bellingham	Watcom	15	100
Bonney Lake	Pierce	18	40
Bothell	King	20	90
Bremerton	Kitsap	15	100
Burien	King	16	325
Covington	King	20	85
Crystal Mt.	Pierce	438	4,380
Des Moines	King	18	370
Edmonds	Snohomish	20	350
Ellensburg	Kittitas	34	1,540
Everett	Snohomish	15	110
Federal Way	King	20	85
Issaquah	King	20	100
Kenmore	King	20	90
Kennewick	Benton	15	400
Kent	King	20	50

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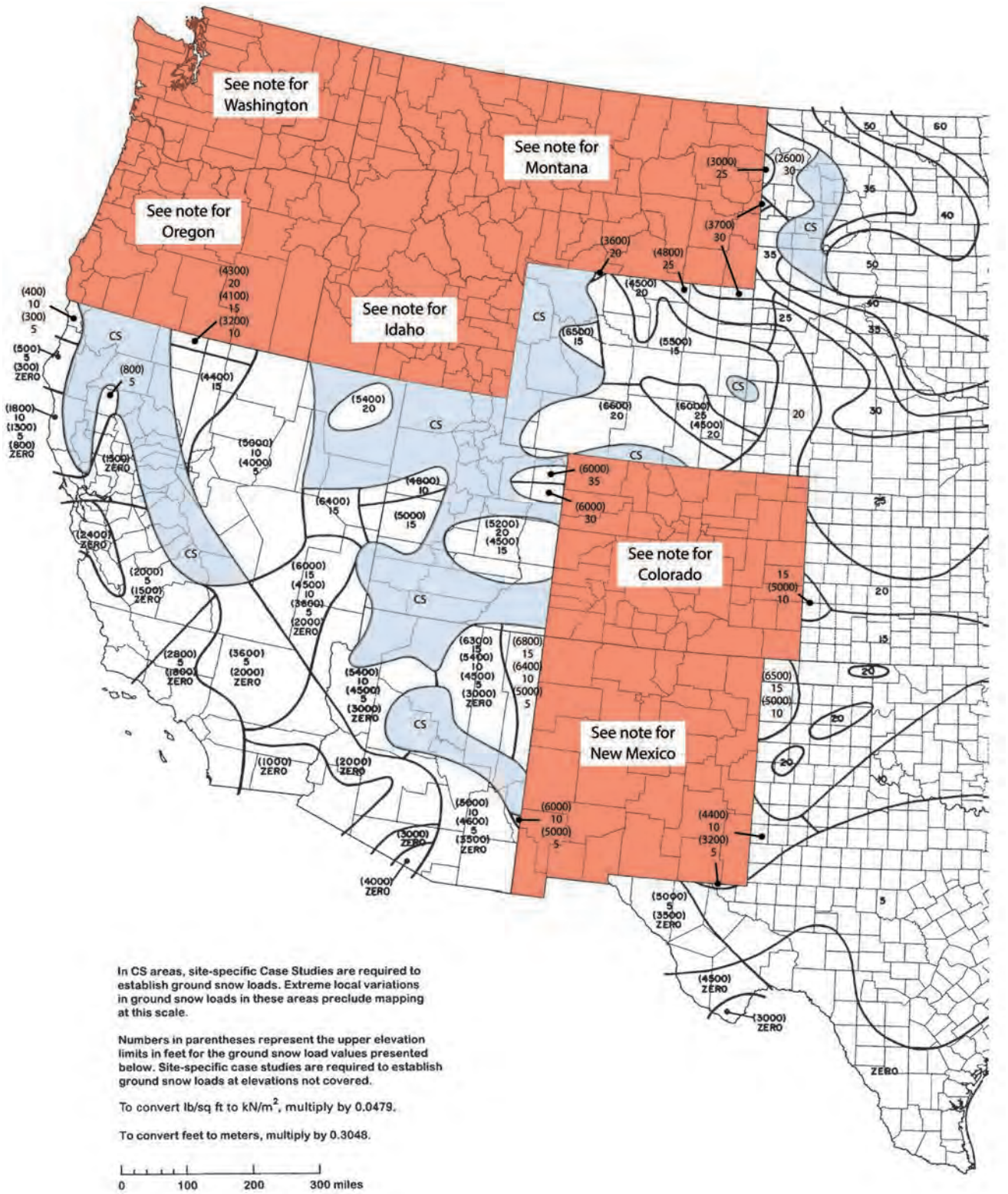


Figure 1608.2(1) Ground Snow Loads, p_g, for the United States (psf).

NOTE: See ASCE 7 Table 7.2-2 for Colorado, Table 7.2-3 for Idaho, Table 7.2-4 for Montana, Table 7.2-5 for Washington, Table 7.2-6 for New Mexico, Table 7.2-7 for Oregon, and Table 7.2-8 for New Hampshire.

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1610.2

Soil-Caused Uplift

CHANGE TYPE: Addition

CHANGE SUMMARY: Concrete slabs on ground must now be designed for uplift due to soil expansion and water pressure in areas prone to soil movement or a shallow water table.

2021 CODE TEXT: **1610.1 ~~General.~~ Lateral pressures.** Foundation walls and retaining walls shall be designed to resist lateral soil loads from adjacent soil. Soil loads specified in Table 1610.1 shall be used as the minimum design lateral soil loads unless determined otherwise by a geotechnical investigation in accordance with Section 1803. Foundation walls and other walls in which horizontal movement is restricted at the top shall be designed for at-rest pressure. Retaining walls free to move and rotate at the top shall be permitted to be designed for active pressure. ~~Design~~ Lateral pressure from surcharge loads shall be added to the lateral ~~earth pressure~~ soil load. ~~Design~~ Lateral pressure shall be increased if expansive soils are present at the site ~~are expansive~~. Foundation walls shall be designed to support the weight of the full hydrostatic pressure of undrained backfill unless a drainage system is installed in accordance with Sections 1805.4.2 and 1805.4.3.

> **Exception:** Foundation walls extending not more than 8 feet (2438 mm) below grade and laterally supported at the top by flexible diaphragms shall be permitted to be designed for active pressure.

1610.2 Uplift loads on floor and foundations. Basement floors, slabs on ground, foundations, and similar approximately horizontal elements below grade shall be designed to resist uplift loads where applicable. The upward pressure of water shall be taken as the full hydrostatic pressure applied over the entire area. The hydrostatic load shall be measured from the underside of the element being evaluated. The design for upward loads caused by expansive soils shall comply with Section 1808.6.



Photo courtesy of Mark Winfrey

Slab foundations require design for soil heave.

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CHANGE SIGNIFICANCE: Section 1610 has not previously addressed uplift loads from hydrostatic pressure or expansive soils. Requirements addressing uplift forces are now to be applied when appropriate and included in the design. The hydrostatic pressure provisions include a required determination of loads based on measuring to the underside of the construction per ASCE 7, Section 3.2.2. While this is a straightforward provision of fluid mechanics, the new provisions are intended to prevent the use of common elevations shown on construction drawings, such as floor elevations or the top of foundation construction, as the elevation at which to apply hydrostatic forces. The new language explicitly states that hydrostatic pressures should be applied to the underside of a foundation's lowest horizontal element.

A pointer has been added to Section 1808.6, Design for Expansive Soils, to help in determining the minimum required uplift or upward load due to the movement of soils below a building when expansive soils are present.

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1611
Rain Loads

CHANGE TYPE: Modification

CHANGE SUMMARY: Secondary drainage system rain loads have been updated to be consistent with ASCE 7.

2021 CODE TEXT: **1611.1 Design rain loads.** Each portion of a roof shall be designed to sustain the load of rainwater ~~that will accumulate on it if the primary drainage system for that portion is blocked plus the uniform load caused by water that rises above the inlet of the secondary drainage system at its design flow.~~ as per the requirements of Chapter 8 of ASCE 7. The design rainfall shall be based on the 100-year ~~hourly rainfall rate indicated in Figure 1611.1~~ 15-minute duration event, or on other rainfall rates determined from approved local weather data. Alternatively, a design rainfall of twice the 100-year hourly rainfall rate indicated in Figures 1611.1(1) through 1611.1(5) shall be permitted.

$$R = 5.2(d_s + d_h) \qquad \textbf{(Equation 16-19)}$$

For SI: $R = 0.0098(d_s + d_h)$

where:

d_h = Additional depth of water on the undeflected roof above the inlet of secondary drainage system at its design flow (in other words, the hydraulic head), in inches (mm).

d_s = Depth of water on the undeflected roof up to the inlet of secondary drainage system when the primary drainage system is blocked (in other words, the static head), in inches (mm).

R = Rain load on the undeflected roof, in psf (kN/m^2). Where the phrase "undeflected roof" is used, deflections from loads (including dead loads) shall not be considered when determining the amount of rain on the roof.



International Code Council

Secondary drainage system outflow.



Photo courtesy of Onfokus

Frequently flooded roof.

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1611.2 Ponding instability. Susceptible bays of roofs shall be evaluated for ponding instability in accordance with ~~Section 8.4~~ Chapters 7 and Chapter 8 of ASCE 7.

CHANGE SIGNIFICANCE: Secondary (overflow) system design has been harmonized with roof rain load provisions for a structure to provide realistic expectations of the roof drainage system and potential roof loading by rainfall. The IBC is now consistent with ASCE 7 provisions. Calculations for the design mean recurrence interval and duration for determining the hydraulic head, d_h, are available in both ASCE 7 and the IBC.

Legacy ASCE load standards' design rainfall durations for plumbing systems were between 15- and 60-minutes for a 100-year mean recurrence interval. The 1995 *Standard Plumbing Code* used the 100-year/60-minute duration for primary drainage system design and a 100-year/15-minute duration storm for the secondary drainage system. In the 2018 *International Building Code* (IBC) *and International Plumbing Code* (IPC), a 100-year/60-minute duration is used for both the primary and secondary systems. Note that the use of twice the 60-minute duration is close to the 15-minute duration rainfall rate. Also note that 2021 IPC and 2021 IBC rainfall maps (Figures 1106.1(1-5) and 1611.1(1-5), respectively) both include a 60-minute duration rather than the 15-minute storm duration. However, the 2021 IBC, by giving two options – the 15-minute duration or twice the 60-minute duration – results in values similar to ASCE 7.

The best source for rainfall data is the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Precipitation Frequency Data Server - Hydrometeorological Design Studies Center (hdsc.nws.noaa.gov/hdsc/pfds/index.html) for precipitation intensity (inches per hour) based on the 100-year mean recurrence interval. NOAA's data lists both 15-minute and 60-minute duration data.

Details of load and drain size calculations:

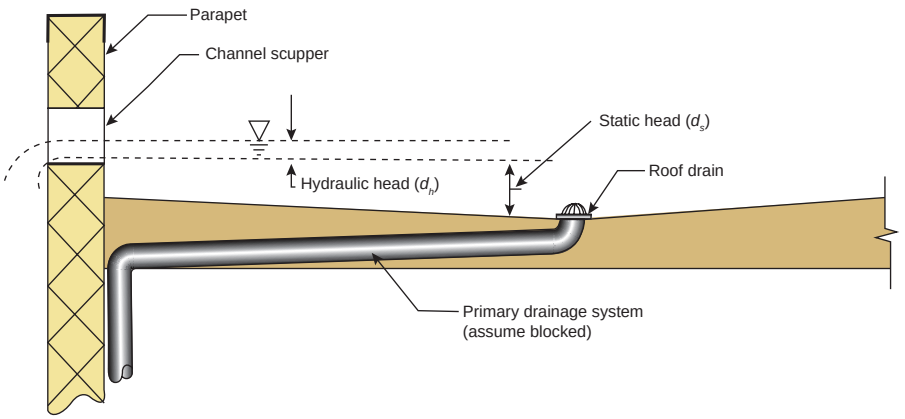
To understand why this makes a difference, the following examples show how to determine rain load, *R*, assuming rainfall for the city of Cedar Rapids, Iowa. The first example uses the 2018 IBC requirements and the second uses the 2021 IBC requirements.

Secondary drain sizes and geometries affect the structural engineer's determination of a maximum height of water above the roof surface by the use of variables d_s and d_h for static and hydraulic head. Secondary drains should be specified, if possible, to keep rain loads reasonable. Engineers should be aware of different secondary drain options available to plumbers and clearly communicate how changes, especially to secondary drain geometry, can impact design rain loads on a building. Important parameters to communicate include the assumed static head, hydraulic head associated with the secondary drain or scupper size and geometry, rain load and rainfall rate.

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Secondary drainage design assumptions.

Example 1: 60-minute rainfall total for primary and secondary systems (2018 IBC).

Design rainfall: 3.30 inches for 100-year mean recurrence, Cedar Rapids Station No. 1.

Calculate primary and secondary drain size and resulting rain load, *R*.

Primary Drain

Depth of water (in 1 hr): 3.30 inches (NOAA)
Tributary area (primary drain): 100 ft by 50 ft = 5,000 ft^2
Flow rate (volume) to maintain roof drainage:

$$Q = 0.0104 \times A \times i \qquad \textbf{(ASCE 7-16 Equation C8.3-1*)}$$

where:

Q = flow rate to maintain drainage rate equal to rainfall rate
A = tributary area
i = water depth in inches per hour

*The 0.0104 factor in the equation converts area, which is in square feet, and rainfall rate, which is in inches per hour, to gallons per minute.

A = 50 ft × 100 ft = 5,000 ft^2
i = 3.30 inches/hr
Q = 0.0104 × 5,000 ft^2 × 3.30 inches/hr = 172 gal/min*

From Table 1106.2 of the 2018 IPC, the minimum drain size is …

4-inch vertical pipe or 6-inch horizontal drain with a minimum slope of 1/16-inch per foot

Secondary Drain and Rain Load (R) Calculation

Given:

d_s = specified distance from the roof surface to the bottom of scupper
d_h = calculated (tabulated) height of water above base of scupper or secondary drain based on drain geometry

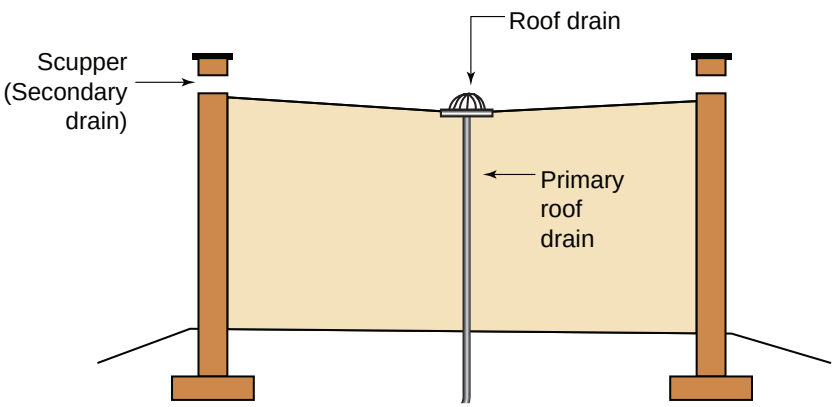
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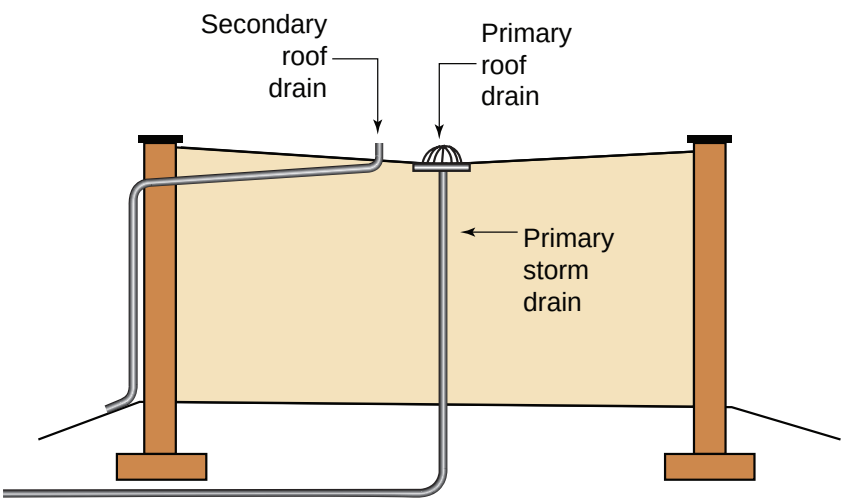
Flow rate (volume) to maintain roof drainage through a scupper or secondary drain is calculated for the secondary drain since the primary drain is assumed to be completely blocked. The secondary system's design rainfall is 3.30 inches per hour per the 2018 IBC. The flow rate, Q, will be 172 gal/min, identical to the primary drain system. This rain load must leave the roof at least at the same rate it is falling. Typically, once the structural engineer determines the rainfall, static head, hydraulic head, d_h, and rain load on a roof, a plumber can size the secondary system pipes or scuppers to a flow rate of 172 gal/min or greater. The structural engineer does this check as an iterative process to keep rain loads on the roof reasonable by limiting the hydraulic head to a reasonable value. Engineers should be aware of different secondary drain options available to plumbers and clearly communicate how changes, especially to secondary drain geometry, can impact design rain loads on a building.

To calculate R:

d_h (hydraulic head) = 5 inches for a 6-inch-wide, 6-inch-high, closed-top scupper which corresponds to a flow rate of 194 gpm (per 2018 IBC Commentary Figure 1611.1(2)), which is sufficient for the calculated flow rate of 172 gpm.



Secondary drainage using scuppers.



Secondary drainage using pipe with visible outlet.

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d_s (static head) = 6 inches (specified distance from the roof surface to the bottom of the scupper)

$R = 5.2(d_s + d_h) = 5.2(6 \text{ in.} + 5 \text{ in.}) = 57.2 \text{ psf}$

(IBC Equation 16-19)

As a second iteration, a 24-inch-wide scupper (open- or closed-top of any height) handles 200 gpm with a corresponding 2-inch hydraulic head. This would reduce the rain load to a more reasonable 41.6 psf.

Note: The 5.2 value in the equation converts the depth of water, which is in inches, to pressure in pounds/square foot (psf) using the density of water of 62.5 pounds per cubic foot (pcf) and the conversion of inches to feet (12 inches per foot); therefore, (62.5pcf)/(12in./ft) = 5.2 psf per inch of water depth.

Example 2: 60-minute rainfall duration for the primary system, 15-minute rainfall duration for the secondary system (2021 IBC). Design rainfall for Cedar Rapids Station No. 1:

3.30 inches for 100-year mean recurrence (60-minute)

1.72 inches for 100-year mean recurrence (15-minute)

Calculate primary and secondary drain size and resulting rain load, *R*.

Primary Drain

Using the parameters from Example 1, calculation of the primary drain diameter per Table 1106.2 of the 2021 IPC requires a minimum:

4-inch vertical pipe or 6-inch horizontal drain (minimum slope of 1/16-inch per foot).

Secondary Drain and Rain Load (R) Calculation

Flow rate (volume) to maintain roof drainage through a scupper or secondary drain is the flow rate calculated for the secondary drain. The primary drain is assumed to be completely blocked.

Flow rate (volume) to maintain roof drainage rate equal to rainfall rate:

$Q = 0.0104 \times A \times i$ **(ASCE 7-16 Equation C8.3-1*)**

where:

Q = flow rate to maintain drainage rate equal to rainfall rate
A = tributary area
i = water depth in inches per hour (must convert 15 min interval to equivalent hour interval)

*The 0.0104 factor in the equation converts area, which is in square feet, and rainfall rate, which is in inches per hour, to gallons per minute.

$A = 50 \text{ ft} \times 100 \text{ ft} = 5{,}000 \text{ ft}^2$
$i = 1.72 \text{ inches}/15 \text{ minutes} \times 60 \text{ minutes/hour} = 6.88 \text{ inches/hour}$
$Q = 0.0104\ (5{,}000 \text{ ft}^2)\ (6.88 \text{ inches/hr}) = 358 \text{ gal/min}$

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Note that a 15-minute design rainfall has a flow rate approximately 2 times the flow rate of the 2018 IBC 60-minute design rainfall. This is true for much of the United States, but check each location to make sure it is true in that region rather than assuming a fixed 100-percent increase in flow rate.

To calculate R:

d_h (hydraulic head) = 3 inches for a 24-inch-wide, open- or closed-top scupper corresponding to a flow rate of 360 gpm (2018 IBC Commentary Figure 1611.1(2)) which is sufficient for the calculated flow rate of 358 gpm.

d_s (static head) = 6 inches (specified distance from the roof surface to the bottom of the scupper)

$$R = 5.2(d_s + d_h) = 5.2(6 \text{ in.} + 3 \text{ in.}) = 46.8 \text{ psf}$$

(IBC Equation 16-19)

Note: The 5.2 value in the equation converts the depth of water, which is in inches, to pressure in pounds/square foot (psf) using the density of water of 62.5 pounds per cubic foot (pcf) and the conversion of inches to feet (12 inches per foot); therefore, (62.5 pcf)/(12 in/ft) = 5.2 psf per inch of water depth.

Notes:

Not only does secondary drain size impact flow rate, but drain size and geometry impacts hydraulic head levels. To keep the rain load to reasonable design levels, larger secondary drains and geometries should be explored to minimize hydraulic head levels. As shown in the examples, flow rates in the 2021 IBC are approximately double for secondary drain design, 2021 IBC flow rate to 2018 IBC flow rate = 358/171 = 2.08. However, for comparably sized roofs and secondary drains (24-inch scuppers), the difference in the hydraulic head is only 1 inch, which only increases the rain load by about 5 psf.

Discussion must occur for the plumber to be aware of the change in the IBC and ASCE 7 to a 15-minute per 100-year rainfall duration. Engineers should clearly communicate how changes, especially to secondary drain geometry, can impact design rain loads on a roof.

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1612.4

Flood Hazard Documents

CHANGE TYPE: Modification

CHANGE SUMMARY: The design of hydrostatic loads on breakaway walls is required when the walls do not meet the requirements of ASCE 24.

2021 CODE TEXT: **1612.4 Flood hazard documentation.** The following documentation shall be prepared and sealed by a registered design professional and submitted to the building official:

1. For construction in flood hazard areas other than coastal high hazard areas or coastal A zones:

(no changes to items 1.1-1.2)

1.3. For dry floodproofed nonresidential buildings, construction documents shall include a statement that the dry floodproofing is designed in accordance with ASCE 24 and shall include the flood emergency plan specified in Chapter 6 of ASCE 24.

2. For construction in coastal high hazard areas and coastal A zones:

(no changes to items 2.1-2.3)

2.4. For breakaway walls where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.



Photo courtesy of David Crunelle / EyeEm

Flooded commercial area.

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CHANGE SIGNIFICANCE: A flood emergency plan needs to be consistent with ASCE 24, *Flood Resistant Design and Construction*. ASCE 24 requires the submittal and approval of a flood emergency plan where dry floodproofing measures require human intervention, for example, where deployable flood shields are used. Flood emergency plans must specify:

- Storage location of shields
- Method of installation
- Conditions activating installation
- Maintenance of shields and attachment devices
- Periodic practice of installing shields
- Testing of sump pumps and other drainage measures
- Inspection of necessary material and equipment to activate or implement floodproofing

The design professional developing dry floodproofing measures that require human intervention should take into consideration the effort needed to effectively deploy such measures. Preparation of a flood emergency plan ensures that the methods specified by the design professional can be installed and implemented within the given warning time. If a design requires more warning time than reasonably available before the onset of flooding, then the designer should interpret that to mean the contemplated dry floodproofing measures must be redesigned or that dry floodproofing may not be appropriate for the building.

Additionally, maintenance, testing and inspection are critical to ensuring system performance. The possible inability of owners or occupants to implement dry floodproofing due to lack of preparation or maintenance is regarded as an unacceptable risk. After Hurricanes Harvey and Irma, FEMA mitigation assessment teams observed dry floodproofing measures that failed due to inadequate deployment or improper maintenance. Challenges included:

- Systems requiring sizeable crews with heavy and specialized equipment to be mobilized over a period of several days in advance of the storm to install a system.
- Lack of maintenance of gaskets around doors and flood shields that allowed water intrusion.
- Lack of inspection and owner awareness of components integral to dry floodproofing meant inadvertent mis-installation.

Breakaway walls are defined in ASCE 24 as:

> any type of wall subject to flooding that is not required to provide structural support to a building … and is designed and constructed such that … it will collapse … [to] (1) allow free passage of floodwaters, and (2) it does not damage the structure or supporting foundation system.

The walls may be designed using a prescriptive approach following ASCE 24, Section 2.7.2.1 for non-engineered openings or use engineering to design openings following the minimum requirements of Section 2.7.2.2. Per the new Section 1612.4, Item 2.4, when ASCE 24, Section 2.7.2.2 is applied, a statement must be included in the construction documents stating that equalization of hydrostatic flood forces was considered in the design of the openings.

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1704.6

Structural Observations

CHANGE TYPE: Modification

CHANGE SUMMARY: A structural observer must now visually observe the construction of structural systems for general design conformance for all buildings assigned to Risk Category III or IV.

2021 CODE TEXT: **1704.6 Structural observations.** Where required by the provisions of Section 1704.6.1~~, 1704.6.2 or 1704.6.3,~~ the owner or the owner's authorized agent shall employ a registered design professional to perform structural observations. The structural observer shall visually observe representative locations of structural systems, details and load paths for general conformance to the approved construction documents. Structural observation does not include or waive the responsibility for the inspections in Section 110 or the special inspections in Section 1705 or other sections of this code. Prior to the commencement of observations, the structural observer shall submit to the building official a written statement identifying the frequency and extent of structural observations. At the conclusion of the work included in the permit, the structural observer shall submit to the building official a written statement that the site visits have been made and identify any reported deficiencies that, to the best of the structural observer's knowledge, have not been resolved.



Photo courtesy of espion

Visual observation of construction of structural systems.

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1704.6.1 Structural observations for structures. Structural observations shall be provided for those structures where one or more of the following conditions exist:

1. The structure is classified as Risk Category III or IV.
2. The structure is a high-rise building.
3. The structure is assigned to Seismic Design Category E and is greater than two stories above the grade plane.

~~3.~~4. Such observation is required by the registered design professional responsible for the structural design.

~~4.~~5. Such observation is specifically required by the building official.

~~**1704.6.2 Structural observations for seismic resistance.**~~

~~**1704.6.3 Structural observations for wind resistance.**~~

CHANGE SIGNIFICANCE: Because the definition of structural observations in the *2018 International Building Code* (IBC), Chapter 2 was considered vague and disconnected from the Chapter 17 requirements, a new description in Section 1704.6 provides clearer direction for the structural observer duties. The structural observer is expected to observe, in person, gravity and lateral force resisting systems, connection details and gravity and lateral load paths. The clarification is also intended to address a widespread perception of overlap between special inspections and structural observation. Special inspections are very detailed inspections of components and materials within structural systems. Special inspections require specialized training, but they do not necessarily require an understanding of how systems are designed to function as part of the overall building.

Structural observations are general, visual overviews of all structural systems and load paths. Broad knowledge of structural design issues and specific knowledge of their application to the project are necessary. Observations of seismic or wind resisting systems and load paths are to be performed by the same registered design professional that observes gravity systems and load paths. Observations do not strictly adhere to a standard's written procedures in the same manner as special inspections, but rather they focus on whether the construction is consistent with the plans and specifications. An observation answers the question, is the building's structural frame being constructed as directed within the construction documents?

Construction site observations by a structural engineer to verify that as-built construction generally conforms to the structural design intent have historically not been required for certain facilities assigned to Seismic Design Categories A, B or C, and with design wind speeds less than 130 mph (fundamentally, Risk Category III buildings located in areas with low or moderate seismic and wind risk). Examples include schools, colleges, arenas, health care facilities, structures that contain a significant amount of hazardous materials and water treatment plants. Risk Category III includes categories of buildings that represent a substantial hazard to human life in the event of failure. Given the relative risk and hazard, it is deemed appropriate to require that a structural engineer conduct site visits to verify general conformance to the design intent for these structures.

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It should be noted that there are no longer separate categories for wind and seismic structural observations as the requirements were incorporated into the updated Section 1704.6. Various requirements for the structural observation of Risk Category III and IV buildings in high wind regions ($V \geq 130$ mph) now fall under the general requirements of Section 1704.6 for all buildings. Requirements for structural observation of all buildings over two stories above grade plane assigned to Seismic Design Category E have also been relocated to Section 1704.6. Since all buildings in Seismic Design Category F are, by definition, Risk Category IV buildings, they are also addressed within the general provisions of Section 1704.6.

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CHANGE TYPE: Addition

CHANGE SUMMARY: Special inspection requirements for precast concrete diaphragm connections have been added to the list of general concrete special inspections and tests.

Table 1705.3

Special Inspection of Precast Concrete

2021 CODE TEXT:

TABLE 1705.3 Required Special Inspections and Tests of Concrete Construction

Type	Continuous Special Inspection	Periodic Special Inspection	Referenced Standard	IBC Reference
10. Inspect erection of precast concrete members.	–	×	ACI 318: 26.9	–
11. For precast concrete diaphragm connections or reinforcement at joints classified as moderate or high deformability elements (MDE or HDE) in structures assigned to Seismic Design Category C, D, E or F, inspect such connections and reinforcement in the field for:				
a. Installation of the embedded parts	×	–	ACI 318: 26.13.1.3	–
b. Completion of the continuity of reinforcement across joints.	×	–		
c. Completion of connections in the field.	×	–	ACI 550.5	
12. Inspect installation tolerances of precast concrete diaphragm connections for compliance with ACI 550.5.	–	×	ACI 318: 26.13.1.3	–

(Full table not shown for clarity and brevity.)

CHANGE SIGNIFICANCE: Special inspection requirements have been added for precast concrete diaphragms. The American Concrete Institute's (ACI) updated standard ACI 318-19, *Building Code Requirements for Structural Concrete and Commentary*, has new provisions for the design of precast concrete diaphragms in Section 18.12.11. The new ACI 318, Section 26.13.1.3 requires the inspection of concrete panel placement and reinforcement in precast concrete diaphragms assigned to Seismic Design Categories (SDC) C, D, E or F using moderate or high-deformability connections. These diaphragms are also required to comply with the requirements of ACI 550.5-18, *Code Requirements for the Design of Precast Concrete Diaphragms for Earthquake Motions and Commentary*. ACI 550.5 has special inspection requirements for precast concrete diaphragm connections or reinforcement at joints classified as high deformability elements (HDE).

A special inspector observes the installation of embedded parts, checks for the completion of reinforcement continuity across joints and the completion of field connections when structures are assigned to SDC C, D, E and F. ACI 318 Section, 26.13.1.3 also requires that installation tolerances of precast concrete diaphragm connections be inspected for compliance with ACI 550.5.

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Photo courtesy of Ahmet K

Precast concrete diaphragm construction.

To incorporate the new requirements, two new items have been added to Table 1705.3. Item 11 is a conservative synthesis of the two requirements from ACI 318 and ACI 550.5. A continuous special inspection is required onsite for precast concrete diaphragm connections or reinforcement at joints classified as moderate or high deformability elements in structures assigned to SDC C, D, E or F with a focus on the reinforcement continuity across the joint, embedded parts installation and onsite connections completion. Item 12 mirrors the ACI 318 requirement to check diaphragm connections against the installation tolerance requirements of ACI 550.5.

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1705.4.1 Empirically Designed Masonry

CHANGE TYPE: Deletion

CHANGE SUMMARY: Empirically designed masonry is no longer allowed in Risk Category IV buildings.

2021 CODE TEXT: **1705.4.1 ~~Empirically designed masonry, glass~~ Glass unit masonry and masonry veneer in Risk Category IV.** Special inspections and tests for ~~empirically designed masonry,~~ glass unit masonry or masonry veneer designed in accordance with Section ~~2109,~~ 2110 or Chapter 14, respectively, where they are part of a structure classified as Risk Category IV shall be performed in accordance with TMS 602 Level 2 ~~402, Level B Quality Assurance~~.

CHANGE SIGNIFICANCE: Special inspection of empirically designed masonry in Risk Category IV buildings is no longer required because the masonry standard, TMS 402, *Building Code Requirements and Specification for Masonry Structures*, does not allow Risk Category IV buildings to be designed following the empirical design method. TMS 402, Section A.1.2.4 (empirical design of masonry) specifically prohibits the use of empirical design in structures assigned to Risk Category IV. Fire stations, hospitals, police stations, emergency operation centers and other Risk Category IV structures all require engineered design.

Glass unit masonry and masonry veneer continue to be allowed in the construction of Risk Category IV buildings, and the installation of veneer or glass masonry will continue to require special inspection.



Photo courtesy of Papa Bear

Glass block masonry in a Risk Category IV building.

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1705.5.3, 1705.20

Mass Timber Special Inspection

CHANGE TYPE: Addition

CHANGE SUMMARY: Special inspection requirements have been added to address the anchorage and connection of mass timber structural elements.

2021 CODE TEXT: **1705.5.3 Mass timber construction.** Special inspections of mass timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1705.5.3.

TABLE 1705.5.3 Required Special Inspections of Mass Timber Construction

Type	Continuous Special Inspection	Periodic Special Inspection
1. Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		×
2. Inspect erection of mass timber construction.		×
3. Inspection of connections where installation methods are required to meet design loads.		
Threaded fasteners.		
Verify use of proper installation equipment.		×
Verify use of pre-drilled holes where required.		×
Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.		×
Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads.	×	
Adhesive anchors not defined in the preceding cell.		×
Bolted connections.		×
Concealed connections.		×

1705.20 Sealing of mass timber. Periodic special inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.7 is applied to mass timber building elements as designated in the approved construction documents.

CHANGE SIGNIFICANCE: Special inspection provisions have been added to Section 1705 for mass timber elements in Types IV-A, IV-B and IV-C construction. This unique type of construction requires a level of inspection consistent with other large buildings and applications. The special inspections are similar to requirements for other prefabricated systems such as precast concrete and structural steel.

The specific elements requiring special inspection for construction Types IV-A, IV-B and IV-C include:

1. The connection of mass timber elements to timber deep foundation elements. These connections are critical to transfer loads from the mass timber elements to the piles, particularly for lateral loading. Connections to concrete foundations are addressed in IBC Table 1705.3 for concrete special inspections.

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Photo courtesy of ATF Fire Research Laboratory

Connections between mass timber products that utilize threaded, bolted or concealed connections require special inspection.



Photo courtesy of ATF Fire Research Laboratory

Sealants and adhesives specified to resist the passage of air require special inspection.

2. Erection of mass timber elements. Similar to precast concrete, tall wood buildings utilizing prefabricated elements need verification that the correct elements are placed in the correct location in accordance with the design drawings.
3. Specialized connections between mass timber products that utilize threaded, bolted or concealed connections. Similar to concrete connections, the strength of many connections is predicated on specific screw lengths and installation angles. Bolted connections require specific diameters, and for lag screws, specific lengths and diameters. Concealed connectors, many of which are proprietary, must be installed correctly for structural performance.
4. Adhesive anchorage installed in horizontal or upwardly inclined positions resisting sustained tension loads. A continuous special inspection is necessary because of issues with adhesive creep under long-term tension loading. All other adhesive anchors need only be inspected periodically.

If, in the judgment of the building official, there are other unusual connections or assemblies not covered in Table 1705.5.3, special inspection per Section 1705.1.1 will be required. The building official can require special inspections where a manufacturer's installation instructions prescribe requirements not contained in the code. For example, field-glued mass timber beam or panel splices, while currently rare in North America, may become more prevalent in the future. Section 1705.1.1 would allow the building official to require special inspection for either proprietary or non-proprietary field-glued splices. Additionally, many design engineers will specify special inspections for unusual conditions in both their structural notes within the construction documents and in the statement of special inspections.

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The new Section 1705.20 requires periodic special inspection of sealants or adhesives where the sealant or adhesive required by IBC Section 703.7 is applied to mass timber building elements as designated in the approved construction documents. Additionally, the new Section 703.7 requires sealing between mass timber elements in Type IV-A, IV-B and IV-C construction to resist the passage of air at the following locations:

1. At abutting edges and intersections of mass timber building elements required to be fire-resistance rated.
2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire-resistance rated.

Sealants must meet the requirements of the ASTM International standard ASTM C920, *Standard Specification for Elastomeric Joint Sealants,* and adhesives must meet the requirements of ASTM D3498, *Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems*.

Special inspection of mass timber sealing does not apply to "joints" as defined in Section 202 since these fire-resistant joint systems have their own requirements for placement and inspection in Section 715 and special inspections in Section 1705.18. Joints are defined as having an opening that is designed to accommodate building tolerances or to allow independent movement. Panels and members that are connected do not meet the definition of a joint since they are rigidly connected and do not have an opening. It should be noted that some mass timber panels are manufactured under proprietary processes to ensure there are no voids at intersections. Where this proprietary process is incorporated and tested, there is no requirement for a sealant or adhesive.

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1705.10

Structural Integrity of Deep Foundations

CHANGE TYPE: Addition

CHANGE SUMMARY: When installed deep foundation elements appear to be understrength due to quality, location or alignment, an engineering assessment must now be done.

2021 CODE TEXT: **1705.10 Structural Integrity of Deep Foundation Elements.** Whenever there is a reasonable doubt as to the structural integrity of a deep foundation element, an engineering assessment shall be required. The engineering assessment shall include tests for defects performed in accordance with ASTM D4945, ASTM D5882, ASTM D6760 or ASTM D7949, or other approved method.

Chapter 35

ASTM D5882-16: Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations

ASTM D6760-16: Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing

ASTM D7949-14: Standard Test Methods for Thermal Integrity Profiling of Concrete Deep Foundations

CHANGE SIGNIFICANCE: Most foundation failures are caused by inadequate soil bearing or lateral capacity. The new Section 1705.10 addresses a less common failure, a lack of structural integrity in a deep foundation element due to material defects. Significant defects may affect the structural strength of deep foundation elements; therefore, the defects need to be detected and corrected prior to further construction above.



Photo courtesy of Chaiyaporn1144

Verification of deep foundation element strength.

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For example, when the integrity of a deep foundation element is in doubt due to issues in alignment during installation, problematic soil conditions or the inadequacy of construction procedures, a deep foundation element should be load-tested during installation to assure that there are no material defects. The visual special inspection provisions addressing deep foundations in Sections 1705.7, 1705.8 and 1705.9 are unchanged. However, tests have been added in the new Section 1705.10 to provide a means to assess portions of deep foundation elements that cannot be visually inspected. Testing may be done by impact, thermal imaging or UT tests. The applicable ASTM standard is used to define appropriate test procedures.

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1705.13.7 Special Inspection of Storage Racks

CHANGE TYPE: Addition

CHANGE SUMMARY: Steel storage rack special inspection duties have been clarified with the addition of special inspection tasks.

2021 CODE TEXT: **~~1705.12.7~~ 1705.13.7 Storage racks.** ~~Periodic special inspection is required for the anchorage of storage racks that are 8 feet (2438 mm) or greater in height in structures assigned to Seismic Design Category D, E or F.~~ Steel storage racks and steel cantilevered storage racks that are 8 feet (2438 mm) in height or greater and assigned to Seismic Design Category D, E or F shall be provided with periodic special inspection as required by Table 1705.13.7.

TABLE 1705.13.7 Required Inspections of Storage Rack Systems

Type	Periodic Inspection	Referenced Standard	IBC Reference
1. Materials used, to verify compliance with one or more of the material test reports in accordance with the approved construction documents.	×		
2. Fabricated storage rack elements.	×		1704.2.5
3. Storage rack anchorage installation.	×	ANSI/MH16.1 Section 7.3.2	
4. Completed storage rack system, to indicate compliance with the approved construction documents.	×		

CHANGE SIGNIFICANCE: The design of storage rack components is based on a minimum steel thickness and minimum yield strength. It is imperative that these minimum properties be included in the design for component fabrication and considered in storage rack installation. Storage rack systems may have complex load paths. Installation must comply with approved drawings to create the necessary load paths. Verification must be made of material minimum quality requirements during fabrication and correct anchorage during installation.

It has been clarified that periodic special inspection is required for steel storage racks, regular or cantilevered, that are eight feet or more in height in Seismic Design Category D, E or F locations. In addition, a definition of cantilevered steel storage racks has been added for clarity. Additional commentary on the storage rack definitions can be found in the significant changes discussion of Section 2209.

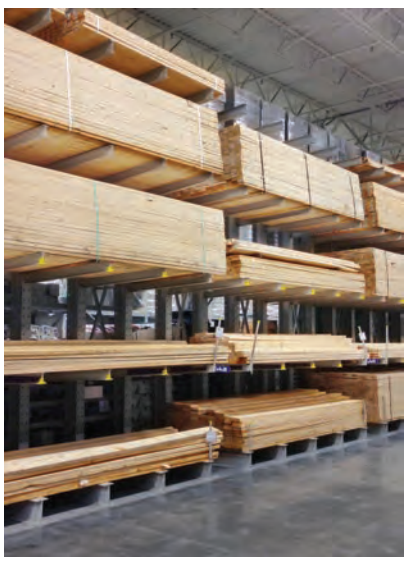


Photo courtesy of Michael Krinke

Cantilevered storage racks.

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1705.18

Firestop Inspections in Group R

CHANGE TYPE: Modification

CHANGE SUMMARY: The installation of firestops, fire-resistant joint systems and perimeter fire barrier systems in residential-use buildings now requires special inspection in those Group R fire areas having an occupant load exceeding 250.

2021 CODE TEXT: ~~**1705.17**~~ **1705.18 Fire-resistant penetrations and joints.** In high-rise buildings ~~or~~, in buildings assigned to Risk Category III or IV, or in fire areas containing Group R occupancies with an occupant load greater than 250, special inspections for through-penetrations, membrane penetration firestops, fire-resistant joint systems and perimeter fire ~~barrier~~ containment systems that are tested and listed in accordance with Sections 714.4.1.2, 714.5.1.2, 715.3.1 and 715.4 shall be in accordance with Section 1705.18.1 or 1705.18.2.

CHANGE SIGNIFICANCE: Firestop, fire-resistant joint system and perimeter fire containment system special inspections are required for buildings in Risk Categories III and IV, as well as in high-rise buildings. However, fire-resistance-rated compartmentation is a critical fire protection feature in many Risk Category II Group R buildings as well. When through-penetration firestop systems and fire-resistant joint systems are not properly installed, the integrity of the fire-rated separations is compromised. To adequately protect people where they live, the requirement for special inspection of firestop, fire-resistant joints and perimeter containment systems has been expanded to include larger buildings containing residential occupancies.

The scope of the special inspection requirement is limited to Group R fire areas containing an occupant load of more than 250 people within the fire area. Unless a high-rise condition exists, such special inspection is not required provided the Group R building has an occupant load of 250 or less, or where the building has been subdivided into complying fire areas so that no Group R fire area occupant load exceeds 250.



Photo courtesy of buzbuzzer

Hotels may require special inspection of firestop systems.

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1709.5

Window and Door Assemblies

CHANGE TYPE: Modification

CHANGE SUMMARY: Testing standards and analysis procedures have been clarified for exterior door and window assemblies, including garage door assemblies.

2021 CODE TEXT: **1709.5 Exterior window and door assemblies.** The design pressure rating of exterior windows and doors in buildings shall be determined in accordance with Section 1709.5.1 or 1709.5.2. For exterior windows and doors tested in accordance with Sections 1709.5.1 or 1709.5.2, required design wind pressures determined from ASCE 7 shall be permitted to be converted to allowable stress design by multiplying by 0.6.

> **Exception:** Structural wind load design pressures for window ~~units smaller~~ or door assemblies other than the size tested in accordance with Section 1709.5.1 or 1709.5.2 shall be permitted to be ~~higher~~ different than the design value of the tested ~~unit~~ assembly, provided that such ~~higher~~ pressures are determined by accepted engineering analysis~~.~~ or validated by an additional test of the window or door assembly to the alternative allowable design pressure in accordance with Section 1709.5.2. Components of the ~~small unit~~ alternate size assembly shall be the same as the tested ~~unit. Where such calculated design pressures are~~ or labeled assembly. Where engineering analysis is used, ~~they~~ it shall be ~~validated by an additional test of the window unit having the highest allowable design pressure.~~ performed in accordance with the analysis procedures of AAMA 2502.

1709.5.1 Exterior windows and doors. Exterior windows and sliding doors shall be tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440. The label shall state the name of the manufacturer,



Photo courtesy of vaximilian

Garage doors must be tested by the manufacturer and labeled.

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the approved labeling agency and the product designation as specified in AAMA/WDMA/CSA 101/I.S.2/A440. Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or comply with Section 1709.5.2. Products tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 shall not be subject to the requirements of Sections 2403.2 and 2403.3.

1709.5.2 Exterior window and door assemblies not provided for in Section 1709.5.1. Exterior window and door assemblies shall be tested in accordance with ASTM E330. ~~Structural performance of garage doors and rolling doors shall be determined in accordance with either ASTM E330 or ANSI/DASMA 108, and shall meet the acceptance criteria of ANSI/DASMA 108.~~ Exterior window and door assemblies containing glass shall comply with Section 2403. The design pressure for testing shall be calculated in accordance with Chapter 16. Each assembly shall be tested for 10 seconds at a load equal to 1.5 times the design pressure.

1709.5.2.1 Garage doors and rolling doors. Garage doors and rolling doors shall be tested in accordance with either ASTM E330 or ANSI/DASMA 108, and shall meet the pass/fail criteria of ANSI/DASMA 108. Garage doors and rolling doors shall be labeled with a permanent label identifying the door manufacturer, the door model/series number, the positive and negative design wind pressure rating, the installation instruction drawing reference number, and the applicable test standard.

CHANGE SIGNIFICANCE: Historically, the IBC has not required any type of label for garage doors. For products that do not have permanent labels, it is nearly impossible for an owner to determine the structural wind load resistance of a building's garage doors. For the past decade, there has been a movement to consider resilience in buildings. As a result, building owners and occupants increasingly want more information about the resilience of the buildings they occupy. Consequently, methods to determine critical components and their performance have been needed. Garage doors are important components of the building envelope, and their performance is critical in preventing wind and water infiltration as well as to maintaining overall structural integrity. Some manufacturers already include permanent labels on their products that provide traceability of manufacture and basic product characteristics.

In response to these issues, garage doors are now required to have a permanent label that provides a way for building owners, homeowners and code officials to be able to determine the performance characteristics of the door after the building has been occupied. The new Section 1709.5.2.1 requires a permanent marking on the garage door indicating the manufacturer, the model/series number and basic performance characteristics regardless of whether the building is in a hurricane-prone region or another geographical area.

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1709.5.3
Impact Protection

CHANGE TYPE: Addition

CHANGE SUMMARY: Required windborne debris protection for glazing has been clarified through the addition of a design standard and a definition of impact protective systems.

2021 CODE TEXT: **1709.5.3 Windborne debris protection.** Protection of exterior glazed openings in buildings located in windborne debris regions shall be in accordance with Section 1609.2.

1709.5.3.1 Impact protective systems testing and labeling. Impact protective systems shall be tested for impact resistance by an approved independent laboratory for compliance with ASTM E1886 and ASTM E1996 and for design wind pressure for compliance with ASTM E330. Required design wind pressures shall be determined in accordance with ASCE 7, and for the purposes of this section, multiplied by 0.6 to convert to allowable stress design.

Impact protective systems shall have a permanent label applied in accordance with Section 1703.5.4 identifying the manufacturer, product designation, performance characteristics, and approved inspection agency.

IMPACT PROTECTIVE SYSTEM. Construction that has been shown by testing to withstand the impact of test missiles and that is applied, attached, or locked over exterior glazing.



Photo courtesy of FotoVoyager

Glazing may be protected by shutters or other protective systems.

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CHANGE SIGNIFICANCE: Although the 2018 IBC does not require any type of label for impact protective systems, the IRC does require such labeling. For products that do not have permanent labels, it becomes nearly impossible to determine the structural wind load resistance and impact resistance of building products. For the past decade, there has been a push towards considering building resilience. As a result, building owners and occupants increasingly want more information about the resilience of the buildings they occupy. This group needs a means to determine how critical building components are expected to perform. Impact protective systems are important building envelope components and their performance is critical to maintaining a building's overall structural integrity during a hurricane.

In IBC-regulated buildings, impact protective systems (hurricane shutters) are now required to have a permanent label that provides a way for building owners and others to determine shutter performance characteristics after the building is in use. Section 1709.5.3 requires a permanent marking on the shutter or other protective system indicating the manufacturer, the model/series number and basic performance characteristics.

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1809.5.1

Frost Protection at Required Exits

CHANGE TYPE: Addition

CHANGE SUMMARY: Frost protection for egress doors has been added to the foundation requirements.

2021 CODE TEXT: **1809.5.1 Frost protection at required exits.** Frost protection shall be provided at exterior landings for all required exits with outward-swinging doors. Frost protection shall only be required to the extent necessary to ensure the unobstructed opening of the required exit doors.

CHANGE SIGNIFICANCE: Frost protection must now be provided for exterior landings at all required means of egress doors. Where frost protection is required, landing areas immediately adjacent to egress doors must be provided with the same frost protection systems as that of the building being served by the exits. This protection is designed to prevent concrete landings from heaving, thereby compromising normal operation of required egress doors. Such heaving actions can render an egress door entirely unusable, creating an untenable situation.

There are multiple conditions that contribute to concrete heaving, making it impossible to predict when and where such heaving may occur. Section 1809.5.1 is intended to provide heave protection only for the area of a landing immediately adjacent to exit doors and only for the area required to allow the door to swing open at least 90 degrees from a closed position. The remaining portions of a larger patio or sidewalk need not be provided with frost protection. Doors that do not swing—for example, a revolving door at a lobby entrance—do not require frost protection.



Photo courtesy of Bim

Frost protection is required in front of a swinging door only.

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Table 1810.3.2.6

Allowable Stresses in Deep Foundations

CHANGE TYPE: Modification

CHANGE SUMMARY: The maximum allowable stress for materials in deep foundation elements has been updated to be consistent with the capacity of materials used today.

2021 CODE TEXT:

TABLE 1810.3.2.6 Allowable Stresses for Materials Used in Deep Foundation Elements

Material Type and Condition	Maximum Allowable Stress[a]
1. Concrete or grout in compression[b]	
Cast-in-place with a permanent casing in accordance with Section 1810.3.2.7 or Section 1810.3.5.3.4	0.4 f'_c
Cast-in-place in ~~a pipe, tube,~~ other permanent casing or rock	0.33 f'_c
Cast-in-place without a permanent casing	0.3 f'_c
Precast nonprestressed	0.33 f'_c
Precast prestressed	0.33 f'_c - 0.27 f_{pc}
2. Nonprestressed reinforcement in compression	0.4 $f_y \leq$ 30,000 psi
3. Steel in compression	
Cores within concrete-filled pipes or tubes	0.5 $F_y \leq$ 32,000 psi
Pipes, tubes or H-piles, where justified in accordance with Section 1810.3.2.8	0.5 $F_y \leq$ 32,000 psi
Pipes or tubes for micropiles	0.4 $F_y \leq$ 32,000 psi
Other pipes, tubes or H-piles	0.35 $F_y \leq$ ~~16,000 psi~~ 24,000 psi
Helical piles	0.6 $F_y \leq$ 0.5 F_u
4. Nonprestressed reinforcement in tension	
Within micropiles	0.6 f_y
Other conditions	
For load combinations that do not include wind or seismic loads	0.5 $f_y \leq$ ~~24,000 psi~~ 30,000 psi
For load combinations that include wind or seismic loads	0.5 $f_y \leq$ 40,000 psi
5. Steel in tension	
Pipes, tubes or H-piles, where justified in accordance with Section 1810.3.2.8	0.5 $F_y \leq$ 32,000 psi
Other pipes, tubes or H-piles	0.35 $F_y \leq$ ~~16,000 psi~~ 24,000 psi
Helical piles	0.6 $F_y \leq$ 0.5 F_u
6. Timber	In accordance with the ANSI/AWC NDS

a. f'_c is the specified compressive strength of the concrete or grout; f_{pc} is the compressive stress on the gross concrete section due to effective prestress forces only; f_y is the specified yield strength of reinforcement; F_y is the specified minimum yield stress of steel; F_u is the specified minimum tensile stress of structural steel.

b. The stresses specified apply to the gross cross-sectional area ~~within~~ of the concrete ~~surface~~ for precast prestressed piles and to the net cross-sectional area for all other piles. Where a temporary or permanent casing is used, the inside face of the casing shall be considered ~~to be~~ the outer edge of the concrete ~~surface~~ cross-section.

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Deep foundation elements.

CHANGE SIGNIFICANCE: Table 1810.3.2.6, Item 1 previously only allowed a maximum allowable stress of 0.40 f'_c for thin-wall casing in deep foundation piles because the concrete is confined. Section 1810.3.2.7 allows cased mandrel-driven cast-in-place elements, a legacy material typically referring to corrugated shell piles, the higher allowable stress of 0.40 f'_c when the piles are much weaker than the steel pipes or tubes following the provisions of Section 1810.3.5.3.4 for steel pipes and tubes. It is reasonable to allow the same maximum allowable stress of 0.40 f'_c when the concrete is confined by a thicker-walled pipe or tube. Therefore, Item 1 now allows the limit of 40 percent of the concrete strength of tubes and pipes referenced in either Section 1810.3.2.7 or Section 1810.3.5.3.4. For other permanent casing or rock, the maximum allowable stress limit is not increased due to variation in the type of permanent casing in this category and because rock as a casing is inherently variable in strength and quality.

For Item 3 in Table 1810.3.2.6 regarding steel in compression, the maximum allowable stress of 0.35 F_y for other steel pipes, tubes and helical piles does not change, but the allowable upper limit has been increased to 24,000 psi because the yield strength for commonly available steel pilings has increased significantly. When the 16,000 psi upper limit was first established, the common steel yield was perhaps 36,000 psi. In the *2021 International Building Code*, yield strengths are normally 50,000 to 60,000 psi. Yields above 70,000 psi are now available and in common use for piling.

Regarding Table 1810.3.2.6, Item 4 dealing with reinforcement in tension, Section 1901.2 states that structural concrete shall be designed and constructed in accordance with the requirements of IBC Chapter 19 and the American Concrete Institute's (ACI) standard ACI 318, *Building Code Requirements for Structural Concrete*. ACI 318 establishes an upper limit of maximum yield strength, F_y, of 80,000 psi for non-prestressed reinforcement; therefore, setting an upper limit of 40,000 psi (50 percent of 80,000 psi) for

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steel provides consistency between the IBC and ACI 318. Using this upper limit for temporary loading conditions, including wind or earthquake loads, is appropriate. Additionally, in Item 4, limiting stresses to 30,000 psi will reduce cracking and the potential for corrosion with permanent load conditions.

Notes for clarity:

1. Stresses should be applied to the net area (gross area minus steel reinforcement area) not to the gross sectional area.
2. Item 1 precast prestressed concrete states a minimum allowable stress of $0.33f'_c - 0.27f_{pc}$. That is an allowable stress obtained by subtracting the applied prestresses from the concrete compressive stress.

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1810.3.3.1.9
Helical Piles

CHANGE TYPE: Clarification

CHANGE SUMMARY: Calculation of the allowable axial design load, P_a, has been clarified.

2021 CODE TEXT: **1810.3.3.1.9 Helical piles.** The allowable axial design load, P_a, of helical piles shall be determined as follows:

$$P_a = 0.5P_u \qquad \textbf{(Equation 18-4)}$$

where P is the least value of:

1. Base capacity plus shaft resistance of the helical pile. The base capacity is equal to the sum ~~Sum~~ of the areas of the helical bearing plates times the ultimate bearing capacity of the soil or rock comprising the bearing stratum. The shaft resistance is equal to the area of the shaft above the uppermost helical bearing plate times the ultimate skin resistance.
2. Ultimate capacity determined from well-documented correlations with installation torque.
3. Ultimate capacity determined from load tests where required by Section 1810.3.3.1.2.



Photo courtesy of Artboy Animation

Helical piles.

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4. Ultimate axial capacity of pile shaft.
5. Ultimate axial capacity of pile shaft couplings.
6. Sum of the ultimate axial capacity of helical bearing plates affixed to pile.

CHANGE SIGNIFICANCE: Larger helical pile elements are now common and shaft friction can play an important role for larger shaft diameters. When determining the allowable axial load, P_a, the base capacity plus the shaft resistance may now be used. Shaft resistance is the shaft area multiplied by the shaft's ultimate skin resistance for the length above the shallowest bearing plate. Base capacity is the soil or rock ultimate bearing capacity in the bearing layer multiplied by the total number of bearing plates multiplied by the plate area for all plates in that layer of soil or rock. The term shaft resistance is used to be consistent with Section 1810.3.3.1.4, addressing allowable shaft resistance.

The determination of ultimate capacity by load testing has never been intended to be a requirement for all piles. Adding the reference to Section 1810.3.3.1.2 for load tests clarifies when a load test for ultimate capacity must be made available. Details for the load test are covered in the load test provisions. Load tests are first required when design compressive loads are greater than those determined for the soils using the allowable stresses specified in Table 1810.3.2.6. A load test is required on one pile within every section of consistent subsoil conditions. When the design load for any deep foundation element is in doubt, a load test of one element in each section with consistent subsoil conditions is required. When cast-in-place deep foundation elements have an enlarged base formed from compacting concrete or by driving a precast base, control test elements shall be tested. The testing protocol must follow either ASTM D 1143, *Standard Test Methods for Deep Foundations Under Static Axial Compressive Load*, or ASTM D4945, *Standard Test Method for High-Strain Dynamic Testing of Deep Foundations*.

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1810.3.5.3.1

Structural Steel H-piles

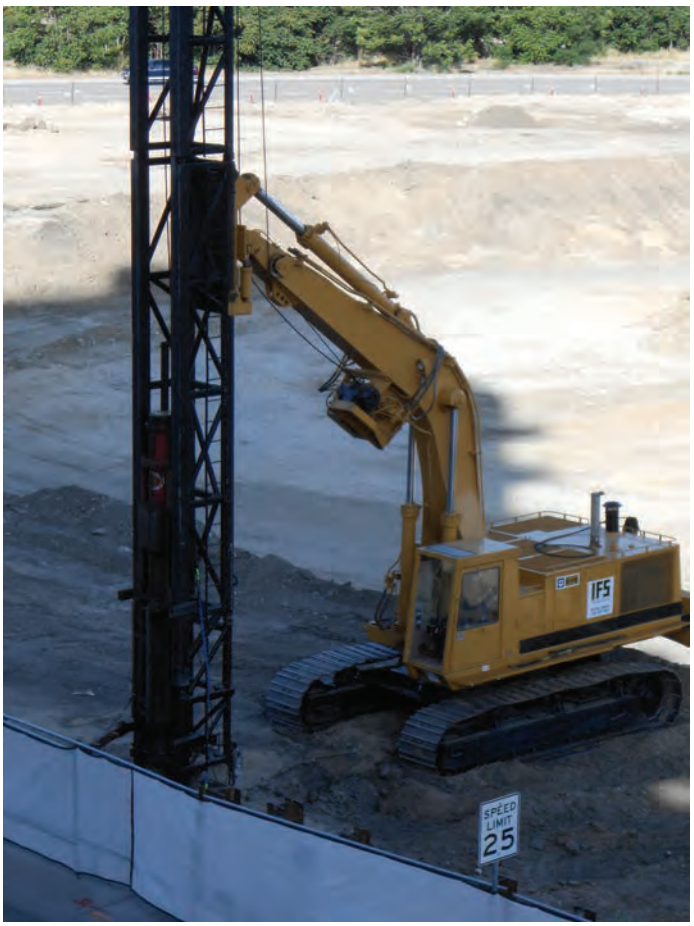
CHANGE TYPE: Modification

CHANGE SUMMARY: The design and detailing of H-piles must now conform with AISC 341 requirements for a structure assigned to Seismic Design Category D, E or F.

2021 CODE TEXT: **1810.3.5.3.1 Structural steel H-piles.** Sections of structural steel H-piles shall comply with the requirements for HP shapes in ASTM A6, or the following:

1. The flange projections shall not exceed 14 times the minimum thickness of metal in either the flange or the web and the flange widths shall be not less than 80 percent of the depth of the section.
2. The nominal depth in the direction of the web shall be not less than 8 inches (203 mm).
3. Flanges and web shall have a minimum nominal thickness of $^3/_8$ inch (9.5 mm).

For structures assigned to Seismic Design Category D, E or F, design and detailing of H-piles shall also conform to the requirements of AISC 341.



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Installation of H-piles.

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CHANGE SIGNIFICANCE: Steel H-piles used in higher seismic design categories are expected to yield just under the pile cap or foundation from a combined bending and axial load. Design and detailing requirements for H-piles in American Institute of Steel Construction's AISC 341, *Seismic Provisions for Structural Steel Buildings,* are intended to produce stable plastic hinge formation in the piles. A plastic hinge is the area along the pile length that yields or stretches with permanent deformation during an earthquake.

Because piles can be subjected to tension caused by an overturning moment during an earthquake, mechanical means to transfer the tension to the pile cap must be designed for the required tension force and not less than 10 percent of the pile compression capacity. This requirement focuses on attachment of a pile to the pile cap with enough strength in the connection that the pile steel will not pull out of the pile cap. See Section 1810.3.11 for more information on changes to the pile cap requirements.

Piles located on site class E or F soils (poor, liquifiable and expansive soils) must satisfy the requirements for moderately ductile members in AISC 341, Section D1.1.

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1810.3.6 Deep Foundation Element Splicing

CHANGE TYPE: Modification

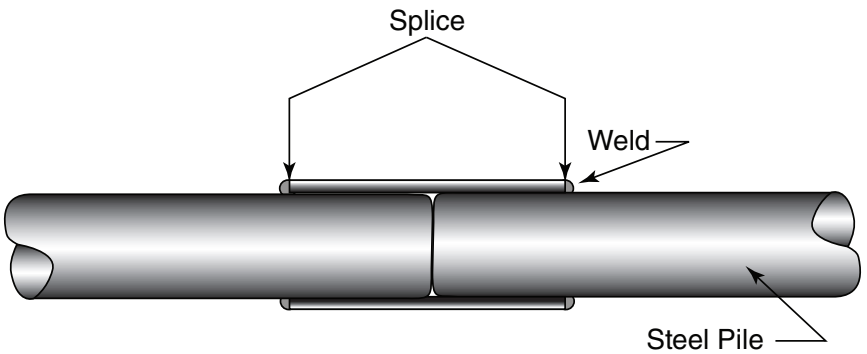
CHANGE SUMMARY: Deep foundation element splices for buildings in Seismic Design Category A and B regions designed by general engineering practices do not have to meet the 50 percent tension and bending capacity requirements.

2021 CODE TEXT: **1810.3.6 Splices.** Splices shall be constructed so as to provide and maintain true alignment and position of the component parts of the deep foundation element during installation and subsequent thereto and shall be designed to resist the axial and shear forces and moments occurring at the location of the splice during driving and for design load combinations. Where deep foundation elements of the same type are being spliced, splices shall develop not less than 50 percent of the bending strength of the weaker section. Where deep foundation elements of different materials or different types are being spliced, splices shall develop the full compressive strength and not less than 50 percent of the tension and bending strength of the weaker section. Where structural steel cores are to be spliced, the ends shall be milled or ground to provide full contact and shall be full-depth welded.

> **Exception:** For buildings assigned to Seismic Design Category A or B, splices need not comply with the 50 percent tension and bending strength requirements where justified by supporting data.

Splices occurring in the upper 10 feet (3048 mm) of the embedded portion of an element shall be designed to resist at allowable stresses the moment and shear that would result from an assumed eccentricity of the axial load of 3 inches (76 mm), or the element shall be braced in accordance with Section 1810.2.2 to other deep foundation elements that do not have splices in the upper 10 feet (3048 mm) of embedment.

CHANGE SIGNIFICANCE: Splices must be designed to resist axial and shear forces as well as moments occurring at a splice location. Conformance with this requirement ensures the structural integrity of the splice. Section 1810.3.6.1 contains restrictive splice requirements for structures assigned to Seismic Design Categories C through F. For low seismic areas, commonly available splices are acceptable in many design situations, such as a splice located deep enough that significant tension or



Steel pile splice.

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bending demands are not expected or possible. Load requirements at the splice diminish due to soil resistance above the splice when the splice is located at depth.

Splices in low seismic design categories are exempt from having to be designed to 50 percent of the tension and bending strength of the pile material. For example, if friction piles are driven to 240 feet, the splice between the two 120 foot sections is 120 feet below grade. These piles do not need to be checked for a capacity of 50 percent of the pile tension and bending capacity. The pile is braced at the splice by the surrounding soil.

All other requirements of Section 1810.3.6 continue to apply for pile splices in areas assigned as Seismic Design Categories A and B.

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1810.3.8

Precast Concrete Piles

CHANGE TYPE: Modification

CHANGE SUMMARY: Precast concrete piles are now to be designed in accordance with ACI 318 rather than IBC provisions.

2021 CODE TEXT: **1810.3.8 Precast concrete piles.** Precast concrete piles shall be designed and detailed in accordance with ~~Sections 1810.3.8.1 through 1810.3.8.3~~ ACI 318.

Exceptions:

1. For precast prestressed piles in Seismic Design Category C, the minimum volumetric ratio of spirals or circular hoops required by Section 18.13.5.10.4 of ACI 318 shall not apply in cases where the design includes full consideration of load combinations specified in ASCE 7, Section 2.3.6 or Section 2.4.5 and the applicable overstrength factor, Ω_0. In such cases, minimum transverse reinforcement index shall be as specified in Section 13.4.5.6 of ACI 318.
2. For precast prestressed piles in Seismic Design Categories D through F, the minimum volumetric ratio of spirals or circular hoops required by Section 18.13.5.10.5(c) of ACI 318 shall not apply in cases where the design includes full consideration of load combinations specified in ASCE 7, Section 2.3.6 or Section 2.4.5 and the applicable overstrength factor, Ω_0. In such cases, the minimum transverse reinforcement shall be as specified in Section 13.4.5.6 of ACI 318.

~~**1810.3.8.1 Reinforcement.**~~

~~**1810.3.8.2 Precast nonprestressed piles.**~~



Photo courtesy of Chaiyaporn1144

Precast piles.

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~~**1810.3.8.3 Precast prestressed piles.**~~

~~**1810.3.8.3.4 Axial load limit in Seismic Design Categories C through F.**~~

(Sections 1810.3.8.1 Reinforcement through 1810.3.8.3.4 Axial load limit in SDC C-F deleted without replacement)

CHANGE SIGNIFICANCE: Sections 1810.3.8.1 through 1810.3.8.3.4 of the IBC have been deleted as similar provisions are included in Chapter 18 of the 2019 edition of ACI 318, *Building Code Requirements for Structural Concrete*. Two exceptions for precast prestressed piles are retained in the 2021 IBC.

Section 1810.3.8.3.2 and Section 1810.3.8.3.3, Item 5 of the 2018 IBC form exception Items 1 and 2 in the 2021 IBC allowing the use of the overstrength factor of ASCE 7 by applying the factor to the load equations with seismic loads included to replace a design following ACI 318. These provisions were not included in ACI 318-19 and thus remain in the IBC.

Exceptions 1 and 2 recognize that the volumetric ratio of spiral reinforcement need not be greater than that required for driving and handling stresses when a pile foundation system is designed for load combinations including overstrength. The minimum spiral reinforcement required per ACI 318, Section 13.4.5.6 for driving and handling stresses is the minimum spiral reinforcement required in Seismic Design Categories A and B.

Increased axial forces, shear forces and bending moments provide a large factor of safety against nonlinear pile behavior when the design includes overstrength effects.

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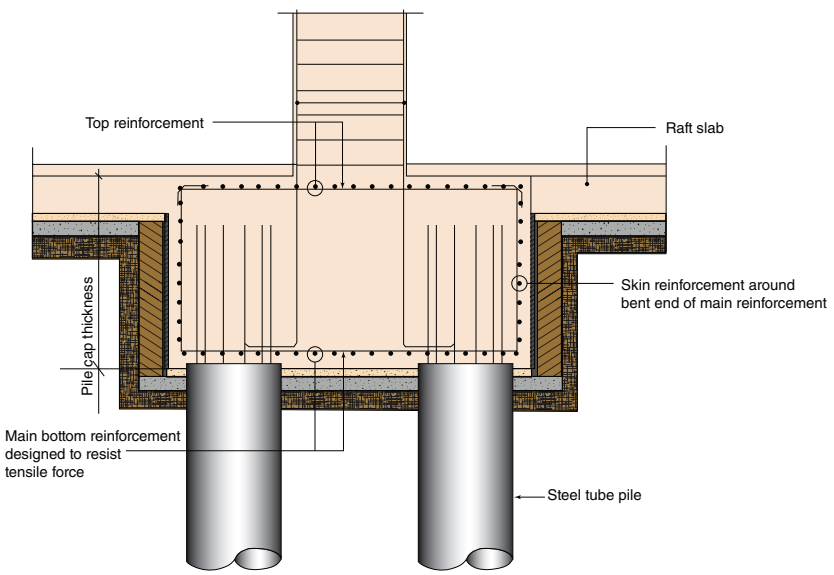
1810.3.11
Pile Caps

CHANGE TYPE: Modification

CHANGE SUMMARY: Pile cap requirements have been updated to align with the 2019 edition of ACI 318.

2021 CODE TEXT: **1810.3.11 Pile caps.** Pile caps shall conform with ACI 318 and this section. Pile caps shall be of reinforced concrete and shall include all elements to which vertical deep foundation elements are connected, including grade beams and mats. The soil immediately below the pile cap shall not be considered as carrying any vertical load, with the exception of a combined pile raft. The tops of vertical deep foundation elements shall be embedded not less than 3 inches (76 mm) into pile caps and the caps shall extend not less than 4 inches (102 mm) beyond the edges of the elements. The tops of elements shall be cut or chipped back to sound material before capping.

1810.3.11.1 Seismic Design Categories C through F. For structures assigned to Seismic Design Category C, D, E or F, concrete deep foundation elements shall be connected to the pile cap ~~by embedding the element reinforcement or field-placed dowels anchored in the element into the pile cap for a distance equal to their development length~~ in accordance with ACI 318. ~~It shall be permitted to connect precast prestressed piles to the pile cap by developing the element prestressing strands into the pile cap provided that the connection is ductile. For deformed bars, the development length is the full development length for compression, or tension in the case of uplift, without reduction for excess reinforcement in accordance with Section 25.4.10 of ACI 318. Alternative measures for laterally confining concrete and maintaining toughness and ductile-like behavior at the top of the element shall be permitted provided that the design is such that any hinging occurs in the confined region. The minimum transverse steel ratio for confinement shall be not less than one-half of that required for columns.~~



Pile cap connecting two foundation piles.

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For resistance to uplift forces, anchorage of steel pipes, tubes or H-piles to the pile cap shall be made by means other than concrete bond to the bare steel section. Concrete-filled steel pipes or tubes shall have reinforcement of not less than 0.01 times the cross-sectional area of the concrete fill developed into the cap and extending into the fill a length equal to two times the required cap embedment, but not less than the development length in tension of the reinforcement.

1810.3.11.2 Seismic Design Categories D through F. For structures assigned to Seismic Design Category D, E or F, deep foundation element resistance to uplift forces or rotational restraint shall be provided by anchorage into the pile cap, designed considering the combined effect of axial forces due to uplift and bending moments due to fixity to the pile cap. Anchorage shall develop not less than 25 percent of the strength of the element in tension. Anchorage into the pile cap shall comply with the following:

(No changes to Items 1 and 2)

3. The connection between the pile cap and the steel H-piles or unfilled steel pipe piles in structures assigned to Seismic Design Category D, E or F shall be designed for a tensile force of not less than 10 percent of the pile compression capacity.

Exceptions:

1. Connection tensile capacity need not exceed the strength required to resist seismic load effects including overstrength of ASCE 7 Section 12.4.3 or 12.14.3.2.
2. Connections need not be provided where the foundation or supported structure does not rely on the tensile capacity of the piles for stability under the design seismic force.

Where the vertical lateral-force-resisting elements are columns, the pile cap flexural strengths shall exceed the column flexural strength. The connection between batter piles and pile caps shall be designed to resist the nominal strength of the pile acting as a short column. Batter piles and their connection shall be designed to resist forces and moments that result from the application of seismic load effects including overstrength factor in accordance with Section 2.3.6 or 2.4.5 of ASCE 7.

CHANGE SIGNIFICANCE: Steel piles used in higher seismic design categories are expected to yield just under the pile cap or foundation because of combined bending and axial loads. The design and detailing requirements of AISC 341 for piles are intended to produce a stable plastic hinge formation in steel piles. Requirements within ACI 318 are similarly intended to produce stable plastic hinges in concrete piles. Because piles can be subjected to tension caused by an overturning moment, mechanical means to transfer such tension must be designed for the required tension force, but not less than 10 percent of the pile compression capacity.

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1810.4.5
Vibratory Drivers

CHANGE TYPE: Modification

CHANGE SUMMARY: Where vibratory drivers are used to install piles, load tests are no longer required when pile installation is completed with an impact hammer or when a pile is only used for lateral resistance.

2021 CODE TEXT: **1810.4.5 Vibratory driving.** Vibratory drivers shall only be used to install deep foundation elements where the element load capacity is verified by load tests in accordance with Section 1810.3.3.1.2. The installation of production elements shall be controlled according to power consumption, rate of penetration or other approved means that ensure element capacities equal or exceed those of the test elements.

Exceptions:

1. The pile installation is completed by driving with an impact hammer in accordance with Section 1810.3.3.1.1.
2. The pile is to be used only for lateral resistance.



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Vibratory Hammer.

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CHANGE SIGNIFICANCE: Axial load tests are only needed when there are axial loads and the pile capacity is in doubt. Piles that are started using a vibratory hammer but completed using an impact hammer should be regulated as piles that are installed by an impact hammer, thus no load tests are required. An impact hammer can be used to assure that the minimum required axial capacity has been achieved or exceeded. The driving criteria of Section 1810.3.3.1.1 require the use of approved driving formulas when allowable loads are less than 40 tons if using an impact hammer. For allowable loads greater than 40 tons, the wave equation analysis method must be utilized to estimate the allowable compressive load.

The exception for piles used only for lateral resistance is applicable because a load test for axial capacity, as required by Section 1810.3.3.1.2, is not appropriate for piles providing lateral resistance only. Lateral load capacity requirements are addressed in Section 1810.3.3.2, requiring calculation of the lateral loads through an approved analysis method or lateral load tests to a minimum of twice the proposed design load.

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1901.2

Concrete Design and Construction

CHANGE TYPE: Modification

CHANGE SUMMARY: ACI 318 has been updated to the 2019 edition and includes changes addressing deep foundations, materials and seismic design.

2021 CODE TEXT: **1901.2 Plain and reinforced concrete.** Structural concrete shall be designed and constructed in accordance with the requirements of this chapter and ACI 318 as amended in Section 1905 of this code...

Chapter 35

318—~~14~~19: Building Code Requirements for Structural Concrete

CHANGE SIGNIFICANCE: The American Concrete Institute's *Building Code Requirements for Structural Concrete* (ACI 318) includes requirements for the design and construction of structural concrete necessary to ensure public health and safety. The 2019 edition is now referenced, with changes responding to new developments in materials, structural systems and seismic design. Not only have the structural design provisions changed, materials advancement and placement techniques are addressed resulting in procedural changes.

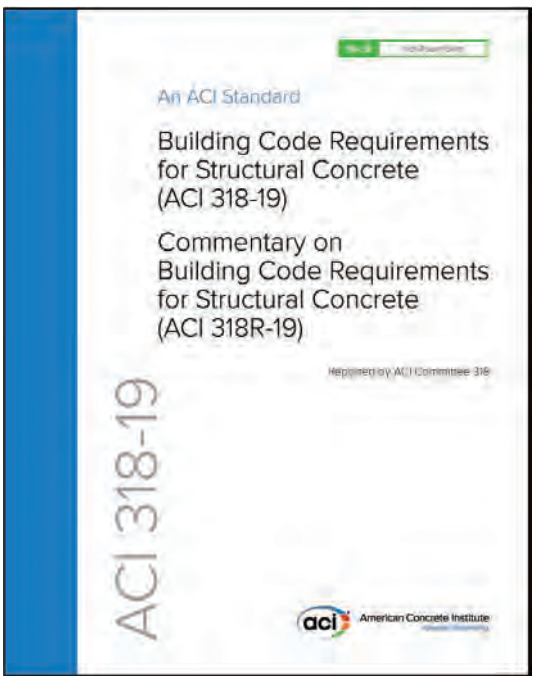


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ACI 318-19 Requirements for Structural Concrete.

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Changes include:

- For the seismic design of structural walls, ACI 318 introduces several new design requirements. New provisions require cross ties with 135-degree hooks, vertical lap splice location restrictions near plastic hinge zones and wall design shear amplification based on flexural overstrength.
- The precast concrete diaphragm design procedure of ACI 550.5, *Code Requirements for the Design of Precast Concrete Diaphragms for Earthquake Motions,* has been adopted. The design method in ACI 550.5 gives designers connection options for selecting a precast concrete diaphragm's target performance when subject to seismic forces.
- Chapter 17, Anchoring to Concrete, has been reorganized and Chapter 26, Construction Documents and Inspection, has been updated.
- Shear provisions have been updated to deal with concerns that requirements were inadequate for the design of thick slabs or deep beams. Provisions addressing one-way shear and two-way punching shear have been consolidated from what was previously a wide range of equations. A method has been added to include size effect in shear design to avoid issues wherein increasing a member's size can reduce its design unit shear strength. The new shear equations also allow a design engineer to consider the reinforcement ratio.
- Structural concrete materials, quality control measures and construction methods are continually evolving, resulting in revisions to ACI 318 provisions. Changes include a new variable for light-weight concrete in design equations, a modified definition for the modulus of elasticity and updated provisions for higher strength reinforcement.

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1901.7

Structural Concrete Tolerances

CHANGE TYPE: Addition

CHANGE SUMMARY: American Concrete Institute standards ACI 117 and ITG-7 have been added to the IBC by reference to provide acceptable tolerances for concrete construction.

2021 CODE TEXT: **1901.7 Tolerances for structural concrete.** Where not indicated in construction documents, structural tolerances for concrete structural elements shall be in accordance with this section.

1901.7.1 Cast-in-place concrete tolerances. Structural tolerances for cast-in-place concrete structural elements shall be in accordance with ACI 117.

Exceptions:

1. Group R-3 detached one- or two-family dwellings are not required to comply with this section.
2. Shotcrete is not required to comply with this section.

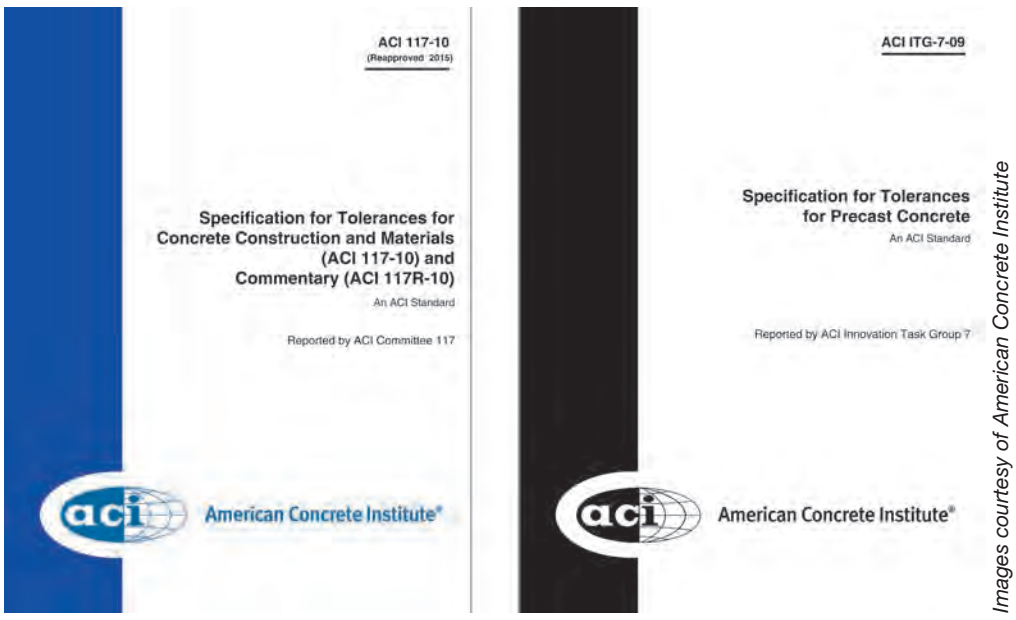
1901.7.2 Precast concrete tolerances. Structural tolerances for precast concrete structural elements shall be in accordance with ACI ITG-7.

Exception: Group R-3 detached one- or two-family dwellings are not required to comply with this section.

Chapter 35

117-10: Specification for Tolerances for Concrete Construction and Materials

ITG-7-09: Specification for Tolerances for Precast Concrete



Images courtesy of American Concrete Institute

ACI 117 and ACI ITG-7.

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CHANGE SIGNIFICANCE: Two standards are now referenced regarding the allowable tolerances of structural concrete elements when such tolerances have not been indicated in construction documents, providing building departments, designers, contractors and special inspectors with information necessary for concrete design and construction within appropriate tolerances.

ACI 117-10, *Specification for Tolerances for Concrete Construction and Materials*, designates standard tolerances for concrete construction. Applicable to exposed concrete and architectural concrete, tolerances in the specification are for typical concrete construction and construction procedures. Materials that interface with, or connect to, concrete elements may have tolerance requirements that are not compatible with those contained in ACI 117. Care should be taken to verify that concrete tolerances work with the steel or wood tolerances of each structural assembly. This specification does not apply to precast concrete or to shotcrete.

As a best practice, a series of preconstruction tolerance coordination meetings should be scheduled and held before the commencement of concrete work. The contractor, subcontractors, material suppliers and other key parties should all attend. At the meeting, all parties should be given an opportunity to identify any tolerance questions and conflicts applicable to the work with materials, prefabricated elements and work to be assembled or installed in the field by the contractor.

ACI ITG 7-09, *Specification for Tolerances for Precast Concrete*, provides standard tolerances for precast concrete construction, deals with dimensional tolerances for precast concrete members used in building construction, and addresses erection tolerances for the individual members. A specifier can supplement the provisions of ITG-7 as needed by including project-specific requirements in the contract documents.

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2109.2.4.8

Exterior Finish of Adobe Masonry

CHANGE TYPE: Addition

CHANGE SUMMARY: The use of plaster as an exterior finish for adobe construction has been clarified, with cement-lime, lime and clay plaster minimum requirements now addressed.

2021 CODE TEXT: ~~**2109.2.4.8 Exterior finish.** Exterior walls constructed of unstabilized adobe units shall have their exterior surface covered with not fewer than two coats of Portland cement plaster having a minimum thickness of 3/4 inch (19.1 mm) and conforming to ASTM C 926. Lathing shall comply with ASTM C 1063. Fasteners shall be spaced at 16 inches (406 mm) on center maximum. Exposed wood surfaces shall be treated with an approved wood preservative or other protective coating prior to lath application.~~

2109.2.4.8 Exterior finish. Exterior finishes applied to adobe masonry walls shall be of any type permitted by this section or Chapter 14, except where stated otherwise in this section.

2109.2.4.8.1 Where required. Unstabilized adobe masonry walls shall receive a weather protective exterior finish in accordance with Section 2109.2.4.8.

2109.2.4.8.2 Vapor permeance. Plaster and finish assemblies shall have a vapor permeance of not less than 5 perms.

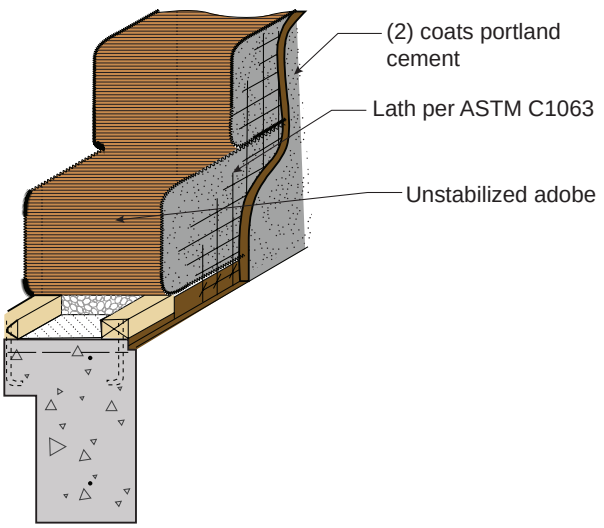
> **Exception:** Insulation products applied to the exterior of stabilized adobe masonry walls in Climate Zones 2B, 3B, 4B and 5B shall not have a vapor permeance requirement.

2109.2.4.8.3 Plaster thickness and coats. Plaster applied to adobe masonry shall be not less than 7/8 inches (22 mm) and not greater than 2 inches (51 mm) thick. Plaster shall be applied in not less than two coats.



Photo courtesy of BCFC

Exterior finish in adobe construction.



Details of adobe construction.

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2109.2.4.8.4 Plaster application. Where plaster is applied directly to adobe masonry walls, no intermediate membrane shall be used.

2109.2.4.8.5 Lath for plaster. Lath shall be provided for all plasters, except where not required elsewhere in Section 2019.2.4.8. Fasteners shall be corrosion resistant and spaced at a maximum of 16 inches (406 mm) on center with a minimum 1½-inches (38 mm) penetration into the adobe wall. Metal lath shall comply with ASTM C1063, as modified by this section, and shall be corrosion resistant. Plastic lath shall comply with ASTM C1788, as modified by this section. Wood substrates shall be protected with No. 15 asphalt felt, an approved wood preservative or other protective coating prior to lath application.

2109.2.4.8.6 Cement plaster. Cement plaster shall conform to ASTM C926 and shall comply with Chapter 25, except that the proportion of lime in plaster coats shall be not less than 1 part lime to 4 parts cement. The combined thickness of plaster coats shall not exceed 1 inch (25mm).

2109.2.4.8.7 Lime Plaster. Lime plaster is any plaster with a binder composed of calcium hydroxide, including Type N or S hydrated lime, hydraulic lime, natural hydraulic lime, or slaked quicklime. Hydrated lime shall comply with ASTM C206. Hydraulic lime shall comply with ASTM C1707. Natural hydraulic lime shall comply with ASTM C141 and EN 459. Quicklime shall comply with ASTM C5.

2109.2.4.8.8 Cement-lime plaster. Cement-lime plaster shall be any plaster mix type CL, F or FL, as described in ASTM C926.

2109.2.4.8.9 Clay Plaster. Clay plaster shall comply with this section.

2109.2.4.8.9.1 General. Clay plaster shall be any plaster having a clay or clay subsoil binder. Such plaster shall contain sufficient clay to fully bind the aggregate and shall be permitted to contain reinforcing fibers. Acceptable reinforcing fibers include chopped straw, sisal, and animal hair.

2109.2.4.8.9.2 Clay subsoil requirements. The suitability of clay subsoil shall be determined in accordance with the Figure 2 Ribbon Test and the Figure 3 Ball Test in the appendix of ASTM E2392/E2392M.

2109.2.4.8.9.3 Weather-exposed locations. Clay plaster exposed to water from direct or wind-driven rain or snow shall be finished with an approved erosion-resistant finish. The use of clay plasters shall not be permitted on weather-exposed parapets.

2109.2.4.8.9.4 Prohibited finish coat. Plaster containing Portland cement shall not be permitted as a finish over clay plaster.

2109.2.4.8.9.5 Conditions where lathing is not required. For unstabilized adobe walls finished with unstabilized clay plaster, lathing shall not be required.

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CHANGE SIGNIFICANCE: Adobe walls require vapor-permeable finishes to ensure appropriate performance and service life. Moisture that is trapped within adobe wall assemblies can cause failures due to finish separation, salt attack, coving and freeze-thaw related spalling. Although it is accepted that earthen walls require vapor-permeable finishes to adequately manage moisture in the assembly, previous code text has been based on legacy requirements that predate current building science. To maintain vapor permeance, Class I and II vapor retarders are prohibited as they are effectively impermeable, having perm ratings of less than 1.

While stabilized adobe does not require any exterior finishes, unstabilized adobe masonry walls are subject to erosion from precipitation. Unstabilized adobe is required to be finished with conventional cement stucco, a finishing system that without modification has been shown to have insufficient permeability. Lime plasters, frequently recommended for use on earthen and other monolithic masonry systems, are now addressed in Section 2109.2.4.8.7.

Clay plasters are a desirable finishing system and are readily available, low cost, have low-embodied carbon and are vapor-permeable. Due to the susceptibility of clay plasters to erosion, specific requirements for the material are necessary. Reinforcing fibers are frequently added to inhibit and control cracking. As clay plasters may be successfully installed without reinforcing fiber (dependent on the material qualities of the clay/sand/aggregate mix), fiber use is not required.

A few types of clay are not suitable for use in clay plasters as they are too expansive or do not provide sufficient binding characteristics. ASTM E2392 is to be referenced to assess the material suitability. The 7/8-inch minimum thickness is required to provide the desired weather protection benefits and to match industry practice. Lime plasters and linseed oil surface applications have also been successfully used to inhibit erosion of rain-exposed clay plasters. Limits on the maximum thickness of applied plasters are required to ensure that they securely bond to the substrate. The 2-inch thickness limitation is consistent with the limit in IRC Appendix S for strawbale construction.

Metallic laths are conventionally used for Portland cement-based plasters. Requirements and conditions for their use are provided by reference to ASTM standards. ASTM C1063, *Standard Specification for the Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster,* and ASTM C926, *Standard Specification for the Application of Portland Cement-Based Plaster,* contain information on metallic lath use with cement plaster.

Requirements for exterior finishes of adobe masonry walls were primarily based on IRC Appendix S, Strawbale Construction, the 2015 *New Mexico Earthen Building Materials Code*, and ASTM E2392, *Standard Guide for Design of Earthen Wall Building Systems*.

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2205.2.1

AISC 358 for Prequalified Connections

CHANGE TYPE: Modification

CHANGE SUMMARY: Beam-column moment connections in Seismic Design Category B and C buildings are now required to be prequalified where the response modification coefficient exception is not applied.

2021 CODE TEXT: **2205.2.1.1 Seismic Design Category B or C.** Structures assigned to Seismic Design Category B or C shall be of any construction permitted in Section 2205. Where a response modification coefficient, *R*, in accordance with ASCE 7, Table 12.2-1, is used for the design of structures assigned to Seismic Design Category B or C, the structures shall be designed and detailed in accordance with the requirements of AISC 341. Beam-to-column moment connections in special moment frames and intermediate moment frames shall be prequalified in accordance with AISC 341, Section K1, qualified by testing in accordance with AISC 341, Section K2, or shall be prequalified in accordance with AISC 358.

Exception: The response modification coefficient, *R*, designated for "Steel systems not specifically detailed for seismic resistance, excluding cantilever column systems" in ASCE 7, Table 12.2-1, shall be permitted for systems designed and detailed in accordance with AISC 360, and need not be designed and detailed in accordance with AISC 341.

2205.2.1.2 Seismic Design Category D, E or F. Structures assigned to Seismic Design Category D, E or F shall be designed and detailed in accordance with AISC 341, except as permitted in ASCE 7, Table

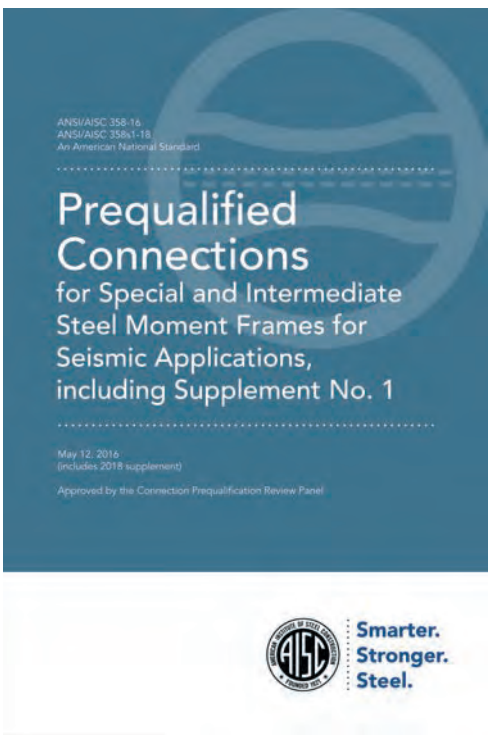


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AISC 358-Prequalified Connections.

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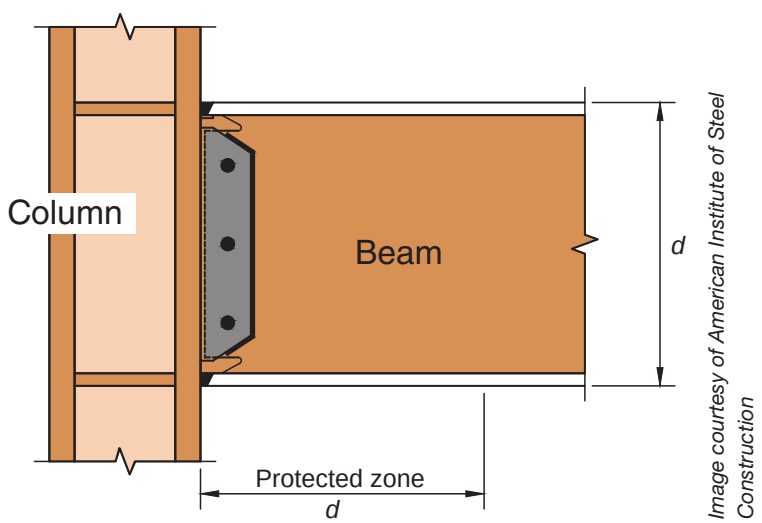
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15.4-1. Beam-to-column moment connections in special moment frames and intermediate moment frames shall be prequalified in accordance with AISC 341, Section K1, qualified by testing in accordance with AISC 341, Section K2, or shall be prequalified in accordance with AISC 358.

CHANGE SIGNIFICANCE: AISC 358, *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications*, includes requirements for the design, detailing, fabrication and quality control of tested connections for use with intermediate and special moment frames. In the past, AISC 358 was directly referenced in AISC 341, *Seismic Provisions for Structural Steel Buildings*, which is referenced in the *International Building Code*. However, supplements to AISC 358 are now produced more frequently than new editions of AISC 341, with the net effect of not recognizing these newer steel provisions in the code, which leads to confusion among building officials, registered design professionals and manufacturers regarding prequalified connections.

By directly referencing AISC 358 in the IBC, the most up-to-date standard is accommodated. AISC 358 is just one approach for the design of structural steel connections for seismic loads. Section K1 or K2 of AISC 341 may also be used. Section K1 offers minimum requirements for the process of prequalifying a beam-to-column connection used in a special or intermediate moment frame. The intent is to allow the use of a few connection configurations that have been tested to the point where typical performance is understood for a narrow set of construction tolerances. Both Section K1 and AISC 358 are based on the premise of a pre-tested connection for a moment frame. Section K2 of AISC 341, addressing testing requirements for both beam-to-column moment frame connections and link-to-column braced frame connections, includes a simplified list of requirements that can be used to create a specific beam-column connection test protocol.

Examples of prequalified moment frame connections are a Welded Unreinforced Flange-Welded Web (WUF-W) connection and a Bolted Flange Plate (BFP) connection. Each structural steel connection ties a beam to a column.



Welded Unreinforced Flange-Welded Web (WUF-W) connection.

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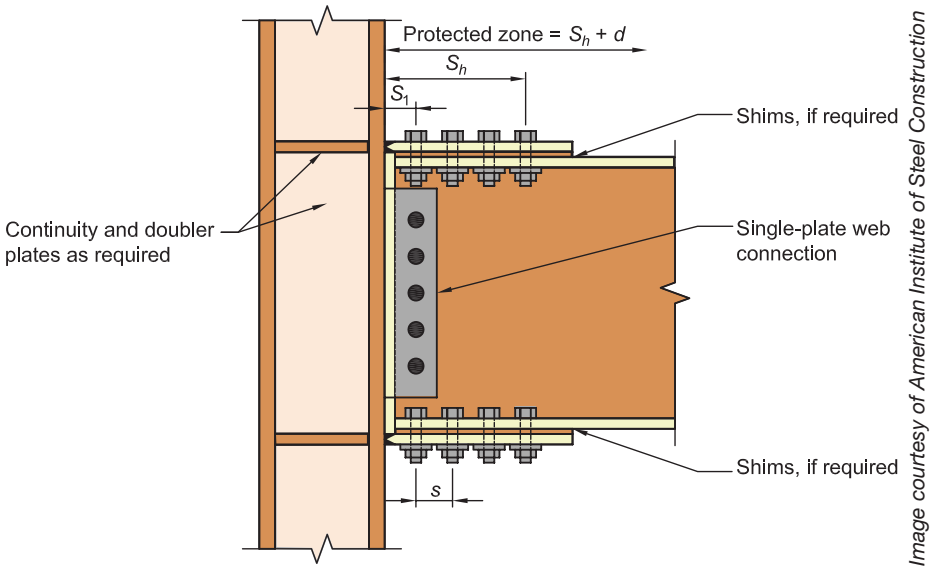


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Bolted Flange Plate (BFP) connection.

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2209
Steel Storage Racks

CHANGE TYPE: Modification

CHANGE SUMMARY: Requirements for steel storage racks and their anchorage qualification continue to be clarified.

2021 CODE TEXT: **2209.1 ~~Storage~~ Steel storage racks.** The design, testing and utilization of steel storage racks made of cold-formed or hot-rolled steel structural members shall be in accordance with RMI ANSI/MH 16.1. Where required by ASCE 7, the seismic design of steel storage racks shall be in accordance with Section 15.5.3 of ASCE 7.

2209.2 ~~Cantilevered steel~~ Steel cantilevered storage racks. The design, testing and utilization of steel cantilevered storage racks made of cold-formed or hot-rolled steel structural members shall be in accordance with RMI ANSI/MH 16.3. Where required by ASCE 7, the seismic design of steel cantilevered ~~steel~~ storage racks shall be in accordance with Section 15.5.3 of ASCE 7.

2209.3 Certification. For rack storage structures that are 8 feet (2438 mm) in height or greater to the top load level and assigned to Seismic Design Category D, E, or F at completion of the storage rack installation, a certificate of compliance shall be submitted to the owner or the owner's authorized agent stating that the work was performed in accordance with approved construction documents.

Storage Racks, Steel. Cold-formed or hot-rolled steel structural members which are formed into steel storage racks, including pallet storage racks, movable-shelf racks, rack-supported systems, automated storage and retrieval systems (stacker racks), push-back racks, pallet-flow racks, case-flow racks, pick modules and rack-supported platforms. Other types of racks, such as drive-in or drive-through racks, cantilever racks, portable racks or racks made of materials other than steel, are not considered storage racks for the purpose of this code.

Storage Racks, Steel Cantilevered. A framework or assemblage composed of cold-formed or hot-rolled steel structural members, primarily in the form of vertical columns, extended bases, horizontal arms projecting from the faces of the columns, and longitudinal (down-aisle) bracing between columns. There may be shelf beams between the arms, depending on the products being stored; this definition does not include other types of racks such as pallet storage racks, drive-in racks, drive-through racks, or racks made of materials other than steel.

CHANGE SIGNIFICANCE: The addition of a steel cantilevered storage rack definition acknowledges that this common type of storage rack has different load and design requirements than a standard steel storage rack. The definition of a steel cantilevered storage rack is consistent with that found in ASCE 7, Section 11.2 and specifically states that the racks will be made of structural steel, that the arms cantilever and that the definition is not applicable to other types of steel storage racks.



Photo courtesy of Michael Krinke

Cantilevered storage rack.

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The design of the components utilized in steel storage racks are based on minimum thicknesses and minimum yield strength. Storage rack systems can be complex, and their fabrication and installation must comply with the approved drawings. The installation and anchorage of storage racks in high seismic regions require special inspection. In addition, a certificate of compliance is to be provided to the owner stating that the rack was installed following the approved construction documents.

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2303.2

Fire-Retardant-Treated Wood

CHANGE TYPE: Modification

CHANGE SUMMARY: ASTM E84 has been updated to now include requirements previously only addressed in the IBC; accordingly, the code language has been deleted.

2021 CODE TEXT: **2303.2 Fire-retardant-treated wood.** Fire-retardant-treated wood is any wood product that, when impregnated with chemicals by a pressure process or other means during manufacture, shall have, when tested in accordance with ASTM E84 or UL 723, a listed flame spread index of 25 or less, ~~and show no evidence of significant progressive combustion when the test is continued~~ Additionally, the ASTM E84 or UL 723 test shall be continued for a 20-minute period~~. Additionally,~~ and the flame front shall not progress more than 10½ feet (3200 mm) beyond the centerline of the burners at any time during the test.

2303.2.1 Pressure process. *(No changes)*

2303.2.2 Other means during manufacture. *(No changes)*

~~**2303.2.3 Testing.** For wood products produced by other means during manufacture, other than a pressure process, all sides of the wood product shall be tested in accordance with and produce the results required in Section 2303.2. Wood structural panels shall be permitted to test only the front and back faces.~~

2303.2.3 Fire testing of wood structural panels. Wood structural panels shall be tested with a ripped or cut longitudinal gap of ⅛ inch.



Photo courtesy of American Wood Council

FRT Plywood.



Photo courtesy of American Wood Council

FRT Lumber.

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CHANGE SIGNIFICANCE: How to test fire-retardant-treated wood has been a discussion point for several years. Surveyed fire test labs indicate that there are only two applicable fire test requirements from ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials:*

1. Flame spread index of not more than 25.
2. Flame front that does not progress more than 10½ feet beyond the burners' centerline when the ASTM E84 test is extended by 20 minutes for a total test time of 30 minutes.

The referenced 2019 edition of ASTM E84 incorporates requirements for conducting an extended 30-minute test. Previously, ASTM E84 did not specify any time frame beyond its 10-minute test. Consequently, ASTM E84 did not provide details on how to assess either "no evidence of significant progressive combustion" or "the flame front shall not progress more than 10½ feet beyond the centerline of the burners." Information for how to determine both of those characteristics is contained in ASTM E2768, *Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test),* and is now directly referenced by ASTM E84.

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2303.4.1.2 Wood Truss Bracing

CHANGE TYPE: Addition

CHANGE SUMMARY: Specific requirements have been added to address wood truss member diagonal bracing and restraint.

2021 CODE TEXT: **2303.4.1.2 Permanent individual truss member restraint (PITMR) and permanent individual truss member diagonal bracing (PITMDB).** Where the truss design drawings designate the need for permanent individual truss member restraint, it shall be accomplished by one of the following methods:

1. PITMR and PITMDB installed using standard industry lateral restraint and diagonal bracing details in accordance with TPI 1, Section 2.3.3.1.1, accepted engineering practice, or Figures 2303.4.1.2(1), (3), and (5).
2. Individual truss member reinforcement in place of the specified lateral restraints (i.e., buckling reinforcement such as T-reinforcement, L-reinforcement, proprietary reinforcement, etc.) such that the buckling of any individual truss member is resisted internally by the individual truss. The buckling reinforcement of individual truss members shall be installed as shown on the truss design drawing, on supplemental truss member buckling reinforcement details provided by the truss designer or in accordance with Figures 2303.4.1.2 (2) and (4).
3. A project-specific PITMR and PITMDB design provided by any registered design professional.

2303.4.1.2.1 Trusses installed without a diaphragm. Trusses installed without a diaphragm on the top or bottom chord shall require a project specific PITMR and PITMDB design prepared by a registered design professional.

Exception: Group U occupancies.

2303.4.1.3 Trusses spanning 60 feet or greater. The owner or the owner's authorized agent shall contract with any qualified registered design professional for the design of the temporary installation restraint and diagonal bracing and the PITMR and PITMDB for all trusses with clear spans 60 feet (18 288 mm) or greater.

(Deleted text not shown for clarity)

Permanent individual truss member restraint (PITMR). Restraint that is used to prevent local buckling of an individual truss chord or web member because of the axial forces in the individual truss member.

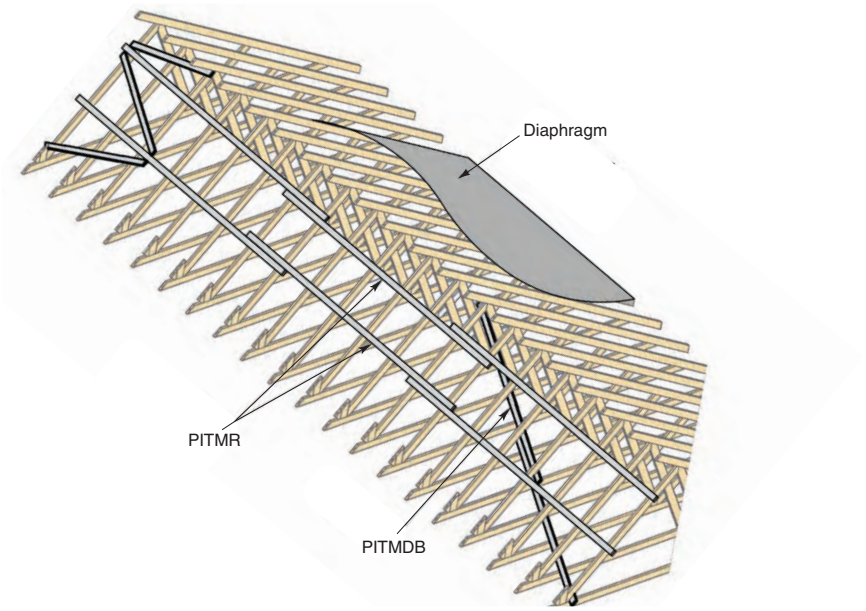
Permanent individual truss member diagonal bracing (PITMDB). Structural member or assembly intended to permanently stabilize the PITMRs.

Individual truss member. A truss chord or truss web.

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PITMR and PITMDB for truss web members requiring two rows of PITMR.

(Only a portion of Figure 2303.4.1.2(3) is shown for brevity)

CHANGE SIGNIFICANCE: Revised Section 2303.4.1 now provides clarity on the installation of permanent truss member restraint and permanent diagonal bracing of individual wood truss members. The current industry standard of care for the installation of permanent truss member restraint and diagonal bracing is to require that a truss installer (framer) rely on standard industry details. Such details are found in the document *Building Component Safety Information (BCSI) – B3: Permanent Restraint/ Bracing of Chords & Web Members* as referenced in *ANSI/TPI 1 National Design Standard for Metal Plate Connected Wood Truss Construction* Section 2.3.3.1.1. The reality in the field, however, is that framers are often not familiar with BCSI-B3 and not provided a copy of that document with the trusses. Owners, building designers, truss designers, truss manufacturers and building officials typically rely on framers to accurately and completely interpret when, where and how to install required restraint and diagonal bracing for pre-engineered wood trusses.

The new Section 2303.4.1.2 requirements are intended to clarify truss bracing needs. Definitions for an Individual Truss Member, a Permanent Individual Truss Member Restraint (PITMR) and Permanent Individual Truss Member Diagonal Bracing (PITMDB) have been added to Section 202. These definitions should eliminate some confusion in the design community and on the job site with respect to what specific bracing members are required and their intended purpose. Terms such as bracing, bridging, continuous lateral brace and x-bracing are often used but do not necessarily mean the same thing to everyone.

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Figures have been added to Section 2303.4.1.2 to assist both framers and building inspectors in understanding when and how permanent restraint and bracing should be installed. The figures and associated connections are prescriptive; however, the following engineering assumptions were used during their development:

1. Some amount of lateral restraint force is required to brace a web member that is in compression. Opinions on how much restraint is needed vary from the traditional and conservative 2 percent of axial compression force in the member to 1 percent of the axial compression force, which is currently used by AISI in light gage steel truss design. Even less than 1 percent of axial compression is sometimes assumed depending on the end fixity provided by the top and bottom chords and associated diaphragms. To more accurately determine the actual lateral restraint force, testing and further analysis is required.
2. Utilizing a minimum of four 0.131-inch × 3-inch nails connecting PITMDB ends to blocking, which is similar to connections framers are currently installing, creates considerable lateral capacity, about 375 pounds assuming SPF framing and a load duration factor of 1.15.
3. Most projects utilizing wood trusses will have both a wood structural panel roof diaphragm and a gypsum board ceiling diaphragm. Since diaphragms brace the top and bottom chords, these provisions address truss web members only.
4. For less common projects where there is no diaphragm on the top or bottom chords, a project-specific restraint and bracing design is required. This is critical for trusses with spans of less than 60 feet and dropped ceilings with no ceiling diaphragm.

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2304.10.1

Mass Timber Connection Protection

CHANGE TYPE: Addition

CHANGE SUMMARY: In Type IV-A, IV-B and IV-C construction, both a testing option for connections that are part of a fire-resistance-rated assembly and a calculation option for connections that are required to be protected for the fire-resistance rating time of the connected elements have been provided.

2021 CODE TEXT: **2304.10.1 Connection fire-resistance rating.** Fire-resistance ratings for connections in Type IV-A, IV-B or IV-C construction shall be determined by one of the following:

1. Testing in accordance with Section 703.2 where the connection is part of the fire-resistance test.
2. Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250°F (139°C), and a maximum temperature rise of 325°F (181°C), for a time corresponding to the required fire-resistance rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners and portions of wood members included in the structural design of the connection.

CHANGE SIGNIFICANCE: Sections 704.2 and 704.3 require connections of columns and other primary structural members to be protected with materials that have the required fire-resistance rating. The new Section 2304.10.1 provides two options for demonstrating such compliance for connections in Types IV-A, IV-B and IV-C construction: a testing option and a calculation option. The provisions are not applicable to connections in heavy timber (IV-HT) construction, because heavy timber structural members do not have a prescribed fire-resistance rating.



Photo courtesy of ATF Fire Research Laboratory

Glulam beam-to-column connection as part of an assembly fire test.

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Sections 704.2 and 704.3 do not require connections that join elements of the structural frame to be tested in accordance with ASTM E119. The connections must only be protected with material having the fire-resistance rating required for the structural members that they connect. It is neither practical nor possible to test connections in a standard fire test furnace since there is no capability to test large connections used to transfer gravity loads. In addition, ASTM E119 does not include any provisions on how to test connections and assess their performance. Section 4.4.4 of ASTM E119-18c clearly states that the test standard does not simulate the fire behavior between building elements such as connections. While the testing of large gravity load connections is not contemplated by ASTM E119, the fasteners that are used to connect elements of an assembly are considered part of the test and critical to the assembly's fire performance. For example, the fastening system used to connect multiple pieces of abutting nail-laminated timber that form a floor assembly is considered to be part of the tested assembly. Proper detailing of the system used to connect abutting segments is a primary factor in meeting the thermal pass/fail criteria established in ASTM E119. The connection system has little bearing on the structural performance but is necessary to prevent the passage of hot gases at the abutting edges.

Option 1, described in Section 2304.10.1, Item 1, is consistent with ASTM E119 because the connection is included as part of the overall assembly being tested. In other words, the connection itself is not being tested; rather, the assembly is being tested with the connection included within it, and, therefore, subject to the ASTM E119 pass/fail criteria that are applicable to that assembly.

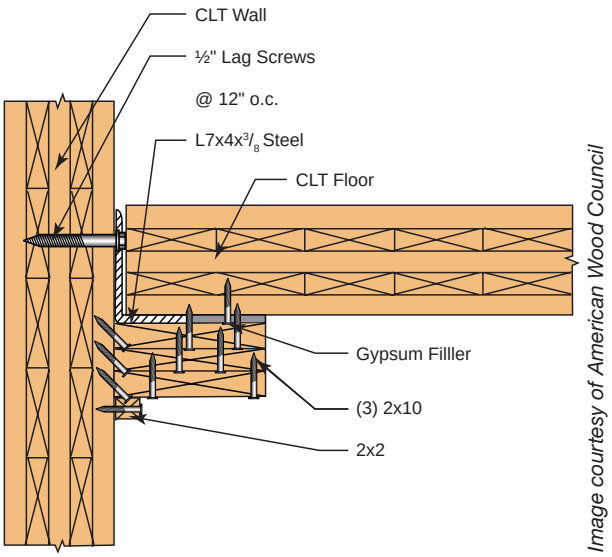
Some connections used in Types IV-A, IV-B and IV-C construction are not part of the mass timber element or assembly testing. For those connections, Option 2, an engineering analysis, is required by Section 2304.10.1, Item 2. Potential options for engineering analysis include:

- IBC Section 722 permits structural fire-resistance ratings of wood members to be determined using Chapter 16 of the American Wood Council's (AWC) *National Design Specification® (NDS®) for Wood Construction*.
- Where a wood connection is required to be fire-resistance-rated, NDS Section 16.3 requires all components of the wood connection, including the steel connector, the connection fasteners and the wood needed in the connection's structural design, to be protected for the minimum required fire-resistance time. The connection is permitted to be protected by wood, gypsum board or other approved materials.
- Analysis procedures have been developed that allow the protection of these connections to be designed based on test results of ASTM E119 fire tests from protection configurations using the wood member outside the connection, additional wood cover and gypsum board.
  - Analysis procedures must demonstrate that the protection will limit temperature rise at any portion of the connection, including metal connectors, connection fasteners and portions of the wood member that are necessary for the connection's structural design.
  - The AWC *Technical Report 10 (TR10): Calculating the Fire Resistance of Wood Members and Assemblies*, which is referenced in the NDS Chapter 16 Commentary, provides examples of connection designs meeting the requirements of IBC Section 704 and NDS Section 16.3.

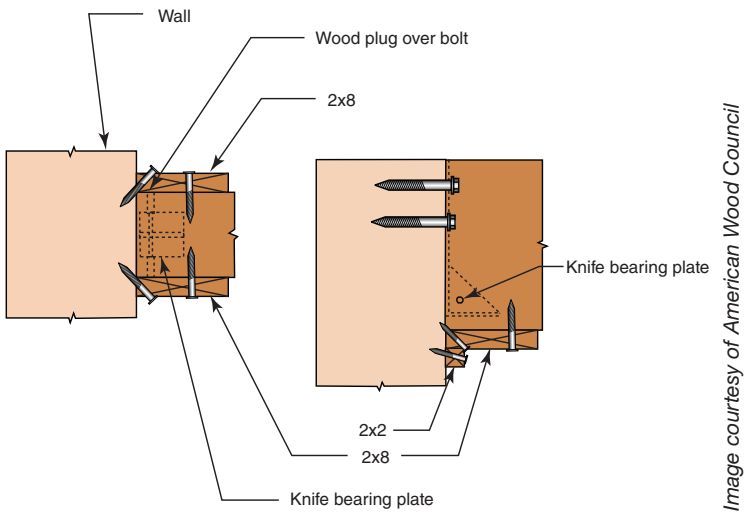
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CLT floor-to-wall example from AWC TR10.



Glulam beam-to-column example from AWC TR10.

Limiting the level of heat allowed to transfer to connections is unique to mass timber and is intended to prevent excessive heating of any portion of the connection. Design guidance for the protection of connections is provided in AWC TR10. The design criteria for protecting a connection is based on thermal separation, which is measured as the distance between the closest surface of the connection and a temperature rise of 250°F within the added protection. Although the code allows for a temperature of 325°F at any single point, determining this is impractical and will not control the thickness of the required cover. Designing for a temperature rise of 250°F above the ambient temperature will always be the more severe case. TR10 provides a method for determining the additional thickness of wood or gypsum board necessary to provide the thermal separation to satisfy this requirement.

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There are two common approaches to protecting a connection for the required fire-resistance rating. One method is to entirely embed a connection within the structural member. However, it is unlikely that a beam or column designed for a specified fire-resistance rating will have a sufficiently oversized cross-section to also provide the protection required for the connection. This approach also adds considerable cost to a project as the entire beam or column must be oversized.

The other approach is to use a cover to provide thermal separation by protecting the connection. TR10 specifies that the thermal separation time provided by wood protection can be determined by multiplying the calculated protection time, t_p, by a factor of 0.85. For example, assuming the NDS-specified nominal char rate of 1.5 inch/hour, if a single layer of wood having a thickness of 3.0 inches is used to provide fire protection to a wood member, the protection time, t_p, provided by this layer would be calculated as follows:

$$t_p = 60 \left(\frac{3.0}{1.5}\right)^{1.23} = 141 \text{ minutes}$$

where

t_p – calculated protection time (in minutes)

However, if this 3.0-inch thick layer of wood is used to protect a connection, then it must also provide thermal protection to limit the average temperature rise at the interface between the protection and the connection to 250°F or less. As noted above, the thermal separation time provided by this wood protection can be determined by multiplying the protection time, t_p, by 0.85 as follows:

$$0.85\ t_p = (0.85)\ 141 \text{ minutes} = 120 \text{ minutes}$$

where

t_p – calculated protection time (in minutes)

Gypsum board can also be used to provide both fire protection and thermal separation. The time assigned to gypsum board for thermal separation is different from the time assigned for use as noncombustible protection in IBC Table 722.7.1(2). Finish rating is explained in the *UL Fire Resistance Directory* as the time it takes the wood surface nearest the fire, but beneath the cover, to reach a temperature rise of 250°F. When protected in this manner, it is commonly referred to as the finish rating and can be provided by the gypsum board manufacturer for a specific product and thickness. It may also be possible to find finish ratings that are provided in listings of certified assemblies.

UL Design No. U332 assigns a finish rating of 23 minutes to any fire resistance classified 5/8-inch Type X gypsum board. Similarly, it is possible to find finish ratings for two-layers of 5/8-inch Type X that are between 55 and 59 minutes. TR10 provides a slightly conservative approach for determining the thermal separation time of gypsum board; specifically, the thermal separation time is taken as the noncombustible protection time multiplied by a factor of 0.50. Thus, a single layer of 5/8-inch Type X gypsum board, which has an assigned noncombustible protection time of 40 minutes, would be conservatively assumed to provide a thermal separation time of 20 minutes.

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Photo courtesy of American Wood Council

Wood cover protection of structural member connections to achieve a fire-resistance rating.

Regardless of whether the thermal separation is being provided by wood protection, gypsum board or a combination of both; where multiple layers of protection are used, the 0.85 or 0.50 factor should only be applied to the layer that is adjacent to the connection itself. For example, if a 1-hour fire-resistance rating is required for a connection, and 5/8-inch Type X gypsum board is to be used for protection of the connection, the layer adjacent to the connection would be assumed to have a thermal separation time of 20 minutes. Therefore, a second outer layer of 5/8-inch Type X gypsum board provides the additional 40 minutes of thermal separation since it is not adjusted by the 0.5 factor.

TR10 also provides guidance on the detailing of wood members and protection to account for char contraction. Where the edges of wood elements abut, such as at the edge of a beam and column interface, the potential effects of char contraction should be evaluated. Char depth is the distance between the location of the original wood surface prior to fire exposure and the char front location (furthest extent of charring into the wood on that face). As wood chars, its volume decreases such that the char layer thickness is less than the char depth. This difference between char depth and the char layer thickness is approximately 0.3 times the char depth at any given time. This phenomenon can result in a wedge-shaped gap formation that propagates along the interface between two wood members. Ignition extends into such gaps a distance that is approximately twice the char depth. As a result, additional wood cover or blocking is required to protect the area around abutting edges. Fasteners used to attach protection are not required to be protected.

It should be noted that Section 110.3.5 establishes new inspection requirements where wood cover is specified to provide fire-resistance protection of connections in Types IV-A, IV-B and IV-C construction.

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CHANGE TYPE: Modification

CHANGE SUMMARY: Additional fastener options have been added to the sheathing fastening schedule and nail patterns have been updated to current industry standards and the new ASCE 7 wind loads.

Table 2304.10.2
Sheathing Fasteners

2021 CODE TEXT:

TABLE 2304.10.2 Fastening Schedule – Sheathing

Description of Building Elements	Number and Type of Fastener[g]	Spacing and Location	
Wood structural panels (WSP), subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing[a]			
		Edges (inches)	Intermediate supports (inches)
30. $^3/_8$" – $^1/_2$"	6d common or deformed (2" × 0.113") or $2^3/_8$" × 0.113" nail (subfloor and wall)	6	12
	8d common or deformed ($2^1/_2$" × 0.131" × 0.281" head) (roof) or RSRS-01 ($2^3/_8$" × 0.113") nail (roof)[d]	6[e]	~~12~~ 6[e]
	$2^3/_8$" × 0.113" × 0.266" head nail (roof)	~~4~~ 3[f]	~~8~~ 3[f]
	$1^3/_4$" 16 gage staple, $^7/_{16}$" crown (subfloor and wall)	4	8
	$1^3/_4$" 16 gage staple, $^7/_{16}$" crown (roof)	3[f]	~~6~~3[f]
31. $^{19}/_{32}$"– $^3/_4$"	8d common ($2^1/_2$" × 0.131"); or ~~6d~~ deformed (2" × 0.113") (subfloor and wall)	6	12
	8d common or deformed ($2^1/_2$" × 0.131" × 0.281" head) (roof) or RSRS-01 ($2^3/_8$" × 0.113") nail (roof)[d]	6[e]	~~12~~ 6[e]
	$2^3/_8$" × 0.113" × 0.266" head nail; or 2" 16 gage staple, $^7/_{16}$" crown	4	8

(no changes to footnotes a-d)

e. Tabulated fastener requirements apply where the ultimate design wind speed is less than 140 mph. For wood structural panel roof sheathing attached to gable-end roof framing and to intermediate supports within 48 inches of roof edges and ridges, nails shall be spaced at 4 inches on center where the ultimate design wind speed is greater than 130 mph in Exposure B or greater than 110 mph in Exposure C. Spacing exceeding 6 inches on center at intermediate supports shall be permitted where the fastening is designed per the AWC NDS.

f. Fastening is only permitted where the ultimate design wind speed is less than or equal to 110 mph.

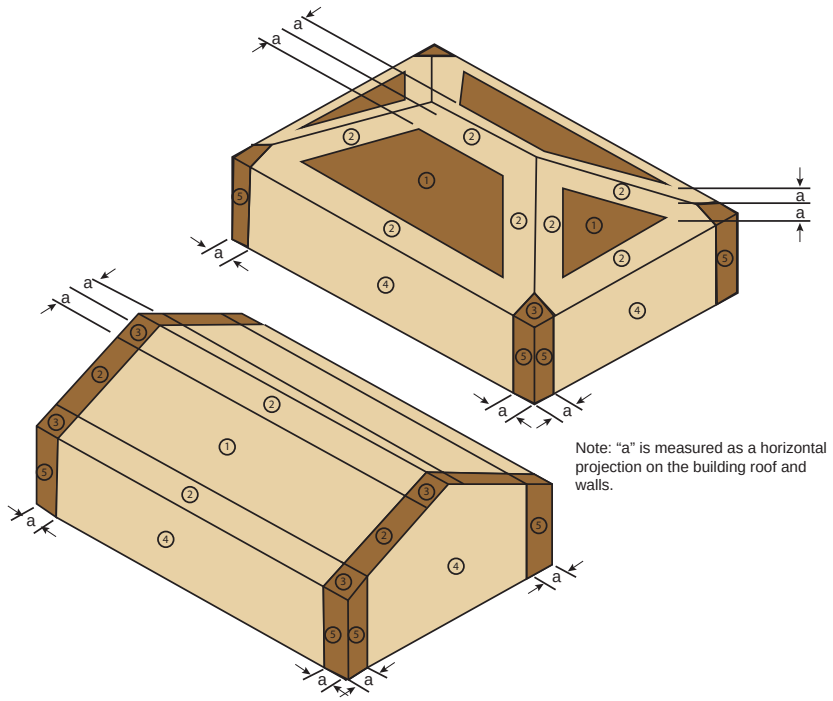
g. Nails and staples are carbon steel meeting the specifications of ASTM F1667. Connections using nails and staples of other materials, such as stainless steel, shall be designed by acceptable engineering practice or approved under Section 104.11.

(Only IBC Table 2304.10.2 Items 30 and 31 are shown here for brevity. All other modifications to this table reflect additional nail size equivalencies.)

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Wind loads at roof edges require tighter sheathing nailing schedules.

CHANGE SIGNIFICANCE: The updated roof sheathing nailing criteria now found in Table 2304.10.2 are based on ASCE 7. The changes are also consistent with the roof sheathing nailing requirements in the *2018 Wood Frame Construction Manual* (WFCM). Wind uplift nailing requirements for common species of roof framing with specific gravities of 0.42 (based on SPF) are the basis of the nail spacing requirements in Table 2304.10.2 to meet the wind uplift loading requirements of ASCE 7 without being overly complex in the specification of wood structural panel roof sheathing nailing. The basic roof sheathing nailing schedule is 6 inches on-center at panel edges and 6 inches on-center at intermediate supports in the panel field. As shown in WFCM Table 3.10A for the common case of roof framing spaced at 24 inches on-center, nailing at intermediate supports in the interior portions of the roof is 6 inches on-center for wind speeds within the scope of IBC Section 2308. Six inches on-center spacing is also appropriate for edge zones except where ultimate wind speeds equal or exceed 130 mph in Exposure B and 110 mph in Exposure C where 4 inches on-center nail spacing is required. These special cases are addressed by modification to footnote e.

To update the alternative fastening schedule to uplift loading requirements of ASCE 7 without being overly complex in the specification of wood structural panel roof sheathing attachment, footnote f was added. The calculation leading to the use of 3 inches on-center spacing at all locations is based on a 0.113-inch diameter nail shank withdrawal capacity from wood framing with a specific gravity equal to 0.42 (SPF) and precalculated wind uplift loads in WFCM Table 3.10. The use of a single 3-inch spacing at all supports was extended to staples based on the assumption that the 2016 edition of ASCE 7 load increase would similarly require reduced spacing. This assumption was applied to staples because a withdrawal value is not available for staples in the NDS.

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2304.11

Concealed Spaces in Type IV-HT

CHANGE TYPE: Modification

CHANGE SUMMARY: Concealed spaces are now permitted in floors and roof decks for Type IV-HT.

2021 CODE TEXT: **2304.11.3 Floors.** Floors shall be without concealed spaces or with concealed spaces complying with Section 602.4.4.3. Wood floors shall be constructed in accordance with Section 2304.11.3.1 or 2304.11.3.2.

2304.11.4 Roof decks. Roofs shall be without concealed spaces ~~and roof~~ or with concealed spaces complying with Section 602.4.4.3. Roof decks shall be constructed in accordance with Section 2304.11.4.1 or 2304.11.4.2. Other types of decking shall be an alternative that provides equivalent fire resistance and structural properties. Where supported by a wall, roof decks shall be anchored to walls to resist forces determined in accordance with Chapter 16. Such anchors shall consist of steel bolts, lags, screws or approved hardware of sufficient strength to resist prescribed forces.

CHANGE SIGNIFICANCE: Historically, concealed spaces have not been permitted in traditional heavy timber construction. Now, concealed spaces are permitted in traditional Type IV-HT construction, with specific requirements for their protection. New protection options include:

- In fully sprinklered buildings, installing automatic sprinkler protection in the concealed space.
- Filling the space with noncombustible insulation.
- Protecting combustible surfaces with not less than 5/8-inch Type X gypsum board.

Concealed spaces in new Types IV-A, IV-B and IV-C construction are addressed separately. The option of having protected concealed spaces in Type IV-HT buildings is important for encouraging adaptive re-use of existing heavy timber buildings as well as providing for the installation of mechanicals (MEP) in Type IV-HT cross-laminated timber construction.



Photo courtesy of ATF Fire Research Laboratory

Concealed spaces must be protected.

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2305

Lateral Force-Resisting Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: The 2021 edition of the SDPWS, which includes shear wall and diaphragm design provisions for cross-laminated timber, is now referenced in the IBC.

2021 CODE TEXT: **2305.1 General.** Structures using wood-frame shear walls or wood-frame diaphragms to resist wind, seismic or other lateral loads shall be designed and constructed in accordance with AWC SDPWS and the applicable provisions of Sections 2305, 2306 and 2307.

Chapter 35

ANSI/AWC SDPWS—2021~~2015~~: Special Design Provisions for Wind and Seismic

CHANGE SIGNIFICANCE: The American Wood Council's *Special Design Provisions for Wind and Seismic* (SDPWS) provides criteria for proportioning, designing and detailing engineered wood systems, members and connections in lateral force resisting systems. Nominal shear capacities of diaphragms and shear walls are provided for reference assemblies. The SDPWS has been updated to the 2021 edition and is now referenced in the IBC.

Changes to the standard include:

- Addition of cross-laminated timber (CLT) shear wall and diaphragm provisions. Using CLT components in seismic force-resisting systems is an area of considerable ongoing research. The referenced

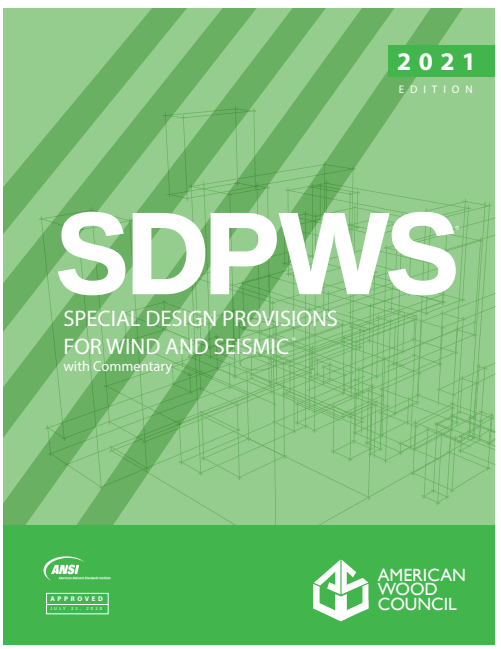


Photo courtesy of American Wood Council

2021 Special Design Provisions for Wind and Seismic (SDPWS).

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2016 edition of ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, does not contain seismic design coefficients for CLT shear wall systems; however, seismic design coefficients for CLT shear wall systems are expected to be provided in the 2022 edition of ASCE 7.

- Addition of deflection equations for cantilevered diaphragms.
- Revision of shear capacity adjustment factors for perforated shear wall design.
- Simplification of nominal unit shear capacity tables for diaphragms and shear walls and clarification of reference nail size and sawn lumber basis of tabulated values.

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2308.5.6, 2308.6.6.2

Cripple Walls

CHANGE TYPE: Modification

CHANGE SUMMARY: Cripple wall requirements have been clarified to emphasize that, if only interior wood-framed cripple walls exist in a design, no sheathing or solid blocking is required.

2021 CODE TEXT: **2308.5.6 Cripple walls.** Foundation cripple walls shall be framed of studs that are not less than the size of the studding above ~~and~~. Exterior cripple wall studs shall be not less than 14 inches (356 mm) in length, or shall be framed of solid blocking. Where exceeding 4 feet (1219 mm) in height, such walls shall be framed of studs having the size required for an additional story. See Section 2308.6.6 for cripple wall bracing.

2308.6.6.2 Cripple wall bracing in Seismic Design Categories D and E. For the purposes of this section, cripple walls in Seismic Design Categories D and E ~~having~~ shall not have a stud height exceeding 14 inches (356 mm) ~~shall be considered to be a story and~~ , and studs shall be ~~braced~~ solid blocked in accordance with Section 2308.5.6 for the full dwelling perimeter and for the full length of interior braced wall lines supported on foundations, excepting ventilation and access openings. ~~Table 2308.6.1. Where interior braced wall lines occur without a continuous foundation below, the length of parallel exterior cripple wall bracing shall be one and one-half times the lengths required by Table 2308.6.1. Where the cripple wall sheathing type used is Method WSP or DWB and this additional length of bracing cannot be provided, the capacity of WSP or DWB sheathing shall be increased by reducing the spacing of fasteners along the perimeter of each piece of sheathing to 4 inches (102 mm) on center.~~



International Code Council

Interior cripple walls.

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CHANGE SIGNIFICANCE: Section 2308.5.6 has been clarified through the addition of the term 'exterior' to the requirements. In addition, contradictory text has been deleted from Section 2308.6.6.2. Where cripple walls are exterior walls supporting one or more stories, the wall must be braced with either solid blocking or sheathing based on wall bracing requirements. These walls have been found to rack sideways and fail in moderate and large earthquakes. Adding sheathing or blocking stiffens the wall.

For buildings in Seismic Design Categories (SDC) A, B and C, where a cripple wall is part of an interior wall line, whether below an interior braced wall line or simply supporting the floor above, there is no requirement for bracing the wall line by blocking or sheathing. These walls are inside a much stiffer exterior foundation wall of concrete or concrete masonry unit (CMU) block and will not move independently of the floor and exterior walls during an earthquake.

Cripple wall bracing in SDC D and E is now limited to 14 inches in height and must be solidly blocked along both the interior and exterior walls. Therefore, buildings may only be one story with a slab on grade foundation or a crawlspace consisting of studs 14 inches or less in height with solid-blocked cripple walls per Table 2308.2.1. Because cripple walls over 14 inches in height are considered an additional story, a one-story building over cripple walls is considered a two-story building and prohibited in SDC D and E. The extent of solid blocking of cripple wall studs to allow for ventilation and access openings has also been clarified.

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Table 2308.7.3.1

Rafter Tie Connections

CHANGE TYPE: Modification

CHANGE SUMMARY: Rafter tie connection requirements have been updated to reflect current standards.

2021 CODE TEXT:

TABLE 2308.7.3.1 Rafter Tie Connections[gi]

Rafter Slope	Tie Spacing (inches)	Ground Snow Load								
		Live Load Only[g]			30 psf			50 psf		
		Roof span (ft)								
		12	24	36	12	24	36	12	24	36
		Required number of 16d common (3½" × 0.162") nails per connection[a, b, c, d, e, f, h]								
3:12	12	3	5	8	3	6	9	5	9	13
	16	4	7	10	4	8	12	6	12	17
	19.2	4	8	12	5	10	14	7	14	21
	24	5	10	15	6	12	18	9	17	26
	32	7	13	20	8	16	24	12	23	34
	48	10	20	29	12	24	35	17	34	51
4:12	12	3	4	6	3	5	7	4	7	10
	16	3	5	8	3	6	9	5	9	13
	19.2	3	6	9	4	7	11	6	11	16
	24	4	8	11	5	9	13	7	13	19
	32	5	10	15	6	12	18	9	17	26
	48	8	15	22	9	18	26	13	26	38
5:12	12	3	3	5	3	4	6	3	6	8
	16	3	4	6	3	5	7	4	7	11
	19.2	3	5	7	3	6	9	5	9	13
	24	3	6	9	4	7	11	6	11	16
	32	4	8	12	5	10	14	7	14	21
	48	6	12	18	7	14	21	11	21	31
7:12	12	3	3	4	3	3	4	3	4	6
	16	3	3	5	3	4	5	3	5	8
	19.2	3	4	5	3	4	6	3	6	9
	24	3	5	7	3	5	8	4	8	11
	32	3	6	9	4	7	10	5	10	15
	48	5	9	13	5	10	15	8	15	22

table continued

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TABLE 2308.7.3.1 *Continued*

Rafter Slope	Tie Spacing (inches)	Live Load Only[g]			Ground Snow Load 30 psf			Ground Snow Load 50 psf		
		Roof span (ft)								
		12	24	36	12	24	36	12	24	36
		Required number of 16d common (3½" × 0.162") nails per connection[a, b, c, d, e, f, h]								
9:12	12	3	3	3	3	3	3	3	3	5
	16	3	3	4	3	3	4	3	4	6
	19.2	3	3	4	3	4	5	3	5	7
	24	3	4	5	3	4	6	3	6	9
	32	3	5	7	3	6	8	4	8	12
	48	4	7	10	4	8	12	6	12	17
12:12	12	3	3	3	3	3	3	3	3	4
	16	3	3	3	3	3	3	3	3	5
	19.2	3	3	3	3	3	4	3	4	6
	24	3	3	4	3	3	5	3	5	7
	32	3	4	5	3	4	6	3	6	9
	48	3	5	8	3	6	9	5	9	13

a. ~~40d box (5" × 0.162") or 16d sinker (3¼" × 0.148") nails are~~ 10d common (3" × 0.148") nails shall be permitted to be substituted for 16d common (3½" × ~~0.16~~" 0.162") nails where the required number of nails is taken as 1.2 times the required number of 16d common nails, rounded up to the next full nail.

b. ~~Nailing requirements are permitted to be reduced 25 percent if nails are clinched.~~

~~e~~ b. Rafter tie heel joint connections are not required where the ridge is supported by a load-bearing wall, header or ridge beam.

~~d~~ c. Where intermediate support of the rafter is provided by vertical struts or purlins to a load-bearing wall, the tabulated heel joint connection requirements are permitted to be reduced proportionally to the reduction in span.

~~e~~ d. Equivalent nailing patterns are required for ceiling joist to ceiling joist lap splices.

~~f~~ e. Connected members shall be of sufficient size to prevent splitting due to nailing.

~~g~~ f. For snow loads less than 30 pounds per square foot, the required number of nails is permitted to be reduced by multiplying by the ratio of actual snow load plus 10 divided by 40, but not less than the number required for no snow load.

g. Applies to roof live load of 20 psf or less.

h. Tabulated heel joint connection requirements assume that ceiling joists or rafter ties are located at the bottom of the attic space. Where ceiling joists or rafter ties are located higher in the attic, heel joint connection requirements shall be increased by the adjustment factors in Table 2308.7.3.1(1).

i. Tabulated requirements are based on 10 psf roof dead load in combination with the specified roof snow load and roof live load.

TABLE 2308.7.3.1(1) Heel Joint Connection Adjustment Factors

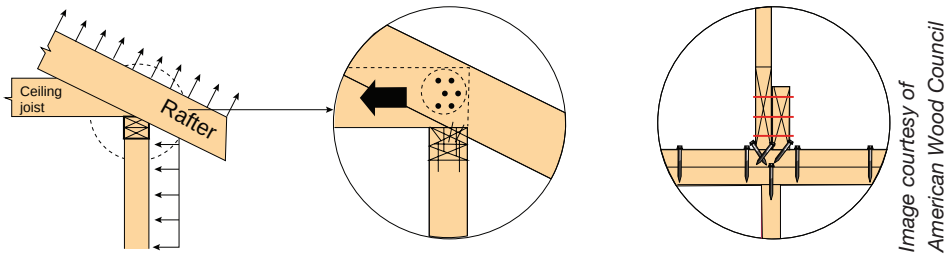
H_C/H_R[a,b]	Heel Joist Connection Adjustment Factor
1/3	1.50
1/4	1.33
1/5	1.25
1/6	1.20
1/10 or less	1.11

a. H_C = Height of ceiling joists or rafter ties measured vertically from the top of the rafter support walls to the bottom of the ceiling joists or rafter ties.
H_R = Height of roof ridge measured vertically from the top of the rafter support walls to the bottom of the roof ridge.

b. Where H_C/H_R exceeds 1/3, connections shall be designed in accordance with accepted engineering practice.

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Nail placement for rafter ties.

CHANGE SIGNIFICANCE: Table 2308.7.3.1 has been revised for consistency with the calculation basis of the American Wood Council's (AWC) *2018 Wood Frame Construction Manual (WFCM)* heel joint nailing requirements based on the AWC *2018 National Design Specification for Wood Construction (NDS)* provisions for nailed connections. The reduction in the required number of 16d common nails for rafter tie connections by approximately 15 percent is due to changes in the penetration factor and load duration assumptions used to develop the previous table. Previously, a reduction factor of 0.77 for penetration (based on the 1991 and 1997 NDS) was used for 16d common nails with less than 12d penetration in the main member and a load duration factor of 1.25.

The revised nailing requirements are based on a 1.15 load duration factor for snow load cases, a 1.25 load duration factor for roof live load cases, and an effective penetration factor equal to 1.0 per the current NDS where lateral design value calculations for nails are based on the actual penetration in the wood member. The ratio of nail design values for snow cases originally used to develop nailing requirements to the new nail design values for snow cases is $(Z \times 0.77 \times 1.25) / (Z \times 1.0 \times 1.15) = 0.84$ and explains the reduced number of nails now required in the table. Due to revised nail design provisions in the NDS, the benefit of a longer nail that is clinched is no longer recognized for this application and footnote b was deleted.

A 10d common nail option is added in new footnote a based on NDS lateral design value calculations for nails. The table heading clarifies the 10 pounds per square foot dead load basis of the nailing requirements. Also, adjustment factors for rafter tie height, consistent with WFCM and IRC, have been added in footnote h to increase connection requirements where the rafter tie, or ceiling joist, is not located at the bottom of the attic space. Generally, rafter ties located at the top of support walls are also ceiling joists.

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2510.6
Water-Resistive Barriers for Stucco

CHANGE TYPE: Modification

CHANGE SUMMARY: Water-resistive barrier requirements for stucco have been divided into two categories based on whether the building is in a dry or moist climate.

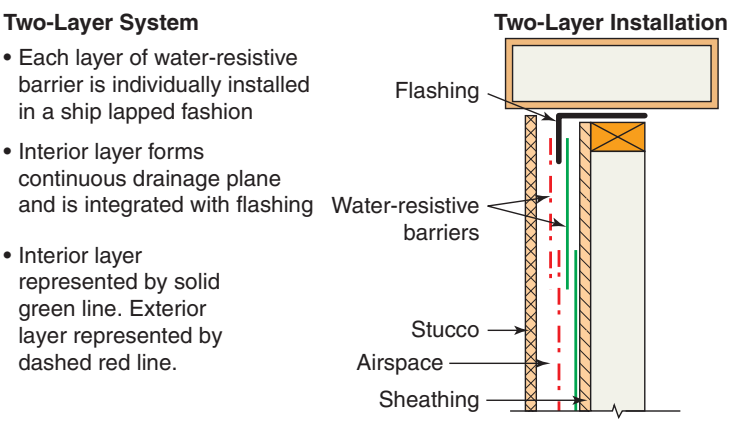
2021 CODE TEXT: **2510.6 Water-resistive barriers.** Water-resistive barriers shall be installed as required in Section 1403.2 and, where applied over wood-based sheathing, shall comply with Section 2510.6.1 or Section 2510.6.2. ~~include a water-resistive vapor-permeable barrier with a performance at least equivalent to two layers of water-resistive barrier complying with ASTM E2556, Type I. The individual layers shall be installed independently such that each layer provides a separate continuous plane and any flashing (installed in accordance with Section 1404.4) intended to drain to the water-resistive barrier is directed between the layers.~~

~~Exceptions:~~

1. ~~Where the water-resistive barrier that is applied over wood-based sheathing has a water resistance equal to or greater than that of a water-resistive barrier complying with ASTM E2556, Type II and is separated from the stucco by an intervening, substantially nonwater-absorbing layer or drainage space.~~
2. ~~Where the water-resistive barrier is applied over wood-based sheathing in Climate Zone 1A, 2A or 3A, a ventilated air space shall be provided between the stucco and water-resistive barrier.~~

2510.6.1 Dry climates. One of the following shall apply for dry (B) climate zones:

1. The water-resistive barrier shall be two layers of 10-minute Grade D paper or have a water resistance equal to or greater than two layers of water-resistive barrier complying with ASTM E2556, Type I. The individual layers shall be installed independently



Two-layer water-resistive barrier.

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such that each layer provides a separate continuous plane and any flashing, installed in accordance with Section 1404.4 and intended to drain to the water-resistive barrier, is directed between the layers.

2. The water-resistive barrier shall be 60-minute Grade D paper or have a water resistance equal to or greater than one layer of water-resistive barrier complying with ASTM E2556, Type II. The water-resistive barrier shall be separated from the stucco by a layer of foam plastic insulating sheathing or other nonwater absorbing layer, or a drainage space.

2510.6.2 Moist or marine climates. In moist (A) or marine (C) climate zones, water-resistive barrier shall comply with of one of the following:

1. In addition to complying with Item 1 or 2 of Section 2510.6.1, a space or drainage material not less than $^{3}/_{16}$-inch (4.8 mm) in depth shall be applied to the exterior side of the water-resistive barrier.
2. In addition to complying with Item 2 of Section 2510.6.1, drainage on the exterior side of the water-resistive barrier shall have a minimum drainage efficiency of 90 percent as measured in accordance with ASTM E2273 or Annex A2 of ASTM E2925.

CHANGE SIGNIFICANCE: Water-resistive barrier provisions for stucco have been reorganized by deleting the two exceptions. The exceptions have been replaced by subsections that indicate when an air gap is required by separating the requirements into dry and wet climate provisions. Additionally, a revised format recognizes two methods of compliance to the stucco water-resistive barrier provisions by requiring materials meet either ASTM E2556 Type I or Type II.

Requirements are now to be applied in relation to climate zones and are intended to abate potential moisture problems in climates that are moist or rainy. The change helps resolve problems with stucco performance due to moisture problems when placed over wood-based sheathing. Dry climates are also now exempt from meeting the more stringent requirements where stucco has a longstanding record of good performance without an installed air gap.

A reference to ASTM E2925, *Standard Specification for Manufactured Polymeric Drainage and Ventilation Materials Used to Provide a Rainscreen Function,* has been added to provide a second option when an air gap of 3/16-inch would be problematic for construction. An assembly can be checked by measuring drainage efficiency using the standard. If 90 percent of the water added above the space drains out, then the materials meet an equivalent drainage requirement. This method will require testing to determine sufficient drainage.

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PART 7

Building Services, Special Devices and Special Conditions

Chapters 27 through 33



- **Chapter 27** Electrical
  No changes addressed
- **Chapter 28** Mechanical Systems
  No changes addressed
- **Chapter 29** Plumbing Systems
- **Chapter 30** Elevators and Conveying Systems
- **Chapter 31** Special Construction
- **Chapter 32** Encroachments into the Public Right-of-Way
  No changes addressed
- **Chapter 33** Safeguards during Construction

Although building services such as electrical systems (Chapter 27), mechanical systems (Chapter 28) and plumbing systems (Chapter 29) are regulated primarily through separate and distinct codes, limited provisions are set forth in the *International Building Code* (IBC). Chapter 30 regulates elevators and similar conveying systems to a limited degree, as most requirements are found in American Society of Mechanical Engineers (ASME) standards. The special construction provisions of Chapter 31 include those types of elements or structures that are not conveniently addressed in other portions of the code. By "special construction," the code is referring to membrane structures, pedestrian walkways, tunnels, awnings, canopies, marquees and similar building features that are unregulated elsewhere. Chapter 32 governs the encroachment of structures into the public right-of-way, and Chapter 33 addresses safety during construction and the protection of adjacent public and private properties. ■

2902
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2902

Minimum Plumbing Facilities

CHANGE TYPE: Modification

CHANGE SUMMARY: Multiple clarifications and modifications have been made to the regulation of plumbing facilities to address significant issues of gender and equality of access.

2021 CODE TEXT: **2902.1.1 Fixture calculations.** To determine the occupant load of each sex, the total occupant load shall be divided in half. To determine the required number of fixtures, the fixture ratio or ratios for each fixture type shall be applied to the occupant load of each sex in accordance with Table 2902.1. Fractional numbers resulting from applying the fixture ratios of Table 2902.1 shall be rounded up to the next whole number. For calculations involving multiple occupancies, such fractional numbers for each occupancy shall first be summed and then rounded up to the next whole number.

Exceptions:

1. The total occupant load shall not be required to be divided in half where approved statistical data indicates a distribution of the sexes of other than 50 percent of each sex.
2. Where multiple-user facilities are designed to serve all genders, the minimum fixture count shall be calculated 100 percent, based on total occupant load. In such multiple-user facilities, each fixture type shall be in accordance with ICC A117.1 and each urinal that is provided shall be located in a stall.
3. Distribution of the sexes is not required where single-user water closets and bathing room fixtures are provided in accordance with Section 2902.1.2.

2902.1.2 Single-user toilet ~~facility~~ and bathing room fixtures. The plumbing fixtures located in single-user toilet ~~facilities~~ and bathing rooms, including family or assisted-use toilet and bathing rooms that are required by Section 1110.2.1, shall contribute toward the total number of required plumbing fixtures for a building or tenant space. Single-user toilet ~~facilities~~ and bathing rooms, and family or assisted-use toilet rooms and bathing rooms shall be identified as being available for use by ~~either~~ all persons regardless of their sex.

The total number of fixtures shall be permitted to be based on the required number of separate facilities or based on the aggregate of any combination of single-user or separate facilities.

2902.2 Separate facilities. Where plumbing fixtures are required, separate facilities shall be provided for each sex.

Exceptions:

(no changes to Exceptions 1 through 4)

5. Separate facilities shall not be required to be designated by sex where single-user toilet rooms are provided in accordance with Section 2902.1.2.

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6. Separate facilities shall not be required where rooms having both water closets and lavatory fixtures are designed for use by both sexes and privacy for water closets are installed in accordance with Section 405.3.4 of the *International Plumbing Code*. Urinals shall be located in an area visually separated from the remainder of the facility or each urinal that is provided shall be located in a stall.

EXAMPLES OF PLUMBING FIXTURE CALCULATIONS

Multiple-User Facility for Serving All Genders

Given: Business Classification having an Occupant Load of 60. Toilet facility design chosen to be one multiple-user facility to serve all genders.

Per Table 2902.1:

Water Closet Ratio:	1 per 25 for the first 50 and 1 per 50 for the remainder > 50
Lavatory Ratio:	1 per 40 for the first 80 and 1 per 80 for the remainder > 80

Calculations:

WCs: 50/25 + (60−50)/50 = 2.2	Round up to **3 water closets minimum.**
LAVs: 60/40 = 1.5	Round up to **2 lavatories minimum.**

Single-User Facilities

Given: Business Classification having an Occupant Load of 60. Toilet facility design chosen to be all single-user facilities.

Per Table 2902.1:

Water Closet Ratio:	1 per 25 for the first 50 and 1 per 50 for the remainder > 50
Lavatory Ratio:	1 per 40 for the first 80 and 1 per 80 for the remainder > 80

Calculations:

WCs: 50/25 + (60−50)/50 = 2.2	Round up to **3 water closets minimum.**
LAVs: 60/40 = 1.5	Round up to 2. However, because each single-user facility requires a LAV, **3 lavatories minimum.**

CHANGE SIGNIFICANCE: In the determination of the minimum required number of plumbing fixtures for a tenant space or building, the total anticipated occupant load served by the fixtures must be established. This total occupant load must then be distributed in a manner that will designate

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the number of females and number of males. As a general rule, the distribution of male occupants and female occupants will be based on a 50/50 split. The resulting numbers for male and female occupants are then used to establish the minimum number of fixtures required. A new allowance applies to those nonseparated ("by sex") multiple-user facilities that serve all genders.

The new Exception 2 to Section 2902.1.1 introduces the concept of multiple-user toilet facilities designed to serve all genders. Additional requirements for this type of facility are limited by Exception 6 of Section 2902.2. The general provisions continue to be applicable for the determination of the minimum required number of plumbing fixtures. A variety of toilet room arrangements are possible, with the regulation of urinal locations as the only privacy feature unique to all-gender facilities beyond what is already required in any multiple-user toilet room intended for use by the same sex. The calculation of fixture count at 100 percent is an exception to the use of the total occupant load divided in half (assuming a 50/50 male/female distribution). Fixture count calculations are straightforward where the male/female ratios in Table 2902.1 are identical; however, some adjustment may be necessary where different table ratios are indicated (such as for theaters and similar assembly uses).

In referencing Section 2902.1.2, Exception 3 recognizes that it is not necessary to account for a distribution of male/female occupants in the application of Table 2902.1 where single-user facilities are provided. A designer could choose to provide all the required plumbing fixtures in single-user toilet rooms.

Language has been added to Section 2902.1.2 to recognize that the required number of fixtures can be provided based on either the required number of separate facilities or the aggregate of any combination of both single-user and separate facilities. The text has also been revised to clarify that single-user, as well as family or assisted-use, toilet rooms and bathing rooms are to be identified to indicate availability for use by all individuals with no regard as to their sex.

Although modifications in the 2018 edition of the *International Building Code* (IBC) recognized the use of single-user toilet rooms, including those intended for family or assisted-use, as contributing to the number of required plumbing fixtures, there was confusion as to the proper application of the allowance. The new Exception 5 to Section 2902.2 now clearly indicates that separate facilities need not be designated by sex where such single-user facilities are provided. In addition, Exception 6 has been added to address those toilet rooms designed to be used by all individuals, regardless of sex, where the water closets and lavatories are available to everyone. It is mandated that water closet privacy be provided with complying compartments. Urinals, where installed, shall be located in a private stall or located in a manner so that they are visually isolated from the remainder of the toilet room.

Further commentary on the modifications related to minimum plumbing facilities can be found in the International Code Council (ICC) publication *Significant Changes to the International Plumbing Code, International Mechanical Code and International Fuel Gas Code, 2021 Edition.*

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2902.3.3

Toilet Fixtures in Storage Facilities

CHANGE TYPE: Modification

CHANGE SUMMARY: The location and distance limits imposed for travel to required employee toilet facilities are no longer applicable to Group S storage occupancies where approved by the building official.

2021 CODE TEXT: **2902.3.3 Location of toilet facilities in occupancies other than malls.** In occupancies other than covered and open mall buildings, the required public and employee toilet facilities shall be located not more than one story above or below the space required to be provided with toilet facilities, and the path of travel to such facilities shall not exceed a distance of 500 feet (152 m).

Exceptions:

1. The location and maximum distances of travel to required employee facilities in factory and industrial occupancies shall be permitted to exceed that required by this section, provided that the location and maximum distances of travel are approved.
2. The location and maximum distances of travel to required public and employee facilities in Group S occupancies shall be permitted to exceed that required by this section, provided that the location and maximum distances of travel are approved.

CHANGE SIGNIFICANCE: To provide building occupants with timely access to a toilet facility, it is important that travel to such facilities be limited to a reasonable distance. In addition, such facilities must be in close proximity vertically in multistory buildings. As such, the distribution of plumbing fixtures within a building must satisfy the mandate that the path of travel must not exceed a distance of 500 feet or require travel beyond the adjacent story above or below. The limits imposed for travel to employee toilet facilities are no longer applicable to Group S storage occupancies where approved by the building official.

The proximity limitations for toilet facilities have historically been applicable to all occupancies other than those classified as Group F. Under such factory and industrial conditions, the appropriate locations



Photo courtesy of James Hardy

Large warehouse.

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for toilet rooms have been considered to be best addressed based on the unique needs of each building. The new Exception 2 extends this recognition to those buildings classified as Group S for similar reasons. As Group S occupancies tend to have extremely low occupancy rates, it is not considered to be a cost-effective use of space or resources to require the same number of independent restrooms when they will rarely be utilized. This consideration is consistent with the reasoning that has historically been applied to Group F occupancies.

The limitations on the vertical location(s) of toilet facilities, within a Group S occupancy, as well as the distance of travel to such facilities, are now established solely by the building official. The building official is permitted to approve an increase in the number of stories between restrooms from every other story to something more appropriate, as well as to permit travel greater than 500 feet to such facilities. The new allowance will be applicable to large warehouses, parking garages with attendants, self-storage facilities and other Group S occupancies.

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3001.2

Emergency Elevator Communication Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: Additional direction and clarity has been provided regarding the appropriate emergency two-way communication features that are mandated for accessible elevators.

2021 CODE TEXT: **3001.2 Emergency elevator communication systems for the deaf, hard of hearing and speech impaired.** An emergency two-way communication system shall be provided. The system shall provide visible text and audible modes that meet all of the following requirements:

1. ~~Is a visual and text-based 24/7 live interactive system.~~ When operating in each mode, includes a live interactive system that allows back and forth conversation between the elevator occupants and emergency personnel.
2. Is ~~fully accessible by the deaf, hard of hearing and speech impaired, and shall include voice-only options for hearing individuals.~~ operational when the elevator is operational.
3. ~~Has the ability to communicate with emergency personnel utilizing existing video conferencing technology, chat/text software or other approved technology.~~ Allows elevator occupants to select the text-based or audible mode depending on their communication needs to interact with emergency personnel.

CHANGE SIGNIFICANCE: In multistory buildings, passenger elevators are typically utilized as vertical accessible routes. In some cases, the elevators may also be considered a part of the accessible means of egress. The *International Building Code* (IBC) mandates than an emergency two-way communication system be provided for accessible elevators. In addition, the elevators and associated elevator landings must have

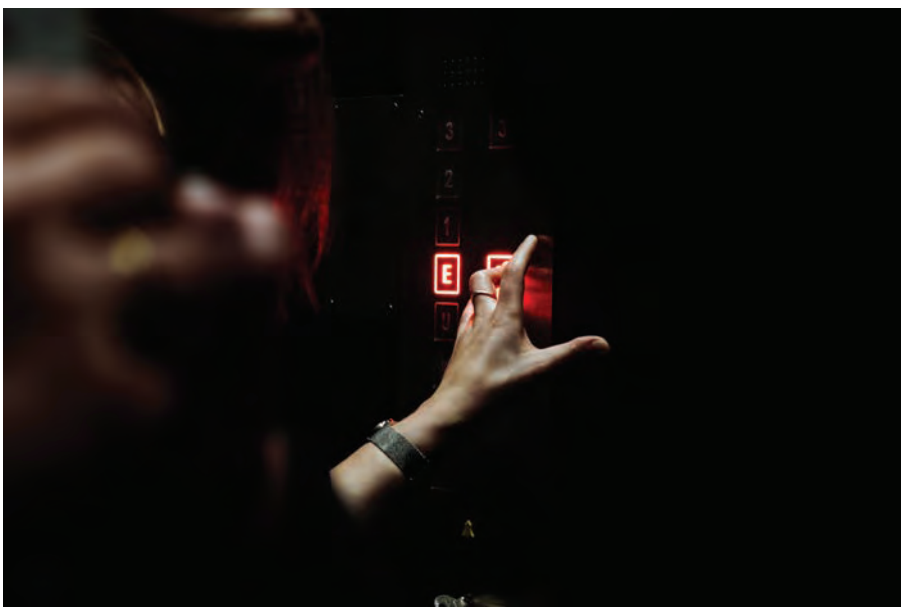


Photo courtesy of Michael Moeller/EyeEm

Elevator control panel.

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accessible features complying with ICC A117.1, the IBC-referenced technical standard for accessibility. Applicable to accessible elevators, the A117.1 standard requires an emergency two-way communication system between the elevator car and a point outside the hoistway. The system must also fully comply with the provisions in ASME A17.1/CSA B44, the *Safety Code for Elevators and Escalators* as published by the American Society of Mechanical Engineers.

The provisions of ICC A117.1 only address requirements regarding the height of operable parts, identification of the system and instructions for its use. Additional communication capabilities were introduced in the 2018 edition of the IBC to enhance the usability of the system by individuals with varying degrees of hearing or speech impairments. The criteria have now been further modified to provide additional direction and clarity in providing the appropriate accessible features.

To provide totally accessible communication between individuals in elevators who are deaf, hard of hearing or speech impaired with local governmental emergency services, additional communication features must be provided within the elevator. It has been clarified that the system must provide both a text mode and an audible mode that, during operation, allows for live interactive communication between those individuals within the elevator and emergency personnel. The system shall be operational during all times the elevator is operational, and it shall be designed to allow the selection of the appropriate communication mode by the elevator occupants. Such occupants may select either the text-based or audible mode based on their specific needs. Along with the necessary visual indicators and button indicators, the text-based mode would allow the use of a keyboard by those entrapped individuals who are deaf or hard-of-hearing.

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3103.1

Special Event Structures

CHANGE TYPE: Clarification

CHANGE SUMMARY: Special event structures, newly defined in Section 202, are now included in the types of temporary structures that are regulated by both the *International Building Code* (IBC) and the *International Fire Code* (IFC).

2021 CODE TEXT: **3103.1 General.** The provisions of Sections 3103.1 through 3103.4 shall apply to structures erected for a period of less than 180 days. Special event structures, tents, umbrella structures and other membrane structures erected for a period of less than 180 days shall also comply with the *International Fire Code*. Those erected for a longer period of time shall comply with applicable sections of this code.

202 SPECIAL EVENT STRUCTURE. Any ground-supported structure, platform, stage, stage scaffolding or rigging, canopy, tower or similar structure supporting entertainment-related equipment or signage.

CHANGE SIGNIFICANCE: The special requirements that are applicable to temporary structures are set forth in Section 3103. For the purpose of applying the applicable code provisions, "temporary" is considered as being erected for a time period of less than 180 days. The IFC contains a significant number of provisions applicable to such structures. In addition, the IBC identifies some key criteria that must be applied to temporary structures, including conformity with the structural strength, fire safety, means of egress, accessibility, light, ventilation and sanitary requirements. Permits are typically required, as are construction documents. The scope of Section 3103 has previously been limited to tents, umbrella structures and other membrane structures. Special event structures, as defined in Section 202, are now included in the types of temporary structures that are regulated by the IBC and IFC.



Photo courtesy of Fish Scale

Special event structures at music festival.

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The new definition in the IBC provides consistency with the IFC definition that was initially established in the 2018 edition. Because special event structures are temporary in nature, such structures are primarily regulated by the IFC for the purposes of approval, permitting, length of use, document submittal, location on lot and inspections. In addition to the provisions mandated by the IFC, limited requirements of the IBC must also be met. Where the structure is to remain in place for a period of 180 days or more, it is to be regulated in the same manner any other "permanent" building or structure by the applicable provisions of the IBC.

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3114

Public Use Restrooms in Flood Hazard Areas

CHANGE TYPE: Addition

CHANGE SUMMARY: Special criteria to be applied where public-use restrooms are located within designated flood hazard areas of publicly owned lands have been established to allow such restrooms to be at-grade or above-grade but below the base flood elevation.

2021 CODE TEXT:

SECTION 3114
PUBLIC USE RESTROOM BUILDINGS IN FLOOD HAZARD AREAS

3114.1 General. For the purpose of this section, public restroom buildings are located on publicly owned lands in flood hazard areas and intended for public use. Public restroom buildings and portions of other buildings that contain public restrooms are limited to toilet rooms, bathrooms, showers and changing rooms. Public restroom buildings and portions of buildings that contain public restrooms shall comply with the requirements of this section. Public-use restrooms that are not elevated or dry floodproofed in accordance with Section 1612 shall comply with Section 3114.2. Portions of buildings that include uses other than public-use toilet rooms, bathrooms, showers and changing rooms shall comply with Section 1612.

3114.2 Flood resistance. Public-use restrooms on publicly owned lands in flood hazard areas shall comply with the requirements of ASCE 24, except for elevation requirements, and shall comply with all of the following criteria:

1. The building footprint is not more than 1,500 square feet (139 m^2).
2. Located, designed and constructed to resist the effects of flood hazards and flood loads to minimize flood damage from a combination of wind and water loads associated with the base flood.



Photo courtesy of Steve Martin, Florida Division of Emergency Management

Public restroom in coastal high hazard area (Zone V/VE).

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3. Anchored to prevent flotation, collapse or lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy during conditions of the base flood.
4. Constructed of flood-damage-resistant materials.
5. Where enclosed by walls, the walls have flood openings.
6. Mechanical and electrical systems are located above the base flood elevation.
7. Plumbing fixtures and plumbing connections are located above the base flood elevation.
8. An emergency plan, approved by the jurisdiction, is submitted to the building official and includes building design documents specifying implementation of protection measures prior to the onset of flooding conditions.

Exceptions:

1. Minimum necessary electric equipment required to address health, life safety and electric code requirements is permitted below the base flood elevation in accordance with ASCE 24 provisions for electric elements installed below the minimum elevations.
2. Plumbing fixtures and connections are permitted below the base flood elevation provided that the fixtures and connections are designed and installed to minimize or eliminate infiltration of floodwaters into the sanitary sewage system and discharges from sanitary sewage systems into floodwaters.

CHANGE SIGNIFICANCE: Chapter 31 provides regulations for unique buildings and building elements. Although many such buildings and elements are not considered as the typical structures regulated under the IBC, they nevertheless pose some degree of hazard or other concern that must be dealt with. Issues that arise in flood hazard areas are addressed in various locations throughout the code, including those related to administrative functions, exterior wall performance, accessibility and flood loads. New provisions established in Section 3114 now address the special criteria to be applied where public-use restrooms are located within designated flood hazard areas of publicly owned lands.

The Federal Emergency Management Agency (FEMA) develops Flood Insurance Rate Maps that identify the land area subject to inundation by the 1-percent annual chance flood. This land area is regulated in the IBC as the flood hazard area unless a state or local jurisdiction creates their own flood hazard areas that are more extensive than those identified by FEMA. In the application of the new provisions addressing public-use restrooms located within flood hazard areas of publicly owned lands, the requirements are applicable to the greater of the two delineated areas.

Public space and parks often occur along rivers and shorelines in communities and state-owned areas. Considerable economic value is derived by these communities from tourism and public access to areas having water features. Historically, the IBC, by reference to ASCE 24 *Flood Resistant Design and Construction*, has required that restrooms provided for public use located in flood hazard areas be in compliance with the same elevation or dry floodproofing requirements as commercial buildings.

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Depending on site-specific conditions, this can result in situations where public restrooms must be constructed as high as 6 to 18 feet above grade, resulting in a variety of challenges including that of access. Although ramp construction is usually possible, extensive travel may be necessary due to significant elevation differences. Other issues include the possible conflict with the code requirement that elevated buildings in coastal high hazard areas (Zone V) and Coastal A Zone must be free of obstruction, as well as possible interference with the ability of enclosure walls to break away under flood conditions. In addition, ramps of extended length may provide no benefit to individuals with disabilities or limited mobility. Although the installation of elevators extending below the base flood elevation would be an acceptable solution, negative issues typically include expense, the extent of required maintenance, and the rate of operational failure.

The new provisions are limited in scope, applicable only where the following three conditions exist: 1) restroom buildings or portions of buildings containing restrooms are 2) located on publicly owned lands in flood hazard areas and 3) intended for public use. Where uses are present in addition to restroom facilities consisting of toilet rooms, bathrooms, showers and/or changing rooms, such uses must fully comply with the applicable elevation and flood-resistance requirements of the IBC.

It is important to emphasize that only the elevation requirements of ASCE 24 are affected. All other flood-resistant design and construction criteria must be met. In addition, other conditions have been established, including a limitation on the floor area of the building and the development of an emergency plan addressing the implementation of protection measures prior to the onset of flooding conditions.

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3115

Intermodal Shipping Containers

CHANGE TYPE: Addition

CHANGE SUMMARY: The use of intermodal shipping containers as buildings and structures is now recognized in the IBC, and criteria have been established to address the minimum safety requirements without duplicating existing code provisions.

CODE TEXT:

SECTION 3115
INTERMODAL SHIPPING CONTAINERS

3115.1 General. The provisions of Section 3115 and other applicable sections of this code shall apply to intermodal shipping containers that are repurposed for use as buildings or structures, or as a part of buildings or structures.

Exceptions:

1. Intermodal shipping containers previously approved as existing relocatable buildings complying with Chapter 14 of *the International Existing Building Code*.
2. Stationary storage battery arrays located in intermodal shipping containers complying with Chapter 12 of the *International Fire Code*.
3. Intermodal shipping containers that are listed as equipment complying with the standard for equipment, such as air chillers, engine generators, modular data centers, and other similar equipment.



Photo courtesy of RADCO, a Twining Company

Multi-level structure of intermodal shipping containers.

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4. Intermodal shipping containers housing or supporting experimental equipment are exempt from the requirements of Section 3115 provided they comply with all of the following:
   - **4.1.** Such units shall be single stand-alone units supported at grade level and used only for occupancies as specified under Risk Category I in Table 1604.5.
   - **4.2.** Such units are located a minimum of 8 feet (2438 mm) from adjacent structures, and are not connected to a fuel gas system or fuel gas utility.
   - **4.3.** In hurricane-prone regions and flood hazard areas, such units are designed in accordance with the applicable provisions of Chapter 16.

(remainder of code text omitted for brevity purposes)

202 INTERMODAL SHIPPING CONTAINERS. A six-sided steel unit originally constructed as a general cargo container used for the transport of goods and materials.

CHANGE SIGNIFICANCE: A wide variety of structures are regulated throughout the IBC. In addition to those typical structures constructed of wood, masonry, concrete or steel, or a combination of such materials, other types of construction are also addressed. Chapter 31 addresses membrane structures, greenhouses and relocatable buildings. However, there are many other types of materials and methods being utilized in the design and construction of buildings that are not regulated by the IBC. As such, Section 104.11 allows for the use of alternative materials and methods of construction provided such methods and materials have been approved by the building official. The use of intermodal shipping containers as buildings and structures is now specifically recognized in the IBC and criteria have been established to address the minimum safety requirements without duplicating existing code provisions.

Over thirty million International Organization for Standardization (ISO) intermodal shipping containers are in use around the world today. These containers, both new and used, are being repurposed and converted to occupiable structures at a significant pace. The applications are widely diverse as is the extent to which the container is used as a structural building element. Before the introduction of the specific requirements now in the 2021 IBC, the lack of code provisions to address such structures had left state and local jurisdictions without appropriate regulations needed to apply and achieve a reasonable and consistent level of code compliance. Such construction practices and materials have required approval through the alternate methods and materials provisions of Section 104.11. ICC G5-2019 *Guideline for the Safe Use of ISO Shipping Containers Repurposed as Buildings and Building Components* was recently published to assist building officials in their evaluation. To provide consistency in design, construction and regulation, Section 3115 has now been introduced into the IBC to provide a consistent and comprehensive set of code provisions specific to such building materials and methods.

A number of key issues are addressed to supplement existing IBC requirements that are applicable to the use of shipping containers as part of a building's construction. A new definition has been developed to identify the scope of this particular type of building component and to avoid any confusion with other types of containers in the marketplace.

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The charging statement indicates the code's application to only intermodal shipping containers that are repurposed for use as buildings or structures. Four exceptions address conditions where such containers would be acceptable for use through the application of another code, such as the IFC or the *International Existing Building Code* (IEBC), where the containers are listed as equipment, and where the containers house experimental equipment. As with any other building regulated by the IBC, construction documents must be provided and contain the necessary information required to ensure compliance with all applicable codes and standards.

Of utmost importance is the verification of the characteristics of the intermodal shipping container prior to it being repurposed as a building or structure. Key is the need for an inspection by an approved agency and verification of the data plate that is attached to the container. Specifics as to the qualifications of the approved agency are not provided to allow the building official and/or state law to apply the appropriate scope, and, further, to avoid dictating that jurisdictions must follow the international agreements that are employed by manufacturers worldwide.

References are made to current provisions of the IBC that are typically applicable to building construction practices using shipping containers. Such areas specifically addressed include protection against decay and termites, under-floor ventilation, roof assemblies, joints and voids. In addition, a number of specific structural considerations are set forth including those for foundations and anchorage. The structural design for the repurposed containers must comply with either the detailed design procedure set forth in Section 3115.8.4 or the simplified structural design method for single-unit containers outlined in Section 3115.8.5. Three ISO standards relevant to the construction of intermodal shipping containers have also been added to Chapter 35 as reference standards. These industry standards have policies and procedures for the inspection of containers throughout the world. Through the application of the new Section 3115, building officials and the business industry will no longer be faced with a patchwork of potentially conflicting or duplicative requirements regarding the use of shipping containers as buildings.

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3313
Fire Protection During Construction

CHANGE TYPE: Modification

CHANGE SUMMARY: The scoping provisions addressing the timing and availability of the required water supply for buildings under construction have been expanded and specific fire flow requirements have now been established.

CODE TEXT: **3313.1 Where required.** An approved water supply for fire protection, either temporary or permanent, shall be made available as soon as combustible building materials arrives on the site, on commencement of vertical combustible construction, and on installation of a standpipe system in buildings under construction, in accordance with Sections 3313.2 through 3313.5.

> **Exception:** The fire code official is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

3313.2 Combustible building materials. When combustible building materials of the building under construction are delivered to a site, a minimum fire flow of 500 gallons per minute (1893 L/m) shall be provided. The fire hydrant used to provide this fire flow supply shall be within 500 feet (152 m) of the combustible building materials, as measured along an approved fire apparatus access lane. Where the site configuration is such that one fire hydrant cannot be located within 500 feet (152 m) of all combustible building materials, additional fire hydrants shall be required to provide coverage in accordance with this section.



Photo courtesy of Matthew Morrison

Minimum water supply required during construction.

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3313.3 Vertical construction of Types III, IV and V construction. Prior to commencement of vertical construction of Type III, IV or V buildings that utilize any combustible building materials, the fire flow required by Sections 3313.3.1 through 3313.3.3 shall be provided, accompanied by fire hydrants in sufficient quantity to deliver the required fire flow and proper coverage.

3313.3.1 Fire separation up to 30 feet. Where a building of Type III, IV or V construction has a fire separation distance of less than 30 feet (9144 mm) from property lot lines, and an adjacent property has an existing structure or otherwise can be built on, the water supply shall provide either a minimum of 500 gallons per minute (1893 L/m), or the entire fire flow required for the building when constructed, whichever is greater.

3313.3.2 Fire separation of 30 feet up to 60 feet. Where a building of Type III, IV or V construction has a fire separation distance of 30 feet (9144 mm) up to 60 feet (18 288 mm) from property lot lines, and an adjacent property has an existing structure or otherwise can be built on, the water supply shall provide a minimum of 500 gallons per minute (1893 L/m), or 50 percent of the fire flow required for the building when constructed, whichever is greater.

3313.3.3 Fire separation of 60 feet or greater. Where a building of Type III, IV or V construction has a fire separation of 60 feet (18 288 mm) or greater from a property lot line, a water supply of 500 gallons per minute (1893 L/m) shall be provided.

3313.4 Vertical construction, Type I and II construction. If combustible building materials are delivered to the construction site, water supply in accordance with Section 3313.2 shall be provided. Additional water supply for fire flow is not required prior to commencing vertical construction of Type I and II buildings.

3313.5 Standpipe supply. Regardless of the presence of combustible building materials, the construction type or the fire separation distance, where a standpipe is required in accordance with Section 3313, a water supply providing a minimum flow of 500 gallons per minute (1893 L/m) shall be provided. The fire hydrant used for this water supply shall be located within 100 feet (30 480 mm) of the fire department connection supplying the standpipe.

CHANGE SIGNIFICANCE: Some of the most hazardous conditions related to buildings often are present during the construction process. Over the past several years, there have been several significant fires in buildings under construction. One of the issues with construction fires is that water supply infrastructure is not always complete prior to vertical construction of a building. The lack of a reliable and sufficient water supply has contributed to significant loss during construction site fires. The fire service requires a dependable water supply to suppress fires of any significant size. Section 3313 has historically mandated that an approved water

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supply, either temporary or permanent, be available prior to the arrival of any combustible materials on the building site. The scoping provisions addressing the timing and availability of such water supply have been expanded and specific fire flow requirements have been established for buildings under construction.

The required timing of providing adequate fire flow has also been affected. Rather than allowing construction to start prior to establishing a water supply, as is often the case, the required fire flow, or a portion thereof, must now be provided as soon as combustible building materials arrive at the site and, further, must be provided prior to any vertical construction.

Only building materials are addressed in the scope of the provisions, as there is no intent to require fire flow water supply for elements such as construction trailers. It is also not the intent to require additional water supply during the construction of noncombustible Type I and II buildings merely due to presence of any combustibles, but rather to focus on combustible construction Types III, IV and V.

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PART 8

Appendices

Appendices A through O

- **Appendix A** — No changes addressed
- **Appendix B** — Board of Appeals
- **Appendix C through N** — No changes addressed
- **Appendix O** — Application of ICC Performance Code

APPENDIX B

Board of Appeals

APPENDIX O

Application of ICC Performance Code

As stated in Chapter 1 of the *International Building Code* (IBC), provisions in the appendices do not apply unless specifically referenced in the adopting ordinance. The appendices are developed in much the same manner as the main body of the model code. However, the appendix information is judged to be outside the scope and purpose of the code at the time of code publication. Many times, an appendix offers supplemental information, alternative methods, or recommended procedures. The information may also be specialized and applicable or of interest to only a limited number of jurisdictions. Although an appendix may provide some guidelines or examples of recommended practices or assist in the determination of alternative materials or methods, it will have no legal status and cannot be enforced until it is specifically recognized in the adopting legislation. Appendix chapters or portions of such chapters that gain general acceptance over time can move into the main body of the model code through the code-development process. ■

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Appendix B
Board of Appeals

CHANGE TYPE: Modification

CHANGE SUMMARY: Appendix B relating to the board of appeals has been expanded by establishing detailed provisions dealing with the application process, board membership, meetings and other areas.

2021 CODE TEXT:

APPENDIX B
BOARD OF APPEALS

B101.1 ~~Application~~ Scope. ~~Applications for appeal shall be obtained from the building official. Applications shall be filed within 20 days after notice has been served.~~ A board of appeals shall be established within the jurisdiction for the purpose of hearing applications for modification of the requirements of this code pursuant to the provisions of Section 113. The board shall be established and operated in accordance with this section, and shall be authorized to hear evidence from appellants and the building official pertaining to the application and intent of this code for the purpose of issuing orders pursuant to these provisions.

B101.2 ~~Membership of board.~~ Application for appeal. Any person shall have the right to appeal a decision of the building official to the board. An application for appeal shall be based on a claim that the intent of this code or the rules legally adopted hereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The application shall be filed on a form obtained from the building official within 20 days after the notice was served.



Photo courtesy of PeopleImages

Board of appeals meeting.

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B101.2.1 Limitation of authority. The board shall not have authority to waive requirements of this code or interpret the administration of this code.

B101.2.2 Stays of enforcement. Appeals of notice and orders, other than Imminent Danger notices, shall stay the enforcement of the notice and order until the appeal is heard by the board.

~~B101.2~~ B101.3 Membership of board. The board ~~of appeals~~ shall consist of ~~persons~~ five voting members appointed by the chief appointing authority of the jurisdiction. Each member shall serve for [INSERT NUMBER OF YEARS] years or until a successor has been appointed. The board members' terms shall be staggered at intervals, so as to provide continuity. The building official shall be an ex officio member of said board but shall not vote on any matter before the board. ~~as follows:~~

~~1. One for 5 years; one for 4 years; one for 3 years; one for 2 years; and one for 1 year.~~

~~2. Thereafter, each new member shall serve for 5 years or until a successor has been appointed.~~

~~The building official shall be an ex officio member of said board but shall have no vote on any matter before the board.~~

~~B101.2.2~~ B101.3.1 Qualifications. The board ~~of appeals~~ shall consist of five individuals, who are qualified by experience and training to pass on matters pertaining to building construction and are not employees of the jurisdiction. ~~one from each of the following professions or disciplines:~~

~~1. Registered design professional with architectural experience or a builder or superintendent of building construction with not fewer than 10 years of experience, 5 of which shall have been in responsible charge of work.~~

~~2. Registered design professional with structural engineering experience.~~

~~3. Registered design professional with mechanical and plumbing engineering experience or a mechanical contractor with not fewer than 10 years of experience, 5 of which shall have been in responsible charge of work.~~

~~4. Registered design professional with electrical engineering experience or an electrical contractor with not fewer than 10 years of experience, 5 of which shall have been in responsible charge of work.~~

~~5. Registered design professional with fire protection engineering experience or a fire protection contractor with not fewer than 10 years of experience, 5 of which shall have been in responsible charge of work.~~

~~B101.2.1~~ B101.3.2 Alternate members. The chief appointing authority ~~shall~~ is authorized to appoint two alternate members who shall be called by the board chairperson to hear appeals during the absence

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or disqualification of a member. Alternate members shall possess the qualifications required for board membership, and shall be appointed for ~~5 years,~~ the same term or until a successor has been appointed.

B101.3.3 Vacancies. Vacancies shall be filled for an unexpired term in the same manner in which original appointments are required to be made.

~~**B101.2.4**~~ **B101.3.4 Chairperson.** The board shall annually select one of its members to serve as chairperson.

~~**B101.2.6**~~ **B101.3.5 Secretary.** The chief ~~administrative officer~~ appointing authority shall designate a qualified clerk to serve as secretary to the board. The secretary shall file a detailed record of all proceedings, ~~in the office of the chief administrative officer.~~ which shall set forth the reasons for the board's decision, the vote of each member, the absence of a member and any failure of a member to vote.

~~**B101.2.5**~~ **B101.3.6** ~~**Disqualification of member.**~~ **Conflict of interest.** A member ~~shall not hear an appeal in which that member has a~~ with any personal, professional or financial interest in a matter before the board shall declare such interest and refrain from participating in discussions, deliberations and voting on such matters.

~~**B101.2.7**~~ **B101.3.7 Compensation of members.** Compensation of members shall be determined by law.

B101.3.8 Removal from the board. A member shall be removed from the board prior to the end of their term only for cause. Any member with continued absence from regular meeting of the board may be removed at the discretion of the chief appointing authority.

~~**B101.2.3**~~ **B101.4 Rules and procedures.** The board ~~is authorized to~~ shall establish policies and procedures necessary to carry out its duties consistent with the provisions of this code and applicable state law. The procedures shall not require compliance with strict rules of evidence, but shall mandate that only relevant information be presented.

~~**B101.3**~~ **B101.5 Notice of meeting.** The board shall meet upon notice from the chairperson, within 10 days of the filing of an appeal or at stated periodic meetings.

~~**B101.3.1**~~ **B101.5.1 Open hearing.** All hearings before the board shall be open to the public. The appellant, the appellant's representative, the building official and any person whose interests are affected shall be given an opportunity to be heard.

B101.5.2 Quorum. Three members of the board shall constitute a quorum.

~~**B101.3.2 Procedure.** The board shall adopt and make available to the public through the secretary procedures under which a hearing will be conducted. The procedures shall not require compliance with strict rules of evidence, but shall mandate that only relevant information be received.~~

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~~B101.3.3~~ B101.5.3 Postponed hearing. When five members are not present to hear an appeal, either the appellant or the appellant's representative shall have the right to request a postponement of the hearing.

B101.6 Legal counsel. The jurisdiction shall furnish legal counsel to the board to provide members with general legal advice concerning matters before them for consideration. Members shall be represented by legal counsel at the jurisdiction's expense in all matters arising from service within the scope of their duties.

~~B101.4~~ B101.7 Board decision. The board shall only modify or reverse the decision of the building official by a concurring vote of ~~two-thirds of its~~ three or more members.

~~B101.4.1~~ B101.7.1 Resolution. The decision of the board shall be by resolution. ~~Certified copies shall be~~ Every decision shall be promptly filed in writing in the office of the building official within three days and shall be open to the public for inspection. A certified copy shall be furnished to the appellant or the appellant's representative and to the building official.

~~B101.4.2~~ B101.7.2 Administration. The building official shall take immediate action in accordance with the decision of the board.

B101.8 Court review. Any person, whether or not a previous party of the appeal, shall have the right to apply to the appropriate court for a writ of certiorari to correct errors of law. Application for review shall be made in the manner and time required by law following the filing of the decision in the office of the chief administrative officer.

CHANGE SIGNIFICANCE: The *International Building Code* (IBC) intends that the board of appeals have the authority to hear and decide appeals of orders and decisions of the building official relative to the application and interpretation of the code. The importance of a board of appeals should not be taken lightly. Its role is equivalent to that of a building official when it comes to the technical questions placed before it; thus, there is a need for highly qualified board members. The board is not merely advisory in its actions, but rather is granted the authority to overturn the decisions of the building official where the determination is within the scope described by the code. Appendix B expands on the scope of Section 113 relating to the board of appeals by establishing detailed provisions dealing with the application-process, board membership, meetings and other areas.

Although this appendix chapter appears to have been extensively modified, many of the modifications are simply format changes. The primary intent of the revision was to provide a comprehensive set of requirements for the board of appeals that could apply consistently throughout all of the I-Codes. The fundamental right for an appeal is established in Section 113. The general workings of the board of appeals are set forth in Appendix B, allowing the jurisdiction to establish their own criteria or to use the appendix as a template. Significant modifications from the previous appendix text include the deletion of specific intervals for staggered appointments as well as the removal of specific qualifications and experience levels for service on the board. New provisions address the removal of members of the board prior to the expiration of their term, the number of members present for a quorum and how vacancies are to be filled.

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Appendix O
Application of ICC Performance Code

CHANGE TYPE: Addition

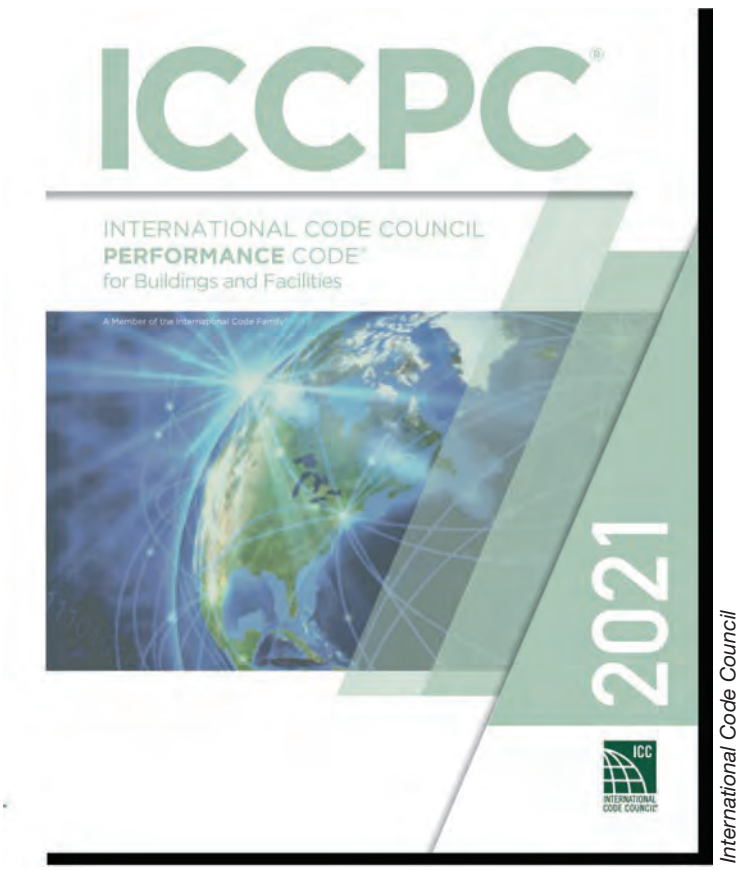
CHANGE SUMMARY: Appendix O, new to the IBC, contains administrative provisions excerpted from the *International Code Council Performance Code for Buildings and Facilities* (ICCPC) to serve as a starting point for the formulation of an effective submittal and corresponding review under the allowances of the IBC for alternative methods, materials and designs.

2021 CODE TEXT:

APPENDIX O
PERFORMANCE-BASED APPLICATION

O101.1 Introduction. The following administrative provisions are excerpted from the *ICC Performance Code for Buildings and Facilities* and can be used in conjunction with the Alternate Methods provisions in Chapter 1, or for a review of submittals requiring a rational analysis or performance-based design. These provisions provide an established framework for the building official in terms of the design expertise needed, the necessary submittals, a review framework and related items.

O101.2 Qualifications. Registered design professionals shall possess the knowledge, skills and abilities necessary to demonstrate compliance with this code.



2021 ICC Performance Code for Buildings and Facilities.

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O101.3 Construction document preparation. Construction documents required by this code shall be prepared in adequate detail and submitted for review and approval in accordance with Section 107.

O101.3.1 Review. Construction documents submitted in accordance with this code shall be reviewed for code compliance with the appropriate code provisions in accordance with Section 107.

O101.4 Construction. Construction shall comply with the approved construction documents submitted in accordance with this code, and shall be verified and approved to demonstrate compliance with this code.

O101.4.1 Facility operating policies and procedures. Policies, operations, training and procedures shall comply with approved documents submitted in accordance with this code and shall be verified and approved to demonstrate compliance with this code.

O101.4.2 Maintenance. Maintenance of the performance-based design shall be ensured throughout the life of the building or portion thereof.

O101.4.3 Changes. The owner or the owner's authorized agent shall be responsible to ensure that any change to the facility, process, or system does not increase the hazard level beyond that originally designed without approval and that changes shall be documented in accordance with the code.

O101.5 Documentation. The registered design professional shall prepare appropriate documentation for the project, clearly detailing the approach and rationale for design submittal, the construction and the future use of the building, facility or process.

O101.5.1 Reports and manuals. The design report shall document the steps taken in the design analysis, clearly identifying the criteria, parameters, inputs, assumptions, sensitivities and limitations involved in the analysis. The design report shall clearly identify bounding conditions, assumptions and sensitivities that clarify the expected uses and limitations of the performance analysis. This report shall verify that the design approach is in compliance with the applicable codes and accepted methods and shall be submitted for concurrence by the building official prior to the construction documents being completed. The report shall document the design features to be incorporated based on the analysis.

The design report shall address the following:

1. Project scope.
2. Goals and objectives.
3. Performance criteria.
4. Hazard scenarios.
5. Design fire loads and hazards
6. Final design.
7. Evaluation.
8. Bounding conditions and critical design assumptions.

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9. Critical design features.
10. System design and operational requirements.
11. Operational and maintenance requirements.
12. Commissioning testing requirements and acceptance criteria.
13. Frequency of certificate renewal.
14. Supporting documents and references.
15. Preliminary site and floor plans.

O101.5.2. Design submittal. Applicable construction documents shall be submitted to the building official for review. The documents shall be submitted in accordance with the jurisdiction's procedures and in sufficient detail to obtain appropriate permits.

O101.6 Review. Construction documents submitted in accordance with this code shall be reviewed for code compliance with the appropriate code provisions.

O101.6.1 Peer review. The owner or the owner's authorized agent shall be responsible for retaining and furnishing the services of a registered design professional or recognized expert, who will perform as a peer reviewer, where required and approved by the building official.

O101.6.2 Costs. The costs of special services, including contract review, where required by the building official, shall be borne by the owner or the owner's authorized agent.

O101.7 Permits. Prior to the start of construction, appropriate permits shall be obtained in accordance with the jurisdiction's procedures and applicable codes.

O101.8 Verification of compliance. Upon completion of the project, documentation shall be prepared that verifies performance and prescriptive code provisions have been met. Where required by the building official, the registered design professional shall file a report that verifies bounding conditions are met.

O101.9 Extent of documentation. Approved construction documents, the operations and maintenance manual, inspection and testing records, and certificates of occupancy with conditions shall be included in the project documentation of the building official's records.

O101.10 Analysis of change. The registered design professional shall evaluate the existing building, facilities, premises, processes, and contents, and the applicable documentation of the proposed change as it affects portions of the building, facility, premises, processes and contents that were previously designed for compliance under a performance-based code. Prior to any change that was not documented in a previously approved design, the registered design professional shall examine the applicable design documents, bounding conditions, operation and maintenance manuals, and deed restrictions.

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CHANGE SIGNIFICANCE: The purpose of the ICC *Performance Code for Buildings and Facilities* (ICCPC) is to promote innovative, flexible and responsive solutions that optimize the expenditure and consumption of resources while preserving social and economic value. While a prescriptive-based code focuses on solutions that achieve a certain outcome, the methodology employed in a performance-based code focuses only on outcomes. The ICCPC creates a framework that both clearly defines the intent of the code and provides a process to understand quantitatively what the code is trying to achieve. Appendix O, new to the IBC, contains administrative provisions excerpted from the ICCPC to serve as a starting point for the formulation of an effective submittal and corresponding review under the allowances of IBC for alternative methods, materials and designs.

Appendix O does not contain any new code requirements, but rather provides an optional design, review and approval framework for use by the building official. Typical applications of the ICCPC would be where the use of Section 104.11 is proposed for an alternative material, design or method of construction, or where an area of the IBC requires a rational analysis such as Section 909 dealing with smoke control systems. Appendix O simply extracts the relevant administrative provisions from the ICCPC and presents them in a more concise, usable format for jurisdictional use.

As an appendix chapter, the provisions are only applicable where specifically adopted. The jurisdiction may adopt the appendix as written, adopt it with local modifications, or use it as a guideline on a case-by-case basis. Appendix O, when specifically adopted, is available as an additional tool for the jurisdiction to utilize as necessary when addressing alternate materials, designs and methods of construction.

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PART 9

2021 *International Existing Building Code* (IEBC)



Chapters 1 through 16 and Appendices A through C

- **Chapter 1** Scope and Administration
  No changes addressed
- **Chapter 2** Definitions No changes addressed
- **Chapter 3** Provisions for All Compliance Methods
- **Chapter 4** Repairs
- **Chapter 5** Prescriptive Compliance Method
- **Chapter 6** Classification of Work
- **Chapter 7** Alterations—Level 1
- **Chapter 8** Alterations—Level 2
- **Chapter 9** Alterations—Level 3
- **Chapter 10** Change of Occupancy
- **Chapter 11** Additions
  No changes addressed
- **Chapter 12** Historic Buildings
  No changes addressed
- **Chapter 13** Performance Compliance Methods
  No changes addressed
- **Chapter 14** Relocated or Moved Buildings
  No changes addressed
- **Chapter 15** Construction Safeguards
  No changes addressed
- **Chapter 16** Reference Standards
  No changes addressed
- **Appendix A** Guidelines for the Seismic Retrofit of Existing Buildings
  No changes addressed
- **Appendix B** Supplementary Accessibility Requirements for Existing Buildings and Facilities
  No changes addressed
- **Appendix C** Gable End Retrofit for High-Wind Areas
  No changes addressed

Applicable to all existing buildings, the IEBC is intended to provide flexibility to permit the use of alternative approaches to achieve compliance with minimum requirements to safeguard the public health, safety and welfare. Both structural and life safety changes are addressed. The IEBC covers existing buildings by creating three paths for compliance. Chapter 3 gives an overview of the paths.

The compliance paths include prescriptive compliance, classification of work and performance compliance. Prescriptive compliance requirements are found in Chapter 5, while performance compliance is covered in Chapter 13. Classification of work is found in Chapters 6 through 11, while more focused topics on repairs, historic buildings, moved buildings and construction safeguards are found in Chapters 4, 12, 14 and 15, respectively. The appendices supply additional requirements and information on seismic retrofit, high wind retrofit and accessibility. ■

303

Storm Shelters

306.7

Accessible Toilet and Bathing Rooms

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Snow Loads and Substantial Damage

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Classroom Acoustics

503.4
Rooftop Equipment Dead Load

503.12, 706.3.2
Roof Diaphragm Wind Loads

503.17, 704.3
Locking in Educational Occupancies

506.4, 1011.5.1, 1011.5.6
Emergency Escape and Rescue Openings

506.5.3, 1006.3
Change of Occupancy from Group U or S

603.1, 704.2, 801.3
Furniture and Equipment

704.1.1
Seating in Nursing Home Corridors

803.2
Sprinklers and Level 2 Alterations

904.1
Sprinklers and Level 3 Alterations

1002.1, 1002.2
Special Uses and Incidental Uses

1011.1, 1011.2
Change of Occupancy Applicability

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303
Storm Shelters

CHANGE TYPE: Modification

CHANGE SUMMARY: Storm shelter requirements have been relocated to Chapter 3. The required occupant capacity is now limited to the total occupant load of the classrooms, vocational rooms and offices in the school while the maximum distance of travel has been deleted.

2021 CODE:

SECTION 303
STORM SHELTERS

303.1 Storm shelters. This section applies to the construction of storm shelters constructed as rooms or spaces within existing buildings for the purpose of providing protection during storms that produce high winds, such as tornadoes and hurricanes. Such structures shall be designated to be hurricane shelters, tornado shelters, or combined hurricane and tornado shelters. Such structures shall be constructed in accordance with this code and ICC 500.

303.2 ~~1106.1~~ Addition to a Group E occupancy. Where an addition is added to an existing Group E occupancy located in an area where the shelter design wind speed for tornados is 250 mph in accordance with Figure 304.2(1) of ICC 500 and the occupant load in the addition is 50 or more, the addition shall have a storm shelter constructed in accordance with ICC 500.

Exceptions:

1. Group E day care facilities.
2. Group E occupancies accessory to places of religious worship.
3. Additions meeting the requirements for shelter design in ICC 500.

303.2.1 ~~1106.1.1~~ Required occupant capacity. The required occupant capacity of the storm shelter shall include all buildings on the site, and shall be the ~~greater of the following:~~

~~1. The~~ total occupant load of the classrooms, vocational rooms and offices in the Group E occupancy.



Photo courtesy of FEMA

School storm shelter with open and closed shutters.

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~~2. The occupant load of any indoor assembly space that is associated with the Group E occupancy.~~

Exceptions:

1. Where an addition is being added on an existing Group E site, and where the addition is not of sufficient size to accommodate the required occupant capacity of the storm shelter for all of the buildings on-site, the storm shelter shall at a minimum accommodate the required capacity for the addition.
2. Where approved by the code official, the required occupant capacity of the shelter shall be permitted to be reduced by the occupant capacity of any existing storm shelters on the site.

~~**1106.1.2 Location.** Storm shelters shall be located within the buildings they serve, or shall be located where the maximum distance of travel from not fewer than one exterior door of each building to a door of the shelter serving that building does not exceed 1,000 feet (305 m).~~

303.2.2 ~~1106.1.3~~ Occupancy classification. The occupancy classification for storm shelters shall be determined in accordance with Section 423.3 of the *International Building Code*.

~~**502.8 Additions to Group E facilities.** For additions to Group E occupancies, storm shelters shall be provided in accordance with Section 1106.1.~~

~~**1301.2.3.1 Additions to Group E facilities.** For additions to Group E occupancies, storm shelters shall be provided in accordance with Section 1106.1.~~

CHANGE SIGNIFICANCE: Storm shelter requirements have been moved from the prescriptive and work area methods and relocated to Chapter 3 to apply generally to all compliance methods. In addition, a new Section 303.1 clarifies the difference between storm shelters used solely during a tornado or hurricane and emergency shelters used after such events, requiring that a storm shelter comply with the International Code Council's standard ICC 500. This language is now consistent with *International Building Code* (IBC) Section 423.

In the *2018 International Existing Building Code* (IEBC), schools had to have a shelter suitable to house everyone who might be in a large assembly space on the site, such as a public library, football field, performing arts center, equestrian arena, natatorium, competition basketball arena or professional development center. Now, only the total occupant load of the students and staff need to be accommodated. The reasoning considers the fact that the code does not require storm shelters for the entire population that outdoor venues, such as outdoor football fields, can accommodate. It should not be necessary for schools to increase the size of the shelters based on their public assembly spaces. The assembly areas do not add to the normal population of students in school nor to the number of staff who are associated with those students. The additional people at the facility outside of school hours elect to be in those assembly areas, similar to any commercial or other public assembly area.

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Section 1106.1.2 also previously required that storm shelters be within 1,000 feet of the buildings they serve. While the 1,000-foot maximum travel limit may be appropriate for new schools, it can be an undue hardship for existing buildings. The location of an addition may be limited by a variety of building and site constraints. Good disaster management practices will typically give schools a response time long enough to be able to move students to on-site shelters as appropriate.

A reference to IBC Section 423 has also been added, as it provides clarification of the occupancy classification of the storm shelter based upon whether it is a standalone structure or part of another occupancy.

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306.7

Accessible Toilet and Bathing Rooms

CHANGE TYPE: Clarification

CHANGE SUMMARY: The requirements for accessible bathing rooms and toilet rooms have been clarified.

2021 CODE: **306.7.11 ~~305.8.10~~ Toilet rooms.** Where it is technically infeasible to alter existing toilet ~~and bathing~~ rooms to be accessible, ~~an~~ one accessible single user toilet room or one accessible family or assisted-use toilet ~~or bathing~~ room constructed in accordance with Section 1110.2.1 of the *International Building Code* is permitted. ~~The family or assisted use toilet or bathing~~ This toilet room shall be located on the same floor and in the same area as the existing toilet ~~or bathing~~ rooms. At the inaccessible toilet ~~and bathing~~ rooms, directional signs indicating the location of the nearest ~~family or assisted use~~ such toilet room ~~or bathing~~ room shall be provided. These directional signs shall include the International Symbol of Accessibility and sign characters shall meet the visual character requirements in accordance with ICC A117.1.

306.7.12 Bathing rooms. Where it is technically infeasible to alter existing bathing rooms to be accessible, one accessible single user bathing room or one accessible family or assisted-use bathing room constructed in accordance with Section 1110.2.1 of the *International Building Code* is permitted. This accessible bathing room shall be located on the same floor and in the same area as the existing bathing rooms. At the inaccessible bathing rooms, directional signs indicating the location of the nearest such bathing room shall be provided. These directional signs shall include the International Symbol of Accessibility and sign characters shall meet the visual character requirements in accordance with ICC A117.1.

CHANGE SIGNIFICANCE: Changes to Section 306.7.11 and the addition of the new Section 306.7.12 separate and clarify requirements for toilet and bathing rooms while coordinating with terminology in the *International*



International Code Council

Accessible toilet room.

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Plumbing Code (IPC). Historically, the requirement originally stated that 'unisex' toilet rooms were permitted, but revisions changed the term to 'family or assisted use' for consistency purposes. The IPC now requires all single-occupant toilet rooms to be gender neutral. It may be questioned whether a family or assisted-use toilet room is for a single user. Family or assisted-use toilet rooms can include both a urinal and a toilet, and may include child fixtures in addition to those for adults. Most of the time, accessible family, assisted-use and accessible single-user toilet rooms are technically the same. Previous language caused questions about whether this option was only allowed where family assisted-use toilet rooms are required in the IBC (Groups A and M), and whether the rooms were allowed to meet fixture counts. The IPC and IEBC have recently been revised to allow both single-user and family or assisted-use toilet rooms to count towards the required fixture count.

In addition, the section title did not include "bathing rooms," although they were addressed in the text. Providing a separate section allows for consistency and also includes shower facilities for occupants. This issue has also been addressed for historic buildings in Sections 306.7.16.4 and 306.7.16.5.

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307, 308

Smoke Alarms and CO Detection

CHANGE TYPE: Modification

CHANGE SUMMARY: The requirements for smoke alarms and CO alarms have been relocated to Chapter 3 to apply to all three methods. In addition, the CO requirements have been revised to recognize the use of both CO alarms and CO detection systems.

2021 CODE:

SECTION 307
SMOKE ALARMS

307.1 Smoke Alarms. Where an alteration, addition, change of occupancy or relocation of a building is made to an existing building or structure of a Group R and I-1 occupancies, the existing building shall be provided with smoke alarms in accordance with the *International Fire Code* or Section R314 of the *International Residential Code*.

Exception: Work classified as Level 1 Alterations in accordance with Chapter 7.

SECTION 308
CARBON MONOXIDE DETECTION

308.1 Carbon monoxide detection. Where an addition, alteration, change of occupancy or relocation of a building is made to Group I-1, I-2, I-4 and R occupancies and classrooms of Group E occupancies, the existing building shall be provided with carbon monoxide detection in accordance with the *International Fire Code* or Section R315 of the *International Residential Code*.



Photo courtesy of Phonlamai Photo

Smoke alarm.



International Code Council

CO alarm.

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Exceptions:

1. Work involving the exterior surfaces of buildings, such as the replacement of roofing or siding, the addition or replacement of windows or doors, or the addition of porches or decks.
2. Installation, alteration or repairs of plumbing or mechanical systems, other than fuel-burning appliances.
3. Work classified as Level 1 Alterations in accordance with Chapter 7.

(Deleted text is not shown for brevity and clarity)

CHANGE SIGNIFICANCE: The requirements for smoke alarms and carbon monoxide (CO) detection systems have been removed from the individual compliance methods and relocated to Chapter 3 to apply generally to all compliance methods. Intended to provide consistent requirements between methods, these requirements will also apply when the performance method is chosen.

The CO requirements have been revised to reflect "detection" versus "alarm" considerations to recognize that either CO alarms or a CO detection system may be used. Group E classrooms have also been added to the locations requiring CO detection to provide consistency with the requirements for existing buildings in Chapter 11 of the *International Fire Code* (IFC). Sections 307 and 308 maintain reference to the IFC and *International Residential Code* (IRC) for the details of the requirements.

Two new exceptions clarify that these provisions are only intended to apply to Level 2 and 3 alterations, changes of occupancy and additions mirroring the application of requirements in the 2018 IEBC.

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309

Exterior Wall Coverings and Envelopes

CHANGE TYPE: Addition

CHANGE SUMMARY: When significant portions of a building's exterior wall coverings or exterior wall envelopes are added or replaced, they must comply with the requirements of Chapters 14 and 26 of the IBC.

2021 CODE:

SECTION 309

ADDITIONS AND REPLACEMENTS OF EXTERIOR WALL COVERINGS AND EXTERIOR WALL ENVELOPES

309.1 General. The provisions of Section 309 apply to all alterations, repairs, additions, relocations of structures and changes of occupancy regardless of compliance method.

309.2 Additions and replacements. Where an exterior wall covering or exterior wall envelope is added or replaced, the materials and methods used shall comply with the requirements for new construction in Chapter 14 and Chapter 26 of the *International Building Code* if the added or replaced exterior wall covering or exterior wall envelope involves two or more contiguous stories and comprises more than 15% of the total wall area on any side of the building.



Photo courtesy of Natalie Oxford

Grenfell fire.

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Exterior wall covering. A material or assembly of materials applied on the exterior side of exterior walls for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including but not limited to, veneers, siding, exterior insulation and finish systems, architectural trim and embellishments such as cornices, soffits, facias, gutters and leaders.

Exterior wall envelope. A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

CHANGE SIGNIFICANCE: Where either replacing an exterior wall covering or envelope, or where an exterior wall assembly or an exterior wall envelope is added, materials and systems must now meet the minimum performance and safety requirements in IBC Chapters 14 and 26 as applicable. This provision applies when the building owner voluntarily makes changes or when replacement is necessary due to damage or failure of the exterior wall covering or envelope.

Added in response to large intentional, and in some cases fatal, fires related to exterior wall envelope or exterior wall covering fires, the requirements will ensure the safety of existing buildings when replacement of the exterior wall covering or envelope is performed. Existing buildings, which may not have the same life safety features as a new building, are more at risk from non-code-compliant exterior wall envelopes and exterior wall coverings.

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405.2.4

Snow Loads and Substantial Damage

CHANGE TYPE: Modification

CHANGE SUMMARY: Snow loads must be addressed for the repair of substantial structural damage regardless of whether the damage was a result of snow.

2021 CODE: **405.2.4 Substantial structural damage to gravity load-carrying components.** Gravity load-carrying components that have sustained substantial structural damage shall be rehabilitated to comply with the applicable provisions for dead, live, and ~~live~~ snow loads in the *International Building Code*. ~~Snow loads shall be considered if the substantial structural damage was caused by or related to snow load effects.~~ Undamaged gravity load-carrying components that receive dead, live or snow loads from rehabilitated components shall also be rehabilitated if required to comply with the design loads of the rehabilitation design.

CHANGE SIGNIFICANCE: Previously, consideration of snow load effects was only required when substantial structural damage was caused by snow loads. Only dead and live loads were considered when rehabilitating the gravity load-carrying components of a building that had sustained substantial structural damage due to rain, wind or lack of maintenance. However, snow loads share the same load path as other gravity loads and it was determined that they should be considered when rehabilitating gravity load-carrying components.

Section 405.2.4 now requires the inclusion of snow load effects for all instances of the rehabilitation of gravity load-carrying components after sustaining substantial structural damage regardless of whether the cause of the substantial structural damage was related to snow loads.

Overloading the structural frame and gravity-carrying elements year after year with high snow loads causes damage that is often undetected. This damage weakens the structure, contributing to later substantial damage. Therefore, it is important to consider snow loads when determining load cases for the roof and other gravity elements of the building under the IBC loads.



Photo courtesy of catnap72

Roof snow load.

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502.6, 503.16, 506.6

Classroom Acoustics

CHANGE TYPE: Addition

CHANGE SUMMARY: Additions, Level 3 alterations and changes of occupancy in educational occupancies are now required to meet the enhanced classroom acoustic requirements of Section 808 of ICC A117.1.

2021 CODE: **502.6 Enhanced classroom acoustics.** In Group E occupancies, enhanced classroom acoustics shall be provided in all classrooms in the addition with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

503.16 Enhanced classroom acoustics. In Group E occupancies, where the work area exceeds 50 percent of the building area, enhanced classroom acoustics shall be provided in all classrooms with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

506.6 Enhanced classroom acoustics. In Group E occupancies, where the work area exceeds 50 percent of the building area, enhanced classroom acoustics shall be provided in all classrooms with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

CHANGE SIGNIFICANCE: Good classroom acoustics are essential to support language acquisition and learning for all children, particularly younger children. For children who have hearing loss and those who use cochlear implants, there is no substitute for a good acoustic environment. Assistive technologies typically only amplify the teacher and do not amplify discussions among children or between the teacher and an



Photo courtesy of skynesher

Typical classroom finishes.

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individual child. Children with disabilities not related to hearing, such as autism and learning disabilities, may be adversely affected by high ambient noise levels.

Based on the scoping volume of 20,000 cubic feet and assuming a 10-foot ceiling height, classrooms up to 2,000 square feet are required to apply the enhanced acoustic requirements. The criteria in ICC A117.1, Section 808 are intended to be applicable to standard size self-contained classrooms while excluding larger spaces used for bands, choir and other large groups. The criteria are also not intended to apply to ancillary learning spaces, such as individual tutoring spaces, corridors or cafeterias.

The classroom is limited to a maximum reverberation time for classroom acoustics, determined through measurement of performance or a calculation based on the materials on the floor, ceiling and walls. Performance in a fully-furnished, unoccupied classroom should include a maximum reverberation time of 0.6 to 0.7 second, depending upon the size of the classroom and a maximum background noise of either 35 dBA or 55 dBC. The intent of the 0.6 to 0.7 second reverberation time is to increase the sound level from the teacher throughout the room while maintaining clarity. The prescriptive calculation requires noise reduction coefficient (NRC) ratings for every surface finish, including finishes on the floor, ceiling and all walls. Ratings range from zero to one, with one indicating the surface absorbs most of the speech sound energy and zero indicating the surface reflects most of the speech sound energy. The A117.1 criterion also considers other sound sources, including ambient sound sources outside the classrooms. These sources may include playground noises, airplane or traffic sources and student movement in halls.

Note that this requirement has been added to both the prescriptive method and the work area method. The new Sections within the work area method include Sections 903.4, 1011.4 and 1101.4. See additional background and commentary in the discussion of IBC Section 1207.

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503.4

Rooftop Equipment Dead Load

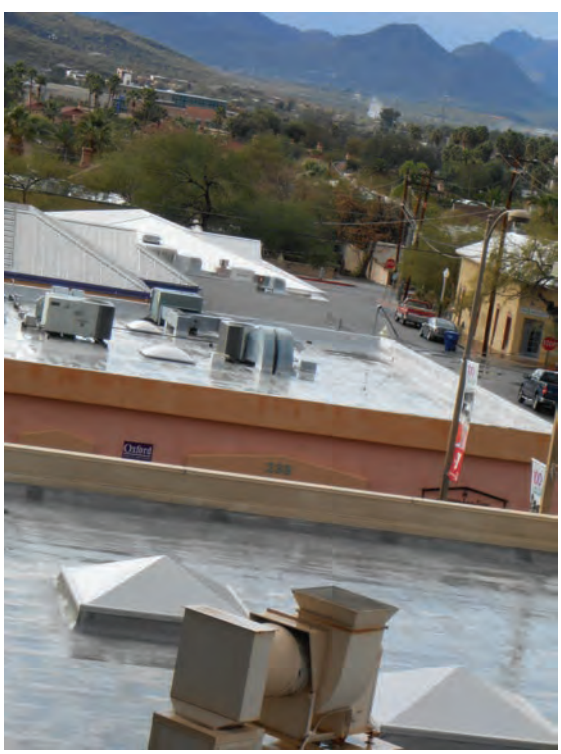
CHANGE TYPE: Modification

CHANGE SUMMARY: The addition of equipment to the roof without a full structural analysis is now permitted when the equipment weighs less than 400 pounds and is less than 10 percent of the total roof dead load.

2021 CODE: **503.4 Existing structural elements carrying lateral load.** Except as permitted by Section 503.13, where the alteration increases design lateral loads, results in a prohibited structural irregularity as defined in ASCE 7, or decreases the capacity of any existing lateral load-carrying structural element, the structure of the altered building or structure shall meet the requirements of Sections 1609 and 1613 of the *International Building Code*. Reduced seismic forces shall be permitted.

Exceptions:

1. Any existing lateral load-carrying structural element whose demand-capacity ratio with the alteration considered is not more than 10 percent greater than its demand-capacity ratio with the alteration ignored shall be permitted to remain unaltered. For purposes of calculating demand-capacity ratios, the demand shall consider applicable load combinations with design lateral loads or forces in accordance with Sections 1609 and 1613 of the *International Building Code*. Reduced seismic forces shall be permitted. For purposes of this exception, comparisons of demand-capacity ratios and calculation of design



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Typical rooftop equipment.

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lateral loads, forces and capacities shall account for the cumulative effects of additions and alterations since original construction.

2. Buildings in which the increase in the demand capacity ratio is due entirely to the addition of roof top supported mechanical equipment individually having an operating weight less than 400 lb. and when the total additional weight of all roof top equipment placed after initial construction of the building is less than 10% of the roof dead load. For purposes of this exception roof shall mean the roof level above a particular story.

CHANGE SIGNIFICANCE: The new exception to Section 503.4 limits the need to hire a structural engineer for small modifications, which is recognized as a more reasonable allowance. Building owners and tenants frequently add or replace rooftop mechanical equipment as a part of an interior tenant improvement. Structural analysis for most projects only considers gravity load effects and ignores the contributions to roof dead load, thereby increasing the seismic weight resisted by the seismic force resisting system at the roof. However, engineers performing the structural design for new buildings determine the total accumulated operating weight of rooftop equipment and divide the load by the area of the roof and add the weight in pounds per square foot to the seismic dead weight. Therefore, new building designs do not account for the localized impacts of rooftop equipment. This code change merely codifies this current practice for existing buildings. The American Society of Civil Engineers standard ASCE 7 does not require that anchorage and bracing be determined for supported equipment having a weight of 400 pounds or less for new buildings.

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503.12, 706.3.2

Roof Diaphragm Wind Loads

CHANGE TYPE: Modification

CHANGE SUMMARY: The requirements of Sections 503.12 and 707.3.2 have been relaxed so that the evaluation of wind loads is now only required when the ultimate design wind speed is greater than 130 mph.

2021 CODE: **503.12 Roof diaphragms resisting wind loads in high-wind regions.** Where the intended *alteration* requires a permit for reroofing and involves removal of roofing materials from more than 50 percent of the roof diaphragm of a building or section of a building located where the ultimate design wind speed is greater than 130 ~~115~~ mph (58 ~~51~~ m/s) in accordance with Figure 1609.3(1) of the *International Building Code* ~~or in a special wind region as defined in Section 1609 of the *International Building Code*~~, roof diaphragms, connections of the roof diaphragm to roof framing members, and roof-to-wall connections shall be evaluated for the wind loads specified in Section 1609 of the *International Building Code*, including wind uplift. If the diaphragms and connections in their current condition are not capable of resisting 75 percent of those wind loads, they shall be replaced or strengthened in accordance with the loads specified in Section 1609 of the *International Building Code*.

Exception: Buildings that have been demonstrated to comply with the wind load provisions in ASCE 7-88 or later editions.

706.3.2 Roof diaphragms resisting wind loads in high-wind regions. Where roofing materials are removed from more than 50 percent of the roof diaphragm or section of a building located where



Photo courtesy of Kenneth Schulze

Hurricane winds uplifting roof.

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the ultimate design wind speed, V_{ult}, determined in accordance with Figure 1609.3(1) of the *International Building Code*, is greater than 130 ~~115~~ mph (58 ~~51~~ m/s) ~~or in a special wind region, as defined in Section 1609 of the *International Building Code*~~, roof diaphragms, connections of the roof diaphragm to roof framing members, and roof-to-wall connections shall be evaluated for the wind loads specified in the *International Building Code*, including wind uplift. If the diaphragms and connections in their current condition are not capable of resisting 75 percent of those wind loads, they shall be replaced or strengthened in accordance with the loads specified in the *International Building Code*.

Exception: Buildings that have been demonstrated to comply with the wind load provisions in ASCE 7-88 or later editions.

CHANGE SIGNIFICANCE: Through the relaxation of requirements in Sections 503.12 and 706.3.2, the evaluation of wind loads is now only required when the ultimate design wind speed exceeds 130 mph under both the prescriptive and work area compliance methods.

The revised wind speed threshold is based on a wind speed above which experience indicates there is a substantial risk of roof diaphragm damage or failure due to uplift in hurricane-prone regions. The value of 130 mph is consistent with windborne debris requirements. No historical data indicates that wind speeds of 115 to 130 mph pose any exceptional risk of building diaphragm damage or failure. Outside of hurricane-prone regions, wind speeds in special wind regions can vary widely from less than 115 mph to speeds much greater. There is no historical evidence indicating that diaphragm deficiencies pose any extraordinary threat outside of hurricane-prone regions. The requirement that a building undergo a diaphragm evaluation, involving a significant investigative and analytical effort by an engineer, must be regarded as an extraordinary burden that is justifiable based on an extraordinary hazard; in other words, the building is at risk of encountering a hurricane. Coordinating the threshold for attaching roof diaphragms to regions with a higher ultimate design windspeed limits the provision's scope to known areas of past vulnerability that are threatened by extraordinary winds.

Previously, the IEBC applied equally to the reroofing of all buildings that met the reroofing percentages and the location thresholds, regardless of when the buildings were constructed. A new exception now exempts buildings from complying with evaluation requirements for wind loads using IBC Section 1609 where the buildings were constructed in accordance with comprehensive wind design provisions. These provisions were first adopted in the 1988 edition of ANSI A58.1, *Minimum Design Loads for Buildings and Other Structures*, the document that would become ASCE 7. All editions since 1988 carry comprehensive provisions for wind design. These buildings comply with current wind development concepts; the roof diaphragms can be demonstrated to resist winds comparative to the current wind provisions.

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503.17, 704.3

Locking in Educational Occupancies

CHANGE TYPE: Addition

CHANGE SUMMARY: Requirements in the IBC have been referenced to provide special allowances for educational occupancies with regard to door lock mechanisms.

2021 CODE: **503.17 Locking arrangements in educational occupancies.** In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors with locking arrangements designed to keep intruders from entering the room shall comply with Section 1010.2.8 of the *International Building Code*.

704.3 Locking arrangements in educational occupancies. In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors with locking arrangements designed to keep intruders from entering the room shall comply with Section 1010.2.8 of the *International Building Code*.

CHANGE SIGNIFICANCE: The new provisions within the prescriptive method and the work area method are intended to correlate with provisions found within the IBC and IEBC regarding locking arrangements in educational spaces. A high priority in educational facilities is the safety of occupants in classrooms and other occupied spaces during the event of a threatening situation. The IBC provides criteria that balance the challenges of providing protection for students and teachers in the classroom and, at the same time, providing for free and immediate egress. Guidance has now been provided to allow for enhanced security measures on educational classroom egress doors and that continue to comply with applicable means of egress requirements for fires and other emergencies. It is especially important to place these requirements in the IEBC to



Photo courtesy of Wirachai

Door hardware in an educational occupancy.

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make sure where alterations are made that the locking arrangements are safe. Existing buildings are more likely to make use of unapproved devices that do not meet egress requirements. Oftentimes, locks or devices are added to doors to provide security, but they do not allow free egress or comply with the single operation requirement. The new provisions within the IEBC are consistent with Section 1010.2.8 of the IBC and IFC to provide guidance for combining security while maintaining safe egress capabilities.

Door locksets with some type of "classroom security function" are readily available at a comparable cost to the traditional "classroom function" door locksets. The most common configuration of a classroom security function lockset is the ability to lock the door from inside the classroom with a key preventing entry to the classroom; and for egress, the door may be easily opened from inside the classroom without a key by a single action on the lever handle. On the outside of the classroom, consistent with tradition, the door may also be locked and unlocked with a key. Many of the traditional locksets required the instructor to leave the classroom and lock the door with a key from the hallway or exterior side, then reenter the classroom for a defend-in-place strategy. This action placed instructors at risk by forcing them to leave the classroom and become exposed. The classroom security function eliminates the need to leave the classroom to lock the door and still allows unrestricted egress from inside the classroom.

Additionally, the IBC requires that the door be unlockable from outside the classroom. This allows for school personnel, law enforcement and emergency responders to obtain entry even after the door is locked from the inside. This can be accomplished at the door with a key or other approved means, including remotely as permitted by the IBC.

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506.4, 1011.5.1, 1011.5.6

Emergency Escape and Rescue Openings

CHANGE TYPE: Addition

CHANGE SUMMARY: The new Sections 506.4 and 1011.4.6 add allowances during a change of occupancy to use replacement window requirements for the installation of emergency escape and rescue openings.

2021 CODE: **506.4 Existing emergency escape and rescue openings.** Where a change of occupancy would require an emergency escape and rescue opening in accordance with Section 1031.1 of the *International Building Code*, operable windows serving as the emergency escape and rescue opening shall comply with the following:

1. An existing operable window shall provide a minimum net clear opening of 4 square feet (0.38 m^2) with a minimum net clear opening height of 22 inches (559 mm) and a minimum net clear opening width of 20 inches (508 mm).
2. A replacement window where such window complies with both of the following:
   - **2.1.** The replacement window meets the size requirements in Item 1.
   - **2.2.** The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.

1011.5.1 Means of egress for change to a higher-hazard category. Where a change of occupancy classification is made to a higher-hazard category (lower number) as shown in Table 1011.5, the means of egress shall comply with the requirements of Chapter 10 of the *International Building Code* (IBC).



Photo courtesy of Melissa Kopka

Typical emergency escape and rescue opening.

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Exceptions:

1. Stairways shall be enclosed in compliance with the applicable provisions of Section 903.1.
2. Existing stairways including handrails and guards complying with the requirements of Chapter 9 shall be permitted for continued use subject to approval of the code official.
3. Any stairway replacing an existing stairway within a space where the pitch or slope cannot be reduced because of existing construction shall not be required to comply with the maximum riser height and minimum tread depth requirements.
4. Existing corridor walls constructed on both sides of wood lath and plaster in good condition or $^1/_2$-inch-thick (12.7 mm) gypsum wallboard shall be permitted. Such walls shall either terminate at the underside of a ceiling of equivalent construction or extend to the underside of the floor or roof next above.
5. Existing corridor doorways, transoms and other corridor openings shall comply with the requirements in Sections 804.6.1, 804.6.2 and 804.6.3.
6. Existing dead-end corridors shall comply with the requirements in Section 804.7.
7. An ~~existing operable window with clear opening area not less than 4 square feet (0.38 m^2) and minimum opening height and width of 22 inches (559 mm) and 20 inches (508 mm), respectively,~~ operable window complying with Section 1011.5.6 shall be accepted as an emergency escape and rescue opening.

1011.5.6 Existing emergency escape and rescue openings. Where a change of occupancy would require emergency escape and rescue opening in accordance with Section 1031 of the *International Building Code*, operable windows serving as the emergency escape and rescue opening shall comply with the following:

1. An existing operable window shall provide a minimum net clear opening of 4 square feet (0.38 m^2) with a minimum net clear opening height of 22 inches (559 mm) and a minimum net clear opening width of 20 inches (508 mm).
2. A replacement window where such window complies with both of the following:
   - **2.1.** The replacement window meets the size requirements in Item 1.
   - **2.2.** The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.

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CHANGE SIGNIFICANCE: New provisions allow the use of existing and smaller replacement windows for emergency escape and rescue openings (EEROs) within a change of occupancy when applying both the prescriptive and work area methods, providing flexibility while still maintaining the level of safety for occupants and emergency responders.

Previously, Sections 505 and 702 were not applicable to Change of Occupancy; therefore, provisions have been added to Section 506 and updated in Chapter 10 to provide this same allowance for a change of occupancy. The new provisions address occupancies that are converted to a Group R-3, R-4 or single exit R-2 occupancy. EEROs are required by IBC Section 1031 in Group R-3 and R-4 dwellings and for Group R-2 apartments in a single exit building (4 units per story, 3 stories above grade plane maximum).

The size of openings currently permitted under 2018 IEBC Section 1011.4.1, Exception 7 for existing windows has been maintained.

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506.5.3, 1006.3

Change of Occupancy from Group S or U

CHANGE TYPE: Modification

CHANGE SUMMARY: An upgrade threshold has been added when changing from a Group S or U occupancy to another occupancy.

2021 CODE: ~~**506.4.3**~~ **506.5.3 Seismic loads (seismic force-resisting system).** Where a change of occupancy results in a building being assigned to a higher risk category, or where the change is from a Group S or Group U occupancy to any occupancy other than Group S or Group U, the building shall satisfy the requirements of Section 1613 of the *International Building Code* for the new risk category using full seismic forces.

Exceptions:

1. Where the area of the new occupancy is less than 10 percent of the building area, the occupancy is not changing from a Group S or Group U occupancy, and the new occupancy is not assigned to Risk Category IV, compliance with this section is not required. The cumulative effect of occupancy changes over time shall be considered.
2. Where a change of use results in a building being reclassified from Risk Category I or II to Risk Category III and the seismic coefficient, S_{DS}, is less than 0.33, compliance with this section is not required.
3. Unreinforced masonry bearing wall buildings assigned to Risk Category III and to Seismic Design Category A or B, shall be permitted to use Appendix Chapter A1 of this code.
4. Where the change is from a Group S or Group U occupancy and there is no change of risk category, use of reduced seismic forces shall be permitted.



Photo courtesy of C. Mae Design

Change of occupancy from Group U to Group A-2.

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1006.3 Seismic loads. Where a change of occupancy results in a building being assigned to a higher risk category, or where the change is from a Group S or Group U occupancy to any occupancy other than Group S or Group U, the building shall satisfy the requirements of Section 1613 of the *International Building Code* for the new risk category using full seismic forces.

Exceptions:

1. Where a change of use results in a building being reclassified from Risk Category I or II to Risk Category III and the seismic coefficient, S_{DS}, is less than 0.33~~:~~, compliance with this section is not required.
2. Where the area of the new occupancy is less than 10 percent of the building area, the occupancy is not changing from a Group S or Group U occupancy, and the new occupancy is not assigned to Risk Category IV, compliance with this section is not required. The cumulative effect of occupancy changes over time shall be considered.
3. Unreinforced masonry bearing wall buildings assigned to Risk Category III and to Seismic Design Category A or B shall be permitted to use Appendix Chapter A1 of this code.
4. Where the change is from a Group S or Group U occupancy and there is no change of risk category, use of reduced seismic forces shall be permitted.

CHANGE SIGNIFICANCE: Since the 2012 edition of the IEBC, a project with a change of occupancy triggers a seismic upgrade only when the change is so significant that it moves the building into a higher risk category. While this is preferable to the pre-2012 triggers, which were complex, an increasingly common case has been missed in which an unoccupied storage, parking, or utility area is converted to an occupied residential unit, leasable office or commercial space. In a seismically deficient building, such a change amounts to adding units to a substandard building, and often in the ground story of a soft-story building. This risk is equivalent to constructing new housing to obsolete seismic standards.

The growing interest in accessory dwelling units (ADUs) makes the problem more urgent when ADUs are proposed inside older storage buildings. Converting collapse-prone unoccupied space to new occupied space represents a significant increase in risk that the code has not previously addressed. Because Group S, U, R, B and M occupancies are generally assigned to Risk Category II, a change from a Group S or U occupancy to a Group R, B or M occupancy typically has not triggered any seismic work. In early editions of the IEBC's work area method, such a change would have triggered a full-building seismic upgrade with full code-level loads.

This change of occupancy now triggers an analysis of the need for seismic upgrade while allowing the use of reduced seismic loads from ASCE 41 for the analysis. This is an exception only for situations where the risk category does not change.

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603.1, 704, 801.3

Furniture and Equipment

CHANGE TYPE: Modification

CHANGE SUMMARY: Furniture, such as office cubicles, reception desks and small bookcases, is exempt from a permit and not intended to be a Level 2 alteration.

2021 CODE: **603.1 Scope.** Level 2 alterations include the ~~reconfiguration of space, the~~ addition or elimination of any door or window, the reconfiguration or extension of any system, or the installation of any additional ~~equipment.~~ equipment; and shall apply where the work area is equal to or less than 50 percent of the building area.

> **Exception:** The movement or addition of non-fixed and movable fixtures, cases, racks, counters and partitions not over 5 feet 9 inches (1753mm) in height shall not be considered a Level 2 alteration.

704.2 Casework. Addition, alteration or reconfiguration of non-fixed and movable cases, counters, and partitions not over 5 feet 9 inches (1753 mm) in height shall maintain the required means of egress path.

801.3 System installations. Requirements related to work area are not applicable where the Level 2 alterations are limited solely to one or more of the following:

1. Mechanical systems, electrical systems, fire protection systems and abatement of hazardous materials.
2. Windows, hardware, operating controls, electrical outlets and signs.
3. Alterations undertaken for the primary purpose of increasing the accessibility of a facility.



Photo courtesy of T_A_P

Typical office cubicle layout.

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CHANGE SIGNIFICANCE: It has been clarified that the work area has limited applicability and does not include building systems, windows and alterations for the purpose of increasing accessibility. Questions arise in large office spaces with cubicles about whether addition or rearrangement of the cubicles qualifies as a reconfiguration of space, creating a work area. Clarification has occurred by recognizing that cubicle walls are considered furniture when they are no more than 5 feet 9 inches in height, and where they do not create a work area. Additionally, a project can be a Level 2 alteration without an assigned work area. Level 2 alterations, as defined in IEBC Chapter 6, include the addition or extension of any system.

Classification of the work as Level 2 is not deemed appropriate where there is only the movement of furniture, including cubicle walls. Section 603.1 now clarifies that the movement of casework is not considered reconfiguration of a space, and so moving furniture will not be considered a Level 2 alteration. Changes to Section 704.2 focus on the movement of casework that affects any means of egress and may require analysis but does not contribute to the work area size.

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704.1.1

Seating in Nursing Home Corridors

CHANGE TYPE: Addition

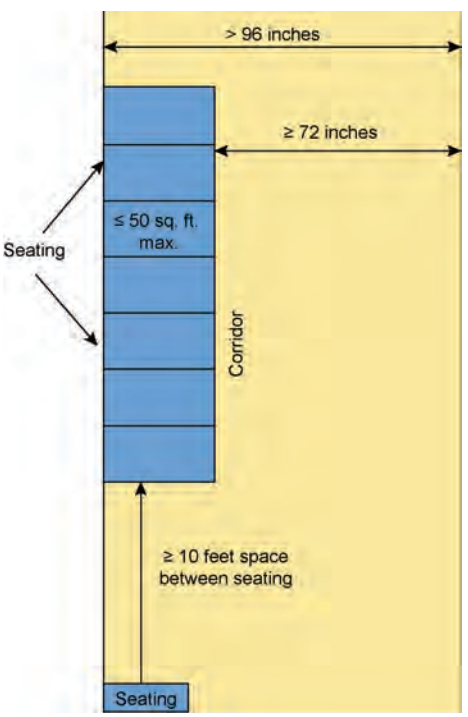
CHANGE SUMMARY: IBC Section 407.4.3 has been referenced allowing, under certain conditions, projections into the corridor within nursing homes.

2021 CODE: **704.1.1 Projections in Nursing Home Corridors.** In Group I-2, Condition 1 occupancies, where the corridor is at least 96 inches wide, projections into the corridor width are permitted in accordance with Section 407.4.3 of the *International Building Code*.

CHANGE SIGNIFICANCE: As part of a Level 1 alteration, furniture may now be added to a corridor in a nursing home. While permitted in the IBC, similar provisions were not found in the 2018 IEBC. The purpose of such seating areas is for socialization and to allow residents to rest along the walking path. The projections are permitted where furniture does not block the means of egress.

A corridor must be at least 96 inches wide if furniture is to be placed along the means of egress path, and the following additional requirements must be met. Furniture must:

1. Be attached to the floor or wall.
2. Not reduce the hall width to less than 72 inches.
3. Only be positioned on one side of the corridor.
4. Be not more than 50 square feet for a single furniture grouping.
5. Be separated by at least 10 feet from other seating.
6. Be considered in fire safety plans.



Nursing home corridor seating.

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803.2.2, 803.2.3, 803.2.5

Sprinklers and Level 2 Alterations

CHANGE TYPE: Modification

CHANGE SUMMARY: Level 2 alteration sprinkler requirements have been revised for buildings and areas with higher hazard or risk.

2021 CODE: **803.2.2 Groups A, B, E, F-1, H, ~~I~~ I-1, I-3, I-4, M, R-1, R-2, R-4, S-1 and S-2.** In buildings with occupancies in Groups A, B, E, F-1, H, ~~I~~ I-1, I-3, I-4,, M, R-1, R-2, R-4, S-1 and S-2, work areas that have exits or corridors shared by more than one tenant or that have exits or corridors serving an occupant load greater than 30 shall be provided with automatic sprinkler protection where both of the following conditions occur:

1. The work area is required to be provided with automatic sprinkler protection in accordance with the *International Building Code* as applicable to new construction.
2. The work area exceeds 50 percent of the floor area.

Exception: If the building does not have sufficient municipal water supply for design of a fire sprinkler system available to the floor without installation of a new fire pump, work areas shall be protected by an automatic smoke detection system throughout all occupiable spaces other than sleeping units or individual dwelling units that activates the occupant notification system in accordance with Sections 907.4, 907.5 and 907.6 of the *International Building Code*.

803.2.2.1 Mixed uses.

803.2.3 Group I-2. In Group I-2 occupancies, an automatic sprinkler system installed in accordance with Section 903.3.1.1 of the *International Fire Code* shall be provided in the following:

1. In Group I-2, Condition 1, throughout the work area.
2. In Group I-2, Condition 2, throughout the work area where the work area is 50 percent or less of the smoke compartment.



Photo courtesy of Marseas

Typical hospital room.

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3. In Group I-2, Condition 2, throughout the smoke compartment in which the work occurs where the work area exceeds 50 percent of the smoke compartment.

~~803.2.3~~ 803.2.4 Windowless stories.

803.2.5 Other required automatic sprinkler systems. In buildings and areas listed in Table 903.2.11.6 of the *International Building Code*, work areas that have exits or corridors shared by more than one tenant or that have exits or corridors serving an occupant load greater than 30 shall be provided with an automatic sprinkler system under the following conditions:

1. The work area is required to be provided with an automatic sprinkler system in accordance with the *International Building Code* applicable to new construction; and
2. The building has sufficient municipal water supply for design of an automatic sprinkler system available to the floor without installation of a new fire pump.

CHANGE SIGNIFICANCE: The Level 2 alteration sprinkler requirements of Section 803 have been revised and expanded. The new Section 803.2.3 provides a method for determining where sprinklers are required for Group I-2 facilities undergoing a Level 2 alteration. An automatic sprinkler system is now mandated regardless of the number of occupants, with automatic sprinkler protection required throughout the work area. If the work area is greater than 50 percent of a smoke compartment, the entire smoke compartment must be sprinklered. Note that having an independent provision also removes the exception for lack of water supply. These requirements are consistent with federal requirements for healthcare occupancies and Chapter 11 of the *International Fire Code* (IFC) for existing buildings.

A previous sprinkler requirement now placed in Section 803.2.5 addresses an unintentional deletion that occurred in the 2018 IBC, focusing on additional automatic sprinkler system requirements for buildings and areas of special use. The requirements apply when work areas include a building or use listed in IBC Table 903.2.11.6 and the work areas have exits or corridors shared by more than one tenant or serve an occupant load greater than 30 people. IBC Table 903.2.11.6 categories are essentially special use conditions such as unlimited area buildings, stages and atriums. Compliance with the IBC's sprinkler requirements is required; however, an exception applies where municipal water supply to the floor is insufficient without the use of a fire pump.

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904.1.4, 904.1.5, 904.1.6, 904.1.7

Sprinklers and Level 3 Alterations

CHANGE TYPE: Addition

CHANGE SUMMARY: Sprinkler requirements for Level 3 alterations have been added to clarify required systems based on the specific occupancy and location of the work area.

2021 CODE: **904.1.4 Groups A, B, E, F-1, H, I-1, I-3, I-4, M, R-1, R-2, R-4, S-1 and S-2.** In buildings with occupancies in Groups A, B, E, F-1, H, I-1, I-3, I-4, M, R-1, R-2, R-4, S-1 work areas shall be provided with automatic sprinkler protection where all of the following conditions occur:

1. The work area is required to be provided with automatic sprinkler protection in accordance with the *International Building Code* as applicable to new construction; and
2. The building site has sufficient municipal water supply for design and installation of an automatic sprinkler system.

Exception: If the building site does not have sufficient municipal water supply for design of an automatic sprinkler system, work areas shall be protected by an automatic smoke detection system throughout all occupiable spaces other than sleeping units or individual dwelling units that activates the occupant notification system in accordance with Sections 907.4, 907.5 and 907.6 of the *International Building Code*.

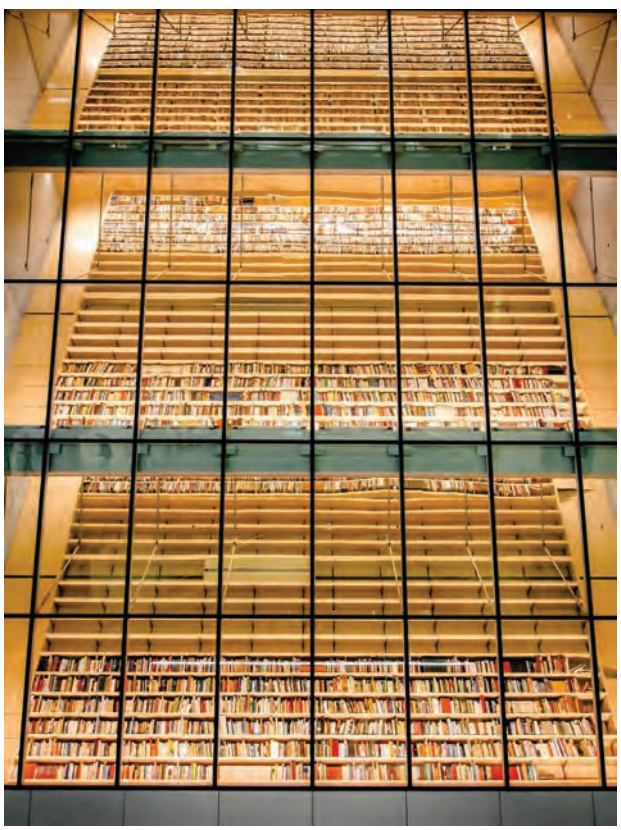


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Existing library.

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904.1.5 Group I-2. In Group I-2 occupancies, an automatic sprinkler system installed in accordance with Section 903.3.1.1 of *the International Fire Code* shall be provided in the following:

1. In Group I-2, Condition 1, throughout the work area.
2. In Group I-2, Condition 2, throughout the work area where the work area is 50 percent or less of the smoke compartment.
3. In Group I-2, Condition 2, throughout the smoke compartment in which the work occurs where the work area exceeds 50 percent of the smoke compartment.

904.1.6 Windowless stories. Work located in a windowless story, as determined in accordance with the *International Building Code*, shall be sprinklered where the work area is required to be sprinklered under the provisions of the *International Building Code* for newly constructed buildings and the building site has a sufficient municipal water supply for the design and installation of an automatic sprinkler system.

~~904.1.4~~ 904.1.7 Other required automatic sprinkler systems. In buildings and areas listed in Table 903.2.11.6 of the *International Building Code*, work areas ~~that have exits or corridors shared by more than one tenant or that have exits or corridors serving an occupant load greater than 30~~ shall be provided with an automatic sprinkler system under the following conditions:

1. The work area is required to be provided with an automatic sprinkler system in accordance with the *International Building Code* applicable to new construction.
2. The building site has sufficient municipal water supply for design and installation of an automatic sprinkler system.

CHANGE SIGNIFICANCE: To make the package of requirements more complete for Level 3 alterations, Sections 904.1.4 through 904.1.6 have been added to clarify the intent of Section 904.1.7 (Section 904.1.4 in the 2018 IEBC). Section 904.1.7 was modified to recognize that once a project becomes a Level 3 alteration, the provisions should not be limited to more than one tenant or a minimum occupant load of 30 people. Level 3 also does not limit the application of sprinkler requirements to situations where a fire pump is not required, but rather the requirements focus on whether sufficient water is available at the building site.

Section 904.1.5 was added to address Group I-2 occupancies, providing consistency with the addition of the new Section 803.2.3 for Level 2 alterations. Unlike other occupancies, whether there is sufficient water supply available is not applicable to Group I-2 occupancies. These requirements are consistent with federal requirements for healthcare occupancies and Chapter 11 requirements of the IFC for existing buildings.

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1002.1 and 1002.2

Special Uses and Incidental Uses

CHANGE TYPE: Modification

CHANGE SUMMARY: Section 1002 has been revised to provide a general reference to IBC Chapter 4 for special uses, to require compliance with incidental uses in accordance with the IBC, and to provide specific requirements for Group I-2 and I-1 occupancies undergoing a change of occupancy.

2021 CODE: **1002.1 Compliance with the building code.** Where ~~the character or use of~~ an existing building or part of an existing building ~~is changed~~ undergoes a change of occupancy to one of the ~~following~~ special use or occupancy categories as ~~defined~~ described in Chapter 4 in the *International Building Code*, the building shall comply with all of the ~~applicable~~ requirements of Chapter 4 of the *International Building Code* applicable to the special use or occupancy.

(Section 1002.1 Items 1-11 are deleted)

1002.2 Incidental uses ~~Underground buildings~~. ~~An underground building in which there is a change of~~ Where a portion of a building undergoes a change of occupancy to one of the incidental uses listed in Table 509.1 of the *International Building Code*, the incidental use shall comply with ~~the requirements~~ Section 509 of the *International Building Code* applicable to the incidental use ~~underground structures~~.

1002.3 Change of occupancy in healthcare. Where a change of occupancy occurs to a Group I-2 or I-1 facility, the work area with the change of occupancy shall comply with the *International Building Code*.

Exception: A change in use or occupancy in the following cases shall not be required to comply with meet-the I*nternational Building Code*:

1. Group I-2 Condition 2 to Group I-2 Condition 1
2. Group I-2 to ambulatory healthcare
3. Group I-2 to Group I-1
4. Group I-1 Condition 2 to a Group I-1 Condition 1



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Special uses.

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CHANGE SIGNIFICANCE: Section 1002.1 has been simplified to provide a general reference back to Chapter 4 of the IBC for special uses rather than a listing that did not include all special uses. With this more general reference to Chapter 4, any time a change of occupancy or use results in a special use, the applicable requirements of IBC Chapter 4 will apply. It is important to note that where a building is already a special use—a high-rise building, for example—this section would not be applicable.

The special use and occupancy section in previous editions of the IEBC listed some of the special uses addressed in IBC Chapter 4. Previous commentary suggested that the list contained special uses that did not constitute a change in occupancy classification but did increase the hazard within a building. Deletion of the list simplifies the requirements and brings in all potential special use hazards that should be mitigated in a change of occupancy involving one of the special uses.

Incidental uses are now addressed with a reference to IBC Section 509 within IEBC Section 1002.2. Previously, incidental uses were listed within Section 1002.1. Because they are not addressed as a special use in Chapter 4 of the IBC, they must be addressed separately.

The new Section 1002.2, which now focuses on incidental uses, previously only addressed underground buildings. Underground structures are a special use within IBC Chapter 4, so technically, Section 1002.1 will address such occupancies. It should be noted that if a building is already considered an underground building, there is not a change resulting in a special use as it was originally designed as an underground building.

The new Section 1002.3 sets out the specific requirements for healthcare uses and denotes when compliance with the IBC is not necessary due to a change to a lower risk occupancy. The provisions specific to healthcare are needed to address situations where current federal requirements allow the "downgrade" of medical facilities from a more intensive to a less intensive use. In effect, this encourages older hospitals to become nursing homes and ambulatory surgery facilities and older nursing homes to become assisted living facilities.

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1011.1, 1011.2

Change of Occupancy Applicability

CHANGE TYPE: Modification

CHANGE SUMMARY: A change of occupancy without alterations need not comply with all IEBC Level 1, 2 and 3 Alteration requirements for the work area method, and the extent of the automatic sprinkler installation has been clarified.

2021 CODE: 1011.1 GENERAL. The provisions of this section shall apply to buildings or portions thereof undergoing a change of occupancy classification. This includes a change of occupancy classification within a group as well as a change of occupancy classification from one group to a different group or where there is a change of occupancy within a space where there is a different fire protection system threshold requirement in Chapter 9 of the *International Building Code*. Such buildings shall also comply with Sections 1002 through 1010 of this code. ~~The application of requirements for the change of occupancy shall be as set forth in Sections 1011.1.1 through 1011.1.3. A change of occupancy, as defined in Section 202, without a corresponding change of occupancy classification shall comply with Section 1001.2.~~

~~**1011.1.1 Compliance with Chapter 9.**~~

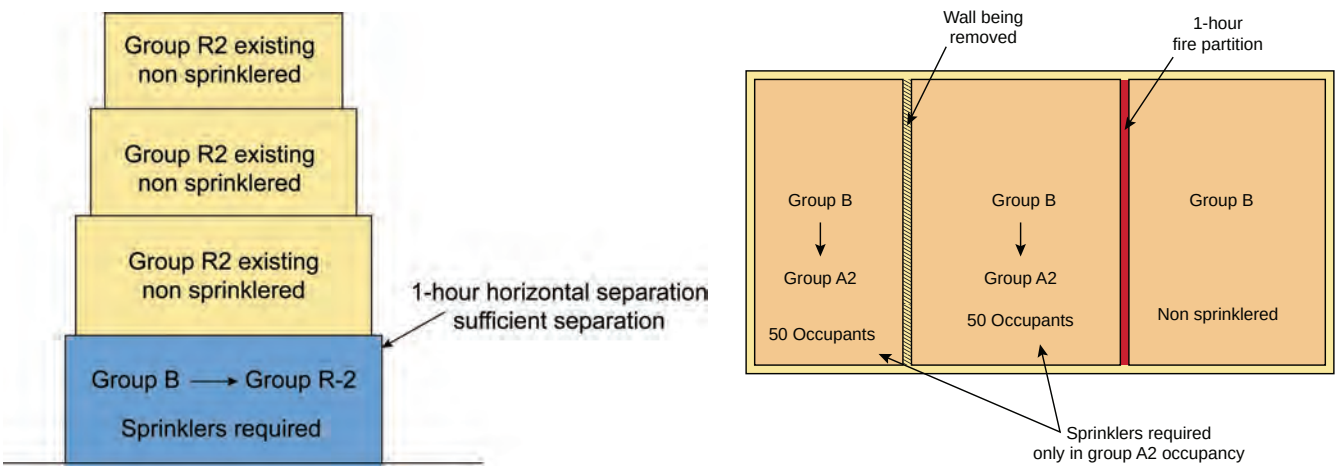
~~**1011.1.1.1 Change of occupancy classification without separation.**~~

~~**1011.1.1.2 Change of occupancy classification with separation.**~~

~~**1011.1.2 Fire protection and interior finish.**~~

~~**1011.1.3 Change of occupancy classification based on hazard category.**~~

1011.2 Fire protection systems. Fire protection systems shall be provided in accordance with Sections 1011.2.1 and 1011.2.2.



Group B/R-2 change of occupancy classification, Group B/A-2 change of occupancy classification.

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1011.2.1 Fire sprinkler system. Where a change in occupancy classification occurs or where there is a change of occupancy within a space where there is a different fire protection system threshold requirement in Chapter 9 of the *International Building Code* that requires an automatic fire sprinkler system to be provided based on the new occupancy in accordance with Chapter 9 of the *International Building Code*. ~~, such~~ The installation of the automatic sprinkler system shall be ~~provided throughout the area where the change of occupancy occurs~~ required within the area of the change of occupancy and areas of the building not separated horizontally and vertically from the change of occupancy by one of the following:

1. Nonrated permanent partition and horizontal assemblies
2. Fire Partition
3. Smoke Partition
4. Smoke Barrier
5. Fire Barrier
6. Fire wall

Exceptions:

1. An automatic sprinkler system shall not be required in a one- or two-family dwelling constructed in accordance with the IRC.
2. Automatic sprinkler system shall not be required in a townhouse constructed in accordance with the IRC.
3. The townhouse shall be separated from adjoining units in accordance with Section R302.2 of the *International Residential Code*.

CHANGE SIGNIFICANCE: The revisions to Section 1011.1 are intended to clarify that the provisions for alterations are only applicable to a change of occupancy classification where an alteration occurs. If there is an alteration, it is addressed by Chapters 7 through 9. The changes should clear up frequent confusion about whether a Level 3 alteration's provisions should be applied regardless of whether an alteration was planned for the building. The remaining provisions in Section 1011 address the minimal requirements for a change of occupancy without an alteration.

Section 1011.2.1 has been revised to clarify that the automatic sprinkler system is only intended in the location of the change of occupancy and, in some cases, may extend farther based on the separations provided. There has been confusion in the past as to how extensive the installation of an automatic sprinkler system required by the IBC should be in an existing building. The IBC often requires installation throughout the fire area, or in the case of residential occupancies, throughout the building. In many cases, installation throughout an existing building is viewed as excessive and not within the intent of the change of occupancy classification requirements. The result, while not confined to separated occupancies or fire areas, should lead to the installation of automatic sprinkler systems throughout the building over time.

Clarity has been added by focusing on how extensive the system should be and what sort of physical separations are needed to get optimal performance. The exemptions clarify that these provisions do not apply to buildings scoped to the *International Residential Code* (IRC).

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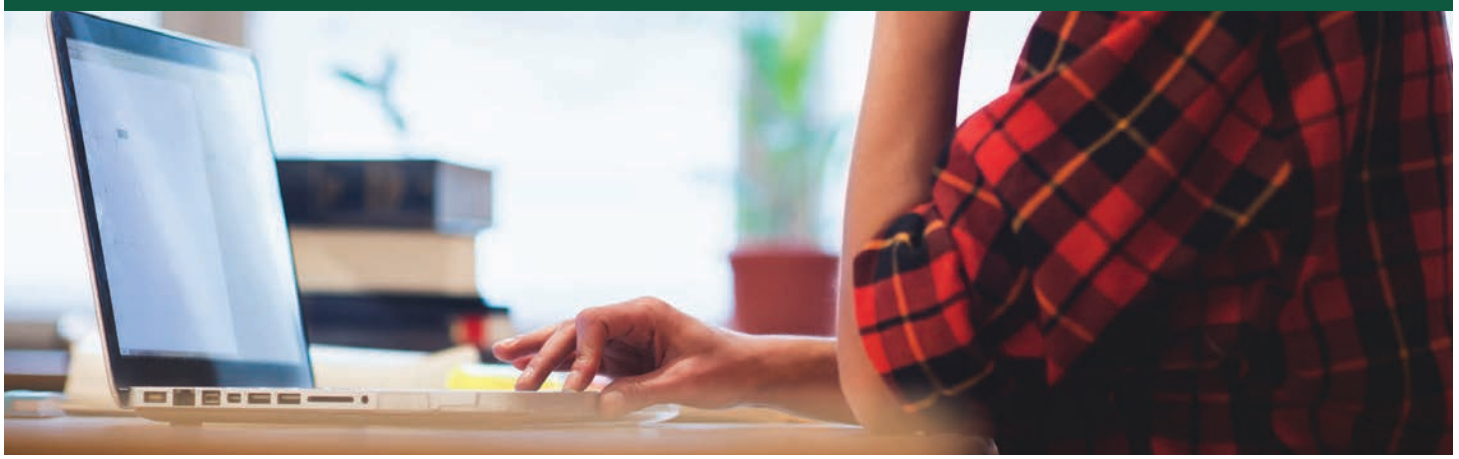
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Preface

The purpose of *Significant Changes to the International Residential Code®, 2021 Edition*, is to familiarize building officials, fire officials, plans examiners, inspectors, design professionals, contractors, and others in the building construction industry with many of the important changes in the 2021 *International Residential Code®* (IRC®). This publication is designed to assist code users in identifying the specific code changes that have occurred and understanding the reasons behind the changes. It is also a valuable resource for jurisdictions in their code-adoption process.

Only a portion of the code changes to the IRC are discussed in this book. The changes selected were identified for a number of reasons, including their frequency of application, special significance, or change in application. However, the importance of the changes not included is not to be diminished. Further information on all code changes can be found in the Complete Revision History to the 2021 I-Codes, available from the International Code Council® (ICC®) online store. This resource provides the published documentation for each successful code change contained in the 2021 IRC since the 2018 edition.

Significant Changes to the International Residential Code, 2021 Edition, is organized into nine parts, each representing a distinct grouping of code topics. It is arranged to follow the general layout of the IRC, including code sections and section number format. The table of contents, in addition to providing guidance in the use of this publication, allows for a quick identification of those significant code changes that occur in the 2021 IRC.

Throughout the book, each change is accompanied by a photograph, an application example or an illustration to assist and enhance the reader's understanding of the specific change. A summary and a discussion of the significance of the change are also provided. Each code change is identified by type, be it an addition, modification, clarification, or deletion.

The code change itself is presented in a legislative format similar to the style utilized for code-change proposals. Deleted code language is shown with a strikethrough, and new code text is indicated by underlining.

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As a result, the actual 2021 code language is provided, as well as a comparison with the 2018 language, so the user can easily determine changes to the specific code text.

As with any code-change text, *Significant Changes to the International Residential Code, 2021 Edition*, is best used as a companion to the 2021 IRC. Because only a limited discussion of each change is provided, the code itself should always be referenced in order to gain a more comprehensive understanding of the code change and its application.

The commentary and opinions set forth in this text are those of the authors and do not necessarily represent the official position of ICC. In addition, they may not represent the views of any enforcing agency, as such agencies have the sole authority to render interpretations of the IRC. In many cases, the explanatory material is derived from the reasoning expressed by code-change proponents.

Comments concerning this publication are encouraged and may be directed to ICC at significantchanges@iccsafe.org.

About the *International Residential Code®*

Building officials, design professionals, contractors and others involved in the field of residential building construction recognize the need for a modern, up-to-date residential code addressing the design and installation of building systems through both prescriptive and performance requirements. The *International Residential Code®* (IRC), *2021 Edition*, is intended to meet these needs through model code regulations that safeguard the public health and safety in all communities, large and small. The IRC is kept up to date through ICC's open code-development process. The provisions of the 2018 edition, along with those code changes approved in the most recent code development cycle, make up the 2021 edition.

The IRC is one in a family of 15 International Codes® (I-Codes®) published by ICC. This comprehensive residential code establishes minimum regulations for residential building systems by means of prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new building designs. The IRC is a comprehensive code containing provisions for building, energy conservation, mechanical, fuel gas, plumbing and electrical systems. The IRC is available for adoption and use by jurisdictions internationally. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference, in accordance with proceedings established by the jurisdiction's laws.

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About the International Code Council®

The International Code Council is a nonprofit association that provides a wide range of building safety solutions including product evaluation, accreditation, certification, codification and training. It develops model codes and standards used worldwide to construct safe, sustainable, affordable and resilient structures. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance, fostering safe and sustainable design and construction.

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PART 1

Administration

Chapters 1 and 2



- **Chapter 1** Scope and Administration
- **Chapter 2** Definitions

The administration part of the *International Residential Code* (IRC) covers the general scope, purpose, applicability, and other administrative issues related to the regulation of residential buildings by building safety departments. The administrative provisions establish the responsibilities and duties of the various parties involved in residential construction and the applicability of the technical provisions within a legal, regulatory, and code-enforcement arena.

Section R101.2 establishes the criteria for buildings that are regulated by the IRC. Buildings beyond the scope of Section R101.2 are regulated by the *International Building Code* (IBC). The remaining topics in the administration provisions of Chapter 1 include the establishment of the building safety department, duties of the building official, permits, construction documents, and inspections.

The definitions contained within the IRC are intended to reflect the special meaning of such terms within the scope of the code. As terms can often have multiple meanings within their ordinary day-to-day use or within the various disciplines of the construction industry, it is important that their meanings within the context of the IRC be understood. Most definitions used throughout the IRC are found in Chapter 2, but additional definitions specific to the applicable topics are found in the energy provisions of Chapter 11, the fuel gas provisions of Chapter 24, and the electrical provisions of Chapter 35. ■

R102.7.1

Additions, Alterations or Repairs

R202

Definition of Emergency Escape and Rescue Opening

R202

Definition of Townhouse

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R102.7.1

Additions, Alterations or Repairs

CHANGE TYPE: Clarification

CHANGE SUMMARY: The code references the *International Existing Building Code*® (IEBC®) only when alterations are part of a change to a use or occupancy outside the scope of the IRC.

2021 CODE: **R102.7.1 Additions, alterations or repairs.** Additions, alterations or repairs to any structure shall conform to the requirements for a new structure without requiring the existing structure to comply with the requirements of this code, unless otherwise stated. Additions, alterations, repairs and relocations shall not cause an existing structure to become ~~unsafe or adversely affect the performance of the building.~~ less compliant with the provisions of this code than the existing building or structure was prior to the addition, alteration or repair. An existing building together with its additions shall comply with the height limits of this code. Where the alteration causes the use or occupancy to be changed to one not within the scope of this code, the provisions of the *International Existing Building Code* shall apply.

CHANGE SIGNIFICANCE: As with other international codes, the IRC provides relief for existing buildings to allow the legal occupancy to continue without fully complying with current codes. To impose regulations to bring existing buildings into current compliance would be impractical and unreasonable. This provision also applies to existing buildings undergoing modifications or additions. Generally, only the modification or addition need comply with the current code. Previous editions of the IRC stated that additions, alterations or repairs could not cause any portion of the existing building to become unsafe or otherwise adversely affect the performance of the building. For clarification, that provision has changed to state that modifications cannot cause the existing building to become less compliant with the



Photo courtesy of benedek/iStock Unreleased/Getty Images

Addition to a single-family dwelling.

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current code. Additional language emphasizes that the building height limitations still apply to additions. The relationship of the IEBC to the IRC has caused some confusion and is clarified in the added language. The IEBC offers alternative compliance paths for renovations to existing buildings. The code now only sends users to the IEBC if the alteration or addition is part of a change of use or change of occupancy that takes the building outside the scope of the IRC. That is, the new use is classified as a building under the IBC and the IEBC applies to the modifications. Similarly, the IEBC states in an exception to its scope that modifications to one- and two-family dwellings and townhouses and their accessory buildings are regulated either by the IEBC or the IRC. Appendix J of the IRC also offers guidance and alternatives for compliance with the code during renovation of existing buildings. The appendix chapters are only in effect if specifically adopted by the jurisdiction. Appendix J provisions, similar to those found in the IEBC, intend to encourage the continued use or reuse of legally existing buildings and structures.

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R202

Definition of Emergency Escape and Rescue Opening

CHANGE TYPE: Clarification

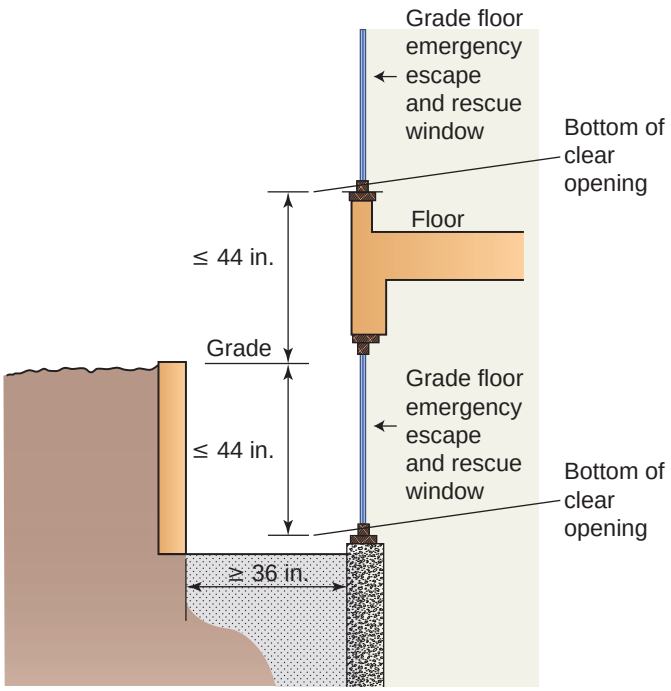
CHANGE SUMMARY: Definitions for emergency escape and rescue openings and grade floor openings have been updated for clarification and to be consistent with the IBC.

2021 CODE: R202 DEFINITIONS

EMERGENCY ESCAPE AND RESCUE OPENING. An operable exterior window, door or other similar device that provides for a means of escape and access for rescue in the event of an emergency. (See also "Grade floor emergency escape and rescue opening.")

GRADE FLOOR EMERGENCY ESCAPE AND RESCUE OPENING. ~~A window or other~~ An emergency escape and rescue opening located such that the ~~sill height~~ bottom of the clear opening is not more than 44 inches (1118 mm) above or below the finished ground level adjacent to the opening. (See also "Emergency escape and rescue opening.")

CHANGE SIGNIFICANCE: The emergency escape and rescue provisions have regularly undergone revisions in past code cycles and the same is true of the 2021 IRC. In conjunction with the reorganization and new text in Section R310, two related definitions have been revised. In part, these changes are for consistency with the IBC and other I-Codes. They also clarify their meaning and application. In the 2012 IRC, the measurement for the maximum height of the emergency escape opening (often referred to as the sill height) was clearly spelled out as the distance from the finished floor to the lowest point of the net clear opening. Traditionally that



Grade floor emergency escape and rescue openings require only 5.0 sq. ft. of clear area.

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has been interpreted and used as the intent of the code, even when the terminology was more ambiguous. The measurement language of the 2012 code was dropped in the 2015 and 2018 editions. Now the definition clearly spells out that the measurement is taken to the lowest point of the opening, which may or may not be a traditional windowsill.

There have been similar misunderstandings related to the definition of grade floor opening. Section R310 has always allowed a reduction in the area of the net clear opening for emergency escape and rescue openings close to grade. This is based on the reduced hazard when compared to escape and rescue from a second or third story opening. However, the definition previously did not mention emergency escape and rescue and its connection to Section R310 was not apparent. As a result, there has been some confusion as to when the exception for reduced opening area was in effect. The code stated that the exception applied to grade floor openings and below grade openings. A literal interpretation of this language would allow a below grade opening deeper than 44 inches below grade and still take advantage of the size reduction, though that was not the intent. To make the connection clear, the definition has been revised to include emergency escape and rescue in the term.

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R202

Definition of Townhouse

CHANGE TYPE: Clarification

CHANGE SUMMARY: A revised definition of townhouse (a building) and a new definition for townhouse unit (a dwelling unit) clarify the appropriate use of the terms.

2021 CODE: R202 DEFINITIONS

BUILDING. Any one- or two-family dwelling or townhouse, or portion thereof, ~~including townhouses,~~ used or intended to be used for human habitation, for living, sleeping, cooking or eating purposes, or any combination thereof, or any accessory structure. For the definition applicable in Chapter 11, see Section N1101.6.

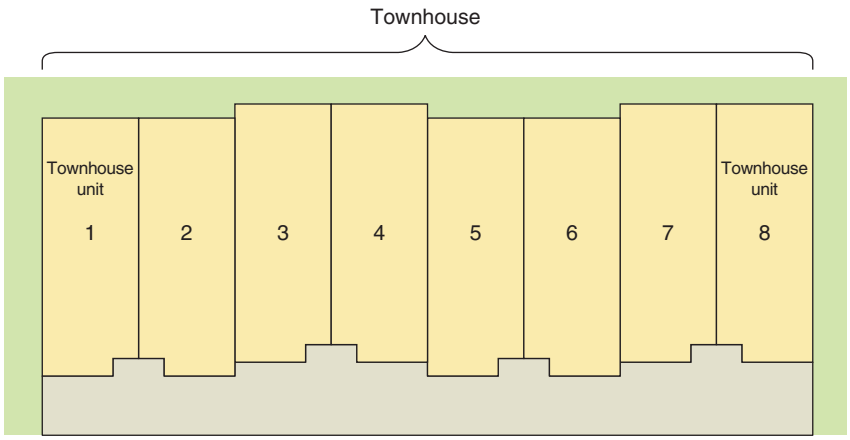
TOWNHOUSE. A ~~single-family dwelling unit constructed in a group of~~ building that contains three or more attached townhouse units. ~~in which each unit extends from foundation to roof and with a yard or public way on not less than two sides.~~

TOWNHOUSE UNIT. A single-family dwelling unit in a townhouse that extends from foundation to roof and that has a yard or public way on not less than two sides.

CHANGE SIGNIFICANCE: There has been some confusion and certainly some inconsistency in the use of the term "townhouse." Previously, a townhouse was defined as a single-family dwelling unit in a group of three or more dwelling units in one building. However, the term was used interchangeably to describe the entire building and the individual dwelling units within that building. The new definition of "townhouse unit" intends to remedy that inconsistency. A townhouse unit describes each individual single-family dwelling unit in a townhouse building. Therefore, a townhouse is a building that contains three or more townhouse units. The new terms appear in the townhouse provisions of Section R302.2 and in other locations throughout the code. The definition of building has also been updated to make a direct reference to townhouse in addition to one- and two-family dwellings and accessory structures.



Townhouse.



Townhouse with 8 townhouse units.

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PART 2

Building Planning

Chapter 3



■ **Chapter 3** Building Planning

Chapter 3 includes the bulk of the nonstructural provisions, including the location on the lot, fire-resistant construction, light and ventilation, emergency escape and rescue, fire protection, safety glazing, fall protection, and many other provisions aimed at protecting the health, safety, and welfare of the public. In addition to such health and life-safety issues, Chapter 3 provides the overall structural design criteria for residential buildings regulated by the IRC. Section R301 addresses live loads, dead loads, and environmental loads such as wind, seismic, and snow. ■

R301.1.4
Intermodal Shipping Containers

R301.2
Wind Speeds

TABLE R301.2.1(1)
Component and Cladding Wind Pressures

R301.2.1.1
Special Wind Regions

R301.2.2.6
Irregular Buildings in Seismic Areas

R301.2.2.10
Seismic Anchorage of Water Heaters

R301.3
Story Height

R302.2
Townhouses

R302.3
Two-Family Dwelling Separation

R302.4
Dwelling Unit Rated Penetrations

R302.5
Dwelling-Garage Opening Protection

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R303.1
Mechanical Ventilation

R305.1
Ceiling Height

R308.4.5
Glazing and Wet Surfaces

R308.6
Skylight Glass Retention Screens

R310.1
Emergency Escape and Rescue Opening Required

R310.2
Emergency Escape and Rescue Openings

R310.3, R310.4
Area Wells for Emergency Escape and Rescue Openings

R310.5, R310.6, R310.7
Emergency Escape and Rescue Openings in Existing Buildings

R311.7, R311.8
Stairways and Ramps

R311.7.7
Stairway and Landing Walking Surface

R312.2
Window Fall Protection

R314.3
Smoke Alarm Locations

R315.2.2
Carbon Monoxide Alarms

R317.1
Protection of Wood Against Decay

R320
Accessibility

R323
Storm Shelters

R324.3
Photovoltaic Systems

R326
Habitable Attics

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R301.1.4

Intermodal Shipping Containers

CHANGE TYPE: Addition

CHANGE SUMMARY: Provisions for construction with intermodal shipping containers are added to the *International Residential Code* (IRC).

2021 CODE TEXT: **R301.1.4 Intermodal shipping containers.** Intermodal shipping containers that are repurposed for use as buildings or structures, shall be designed in accordance with the structural provisions in Section 3115 of the *International Building Code*.

CHANGE SIGNIFICANCE: A wide variety of materials are regulated throughout the IRC. In addition to typical homes constructed of wood, other types of construction are addressed by reference to other codes or standards. Section R104.11 allows for the use of alternative materials and methods of construction provided such methods and materials have been approved by the building official. The use of intermodal shipping containers as buildings and structures is now specifically recognized in the IRC and criteria have been established to address the minimum safety requirements by reference to Section 3115 of the *International Building Code* (IBC). Additionally, ICC G5-2019 *Guideline for the Safe Use of ISO Shipping Containers Repurposed as Buildings and Building Components* was recently published to assist building departments in their evaluation.

Over 30 million intermodal shipping containers are in use around the world today. These containers, both new and used, are being repurposed and converted to occupiable structures. About 80 percent of shipping containers are either 20-foot (6.1 m) or 40-foot (12.2 m) standard length boxes for dry freight. These typical containers are rectangular, closed boxes, with doors fitted at one end, and made of corrugated weathering steel with a plywood floor. The corrugating of the sheet metal used for the sides and roof contributes significantly to the container's rigidity and



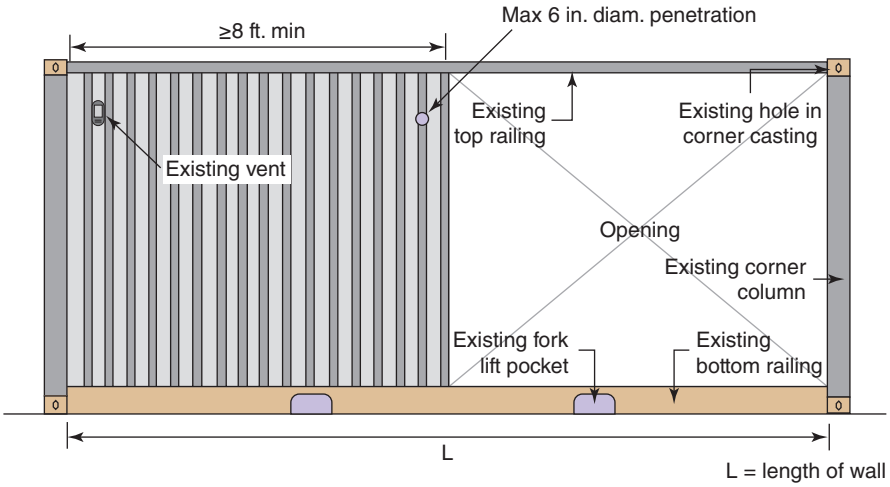
Photo courtesy of Aleksandra Zlatkovic/E+/Getty Images

Single container home.

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Maximum penetration size in shipping containers used for bracing.

stacking strength. Standard containers are 8-foot (2.44 m) wide by 8.5 feet (2.59 m) tall, although the taller hi-cube units measuring 9.5 feet (2.90 m) tall have become common in recent years.

The containers may sit at yards waiting to be used or can be appropriated for use as building materials. Like any repurposed material, they must be evaluated for strength and condition. By referencing Section 3115 of the IBC, the IRC brings in requirements for inspection of the containers before use to ensure material quality. The IBC requires an engineered design for the use of the containers. This design assumes that the containers meet the requirements of ISO 1496-1 which details testing for the strength capacity of the containers. All containers will be tested by an approved third-party to verify that they still meet the capacity of the ISO standard. This testing includes a check of the strength of the side walls, end walls, floor and roof; the rigidity of the container; and its ability to be lifted and stacked. When containers will be used individually in Seismic Design Categories (SDC) A, B or C, they may meet a simplified list of structural criteria.

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CHANGE TYPE: Modification

R301.2
Wind Speeds

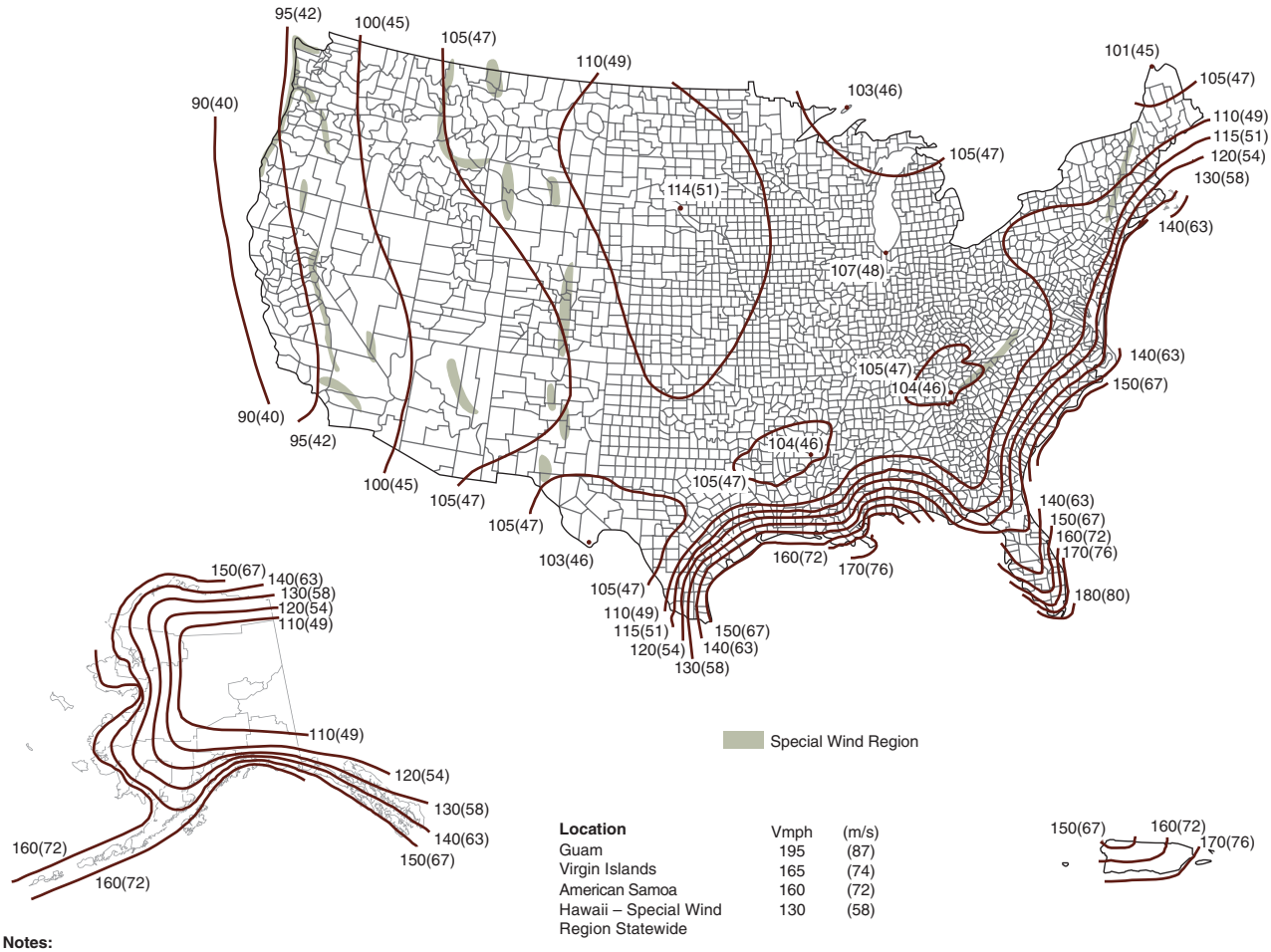
CHANGE SUMMARY: Updated wind speed maps match IBC and ASCE 7 maps with a large portion of the country having wind speeds less than 115 mph.

2021 CODE TEXT: **R301.2.1 Wind design criteria.** Buildings and portions thereof shall be constructed in accordance with the wind provisions of this code using the ultimate design wind speed in Table ~~R301.2(1)~~ R301.2 as determined from Figure ~~R301.2(5)A~~ R301.2(2). The structural provisions of this code for wind loads are not permitted where wind design is required as specified in Section R301.2.1.1. Where different construction methods and structural materials are used for various portions of a building, the applicable requirements of this section for each portion shall apply. Where not otherwise specified, the wind loads listed in Table ~~R301.2(2)~~ R301.2.1(1) adjusted for height and exposure using Table ~~R301.2(3)~~ R301.2.1(2) shall be used to determine design



Photo courtesy of JamesBrey/E+/Getty Images

Wind damage.



Location	Vmph	(m/s)
Guam	195	(87)
Virgin Islands	165	(74)
American Samoa	160	(72)
Hawaii – Special Wind Region Statewide	130	(58)

Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation is permitted between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and land boundaries outside the last contour shall use the last wind speed contour.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).
6. Location-specific basic wind speeds shall be permitted to be determined using www.atcouncil.org/windspeed.

Updated Wind Speeds.

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load performance requirements for wall coverings, curtain walls, roof coverings, exterior windows, skylights, garage doors and exterior doors. Asphalt shingles shall be designed for wind speeds in accordance with Section R905.2.4. Metal roof shingles shall be designed for wind speeds in accordance with Section R905.4.4. A continuous load path shall be provided to transmit the applicable uplift forces in Section ~~R802.11.1~~ R802.11 from the roof assembly to the foundation. Where ultimate design wind speeds in Figure R301.2(2) are less than the lowest wind speed indicated in the prescriptive provisions of this code, the lowest wind speed indicated in the prescriptive provision of this code shall be used.

CHANGE SIGNIFICANCE: Section R301.2.1 coordinates the IRC wind design criteria with the 2016 edition of the engineering standard *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE 7). In ASCE 7-16, wind speeds in non-hurricane prone areas of the contiguous United States have been revised using contours to better reflect regional variations in extreme straight-line winds due to thunderstorms.

In Figure R301.2(2), wind speeds are no longer a minimum of 115 mph for the center of the country and 110 mph in the west. The map is updated to show lower wind speeds with isolines for 90, 95, 100 and 105 mph. Point values are added to the map to aid interpolation between isolines. Generally, wind speeds have dropped across the country, and in some locations the wind speed dropped significantly. Any area that had wind speeds set at 110 mph (west coast) or 115 mph (central United States) now has reduced wind speeds.

With updates to Figure R301.2(2), the map is now identical to the 2021 IBC and ASCE 7-16 wind speed maps for Risk Category II buildings – the category for most buildings including single- and two-family residences and townhouses. Wind speeds in hurricane-prone regions generally remained the same. For the northeastern United States, certain wind speeds dropped 5 to 10 mph inland away from the coastline. New hurricane contours were developed based on updated hurricane models, and hurricane coastline contour locations were adjusted to reflect new research into hurricane decay rates over land. The details of changes, data behind the isolines and methods used to estimate both non-hurricane and hurricane wind speeds are provided in ASCE 7-16's Commentary to Chapter 26. Note that while wind speeds have decreased in certain parts of the country, component and cladding roof wind pressures in certain cases have increased due to changes in Table R301.2.1(1). See the significant change discussion for roof components and cladding.

To see a specific wind speed for a town or individual building, go to either hazards.atcouncil.org or asce7hazardtool.online and type in an address or GPS coordinates. The website will give the wind speed assigned to the location. It is now possible to determine the ground snow load, wind speed, seismic design category and tornado risk from the Applied Technology Council (ATC) website, which remains free to users. The American Society of Civil Engineers (ASCE) website contains additional information while charging a nominal yearly fee and offering wind speeds and tsunami hazard zones for free.

Section R301.2.1 now also includes a reference for wind design of metal roof shingles. Metal roof shingles are fastened following the requirements of Section R905.4.4.

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CHANGE TYPE: Modification

CHANGE SUMMARY: Component and cladding wind pressures in Table R301.2.1(1) are updated for new design wind speeds and hip or gable roof profiles.

2021 CODE TEXT:

Table R301.2.1(1)

Component and Cladding Wind Pressures

TABLE R301.2.1(1): Component and Cladding Loads for a Building with a Mean Roof Height of 30 Feet Located in Exposure B (ASD) (psf)

	Zone	Effective Wind Areas (ft^2)	Ultimate Design Wind Speed, V_{ult}													
			90		95		100		105		110		...		180	
			Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg
Gable Roof >7 to 20 degrees	1, 2e	10	5.4	-16.2	6	-18.0	6.7	-19.9	7.4	-22	8.1	-24.1	...	...	21.6	-64.6
	1, 2e	20	4.9	-16.2	5.4	-18	6.0	-19.9	6.6	-22	7.2	-24.1	...	...	19.4	-64.6
	1, 2e	50	4.1	-9.9	4.6	-11	5.1	-12.2	5.6	-13.4	6.1	-14.7	...	...	16.4	-39.4
	1, 2e	100	3.6	-5	4	-5.6	4.4	-6.2	4.8	-6.9	5.3	-7.5	...	...	14.2	-20.2
	2n, 2r, 3e	10	5.4	-23.6	6	-26.3	6.7	-29.1	7.4	-32.1	8.1	-35.2	...	...	21.6	-94.2
	2n, 2r, 3e	20	4.9	-20.3	5.4	-22.7	6	-25.1	6.6	-27.7	7.2	-30.4	...	...	19.4	-81.4
	2n, 2r, 3e	50	4.1	-16	4.6	-17.9	5.1	-19.8	5.6	-21.8	6.1	-24	...	...	16.4	-64.2
	2n, 2r, 3e	100	3.6	-12.8	4	-14.3	4.4	-15.8	4.8	-17.4	5.3	-19.1	...	...	14.2	-51.3
	3r	10	5.4	-28	6	-30.2	6.7	-34.6	7.4	-38.1	8.1	-41.8	...	...	21.6	-112
	3r	20	4.9	-24	5.4	-26.7	6	-29.6	6.6	-32.7	7.2	-35.9	...	...	19.4	-96
	3r	50	4.1	-18.7	4.6	-20.8	5.1	-23.1	5.6	-25.4	6.1	-27.9	...	...	16.4	-74.7
	3r	100	3.6	-14.7	4	-16.3	4.4	-18.1	4.8	-20	5.3	-21.9	...	...	14.2	-58.7
Hipped Roof >7 to 20 degrees	1	10	6.5	-14.7	7.3	-16.3	8	-18.1	8.9	-20	9.7	-21.9	...	...	26.1	-58.7
	1	20	5.6	-14.7	6.3	-16.3	7	-18.1	7.7	-20	8.4	-21.9	...	...	22.5	-58.7
	1	50	4.4	-11.3	5	-12.6	5.5	-14	6.1	-15.4	6.6	-16.9	...	...	17.8	-45.3
	1	100	3.6	-8.7	4	-9.7	4.4	-10.8	4.8	-11.9	5.3	-13.1	...	...	14.2	-35
	2r	10	6.5	-19.1	7.3	-21.3	8	-23.6	8.9	-26	9.7	-28.6	...	...	26.1	-76.5
	2r	20	5.6	-17.2	6.3	-19.2	7	-21.3	7.7	-23.4	8.4	-25.7	...	...	22.5	-68.9
	2r	50	4.4	-14.7	5	-16.4	5.5	-18.2	6.1	-20	6.6	-22	...	...	17.8	-58.8
	2r	100	3.6	-12.8	4	-14.3	4.4	-15.8	4.8	-17.4	5.3	-19.1	...	...	14.2	-51.3
	2e, 3	10	6.5	-20.6	7.3	-22.9	8	-25.4	8.9	-28	9.7	-30.8	...	...	26.1	-82.4
	2e, 3	20	5.6	-18.5	6.3	-20.6	7	-22.9	7.7	-25.2	8.4	-27.7	...	...	22.5	-74.1
	2e, 3	50	4.4	-15.8	5	-17.6	5.5	-19.5	6.1	-21.5	6.6	-23.6	...	...	17.8	-63.1
	2e, 3	100	3.6	-13.7	4	-15.3	4	-16.9	4.8	-18.7	5.3	-20.5	...	...	14.2	-54.8

(Only a portion of the table is shown for brevity and clarity.)

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Roof cladding damage.

CHANGE SIGNIFICANCE: Changes to Section R301.2 coordinate wind design criteria in the IRC with the referenced engineering load standard *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE 7-16). Simplified component and cladding loads in Table R301.2.1(1) are revised for consistency with ASCE 7 roof component and cladding loads (C&C) for buildings with mean roof heights less than or equal to 60 feet. The roof zones and pressure coefficients in ASCE 7-16 Figure 30.3-2 (which includes Figures 30.3-2A through 30.3-2I) have been revised based on analysis of an extensive wind tunnel test results database.

Compared to previous versions of the IRC, C&C pressure coefficients have increased. C&C roof zone sizes are also modified. Monitoring of buildings across the country indicates that for low-rise buildings, C&C roof zone sizes depend primarily on building height, *h*. Note that for Exposure B, when the building mean roof height is less than 30 feet, the adjustment is less than 1.0 allowing a reduction in required wind pressure. Mean roof height is defined as the average of the ridge and eave heights.

TABLE R301.2.1(2) Height and Exposure Adjustment Coefficients for Table R301.2.1(1)

Mean Roof Height (ft)	Exposure		
	B	C	D
15	0.82 ~~1.00~~	1.21	1.47
20	0.89 ~~1.00~~	1.29	1.55
25	0.94 ~~1.00~~	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70

Figure R301.2.1, component and cladding pressure zones, is illustrated in the figure on gable roof wind zones and shows corner (3, 3e, 3r), edge (2e, 2r, 2n) and interior (1) roof zones. These C&C zones are different from roof zones in previous editions of the IRC. The updated Figure R301.2.1 and Table R301.2.1(1) incorporate recent research by increasing edge and corner wind pressures as appropriate. To better define which roof surface areas require increased wind resistance, gable and hip roofs are divided into two categories and low-slope roofs (0 to 7 degrees) are separated from roofs with shallow slopes (>7 to 20 degrees) and steeper slopes (>20 to 27) and (>27 to 45 degrees). By separating the roof slope into multiple categories and dividing the roof surface into multiple regions, nailing patterns are increased only when necessary and less restrictive patterns can be used where appropriate.

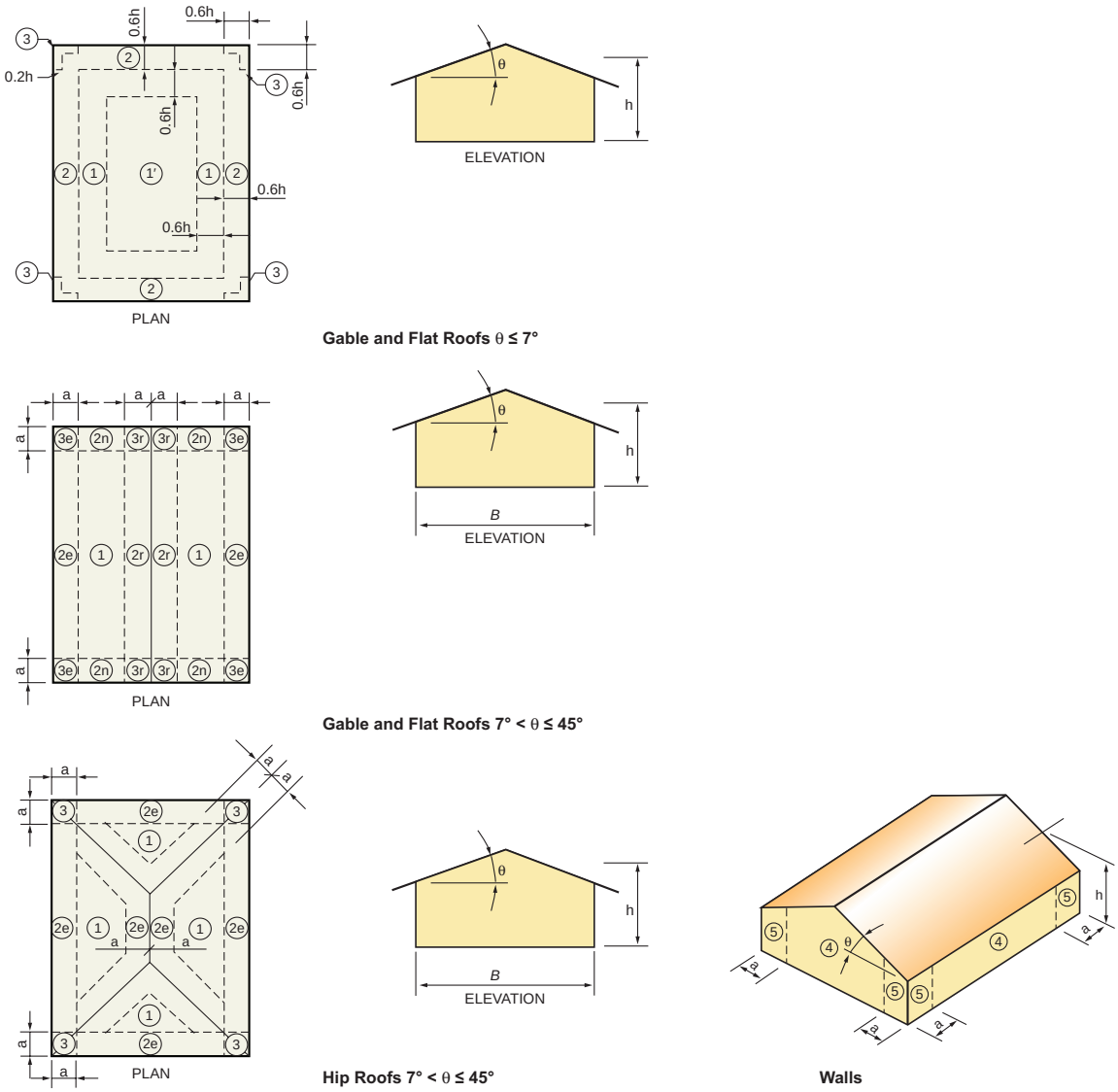
New vocabulary includes division of C&C corner and edge zones as follows:

2 – edge zones
- 2e – edge zone along bottom of roof above the soffit
- 2r – edge zone along roof peak
- 2n – edge zone along rake edge of gable roof

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Component and cladding pressure zones.

3 – corner zones
- 3e – corner zone at bottom of roof above the soffit
- 3r – corner zone at roof peak
- a = 4 feet

Interior C&C zones are broken into two categories. For the IRC, zone 1 and zone 1′ use the same value. If the roof requires design per the IBC, these values will be different.
- 1 – interior zone
- 1′ – central interior zone, flat or low slope roof

When considering nailing patterns for buildings constructed following the 2021 IRC, consider how many different nailing patterns are reasonable to require on a single roof. A single nailing pattern is preferred by framers, but in high wind zones, it may be preferable to have a nailing pattern for corner and edge zones with a different pattern in the interior of the roof. Also note that relatively new fasteners, such as Roof Sheathing Ring Shank (RSRS) nails have been tabulated in Table R602.3(1) specifically to address these increased roof wind pressures.

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R301.2.1.1

Special Wind Regions

CHANGE TYPE: Clarification

CHANGE SUMMARY: Engineered design requirements for special wind regions are explicitly stated in Section R301.2.1.1.

2021 CODE TEXT: **R301.2.1.1 Wind limitations and wind design required.** The wind provisions of this code shall not apply to the design of buildings where wind design is required in accordance with ~~Figure R301.2(5)B~~ Figure R301.2.1.1, or where the ultimate design wind speed, V_{ult}, in Figure R301.2(2) equals or exceeds 140 mph in a special wind region.

Exceptions:

1. For concrete construction, the wind provisions of this code shall apply in accordance with the limitations of Sections R404 and R608.
2. For structural insulated panels, the wind provisions of this code shall apply in accordance with the limitations of Section R610.
3. For cold-formed steel light-frame construction, the wind provisions of this code shall apply in accordance with the limitations of Sections R505, R603 and R804.



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High winds in a special wind region.

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In regions where wind design is required in accordance with ~~Figure R301.2(5)B~~ Figure R301.2.1.1 or where the ultimate design wind speed, V_{ult}, in Figure R301.2(2) equals or exceeds 140 mph in a special wind region, the design of buildings for wind loads shall be in accordance with one or more of the following methods:

1. AWC *Wood Frame Construction Manual* (WFCM).
2. ICC *Standard for Residential Construction in High-Wind Regions* (ICC 600).
3. ASCE *Minimum Design Loads for Buildings and Other Structures* (ASCE 7).
4. AISI *Standard for Cold-Formed Steel Framing—Prescriptive Method for One- and Two- Family Dwellings* (AISI S230).
5. *International Building Code*.

The elements of design not addressed by the methods in Items 1 through 5 shall be in accordance with the provisions of this code.
Where ASCE 7 or the *International Building Code* is used for the design of the building, the wind speed map and exposure category requirements as specified in ASCE 7 and the *International Building Code* shall be used.

CHANGE SIGNIFICANCE: The *2018 International Residential Code* (IRC) did not explicitly prohibit IRC prescriptive provisions in special wind regions for wind speeds less than 140 mph. Rather, special wind regions were identified in the map for areas with wind design required in hurricane prone regions but no text stated whether the special wind region also required wind design. The 2021 IRC clarifies the intent of the code by stating that the IRC prescriptive provisions can be used in special wind regions where the wind speed is less than 140 mph. If design wind speeds are 140 mph or greater, an alternative design method must be followed.

Figure R301.2.1.1 prohibits use of IRC prescriptive provisions for the structural frame of the building in shaded areas of the map which are defined as "wind design required" regions. These regions mainly cover hurricane-prone areas where wind speeds exceed 130 mph (gulf coast and southern Atlantic coast, Caribbean, South Pacific and Hawaii) and other coastal areas where wind speeds exceed 140 mph (northern and central Atlantic coast and Alaska). Special wind regions are also defined on the map, but a special wind region has highly variable wind speeds depending on specific lot locations. Not all wind speeds in these regions are above 140 mph. With this clarification, it is clear that engineering is only required in special wind regions where design wind speeds exceed 140 mph.

Engineered design is also required for buildings on upper slopes of hills when design wind speeds exceed 140 mph. Table R301.2.1.5.1, Ultimate Design Wind Speed Modification for Topographic Wind Effect, now lists wind speeds for buildings on the upper half of a hill for lower design wind speed areas. Values have been added for design wind speeds of 95, 100 and 105 mph.

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R301.2.2.6

Irregular Buildings in Seismic Areas

CHANGE TYPE: Addition

CHANGE SUMMARY: Irregular building limitations now include hillside light-frame construction.

2021 CODE TEXT: **R301.2.2.6 Irregular buildings.** The seismic provisions of this code shall not be used for structures, or portions thereof, located in Seismic Design Categories C, D_0, D_1 and D_2 and considered to be irregular in accordance with this section. A building or portion of a building shall be considered to be irregular where one or more of the conditions defined in Items 1 through ~~7~~ 8 occur. Irregular structures, or irregular portions of structures, shall be designed in accordance with accepted engineering practice to the extent the irregular features affect the performance of the remaining structural system. Where the forces associated with the irregularity are resisted by a structural system designed in accordance with accepted engineering practice, the remainder of the building shall be permitted to be designed using the provisions of this code.

(No changes to Items 1-7)

8. **Hillside Light-Frame Construction**. Conditions in which all of the following apply:
   8.1. The grade slope exceeds 1 vertical in 5 horizontal where averaged across the full length of any side of the dwelling.



Irregular building shape.

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8.2. The tallest cripple wall clear height exceeds 7 feet (2134 mm), or where a post and beam system occurs at the dwelling perimeter, the post and beam system tallest post clear height exceeds 7 feet (2134 mm),

8.3. Of the total plan area below the lowest framed floor, whether open or enclosed, less than 50 percent is living space having interior wall finishes conforming to Section R702.

Where Item 8 is applicable, design in accordance with accepted engineering practice shall be provided for the floor diaphragm immediately above the cripple walls or post and beam system and all structural elements and connections from this diaphragm down to and including connections to the foundation and design of the foundation to transfer lateral loads from the framing above.

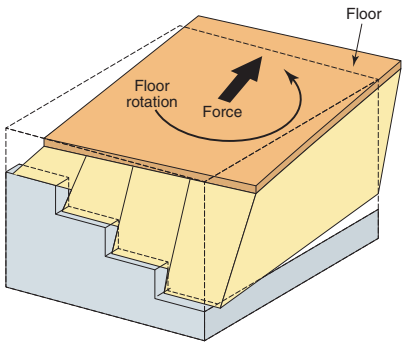
Exception: Light-frame construction in which the lowest framed floor is supported directly on concrete or masonry walls over the full length of all sides except the downhill side of the dwelling need not be considered an irregular dwelling under Item 8.

R202 CRIPPLE WALL CLEAR HEIGHT. The vertical height of a cripple wall from the top of the foundation to the underside of floor framing above.

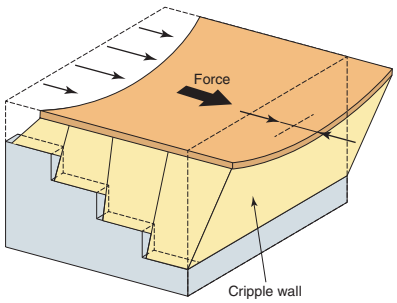
CHANGE SIGNIFICANCE: For light-frame dwellings on steep hillsides, the typical assumption of floor loads transferring to braced wall panels based on the tributary area of a flexible wood floor does not work for adequate seismic performance. Whether earthquake shaking is across the slope or perpendicular to the hill, seismic forces follow the stiffest load path to the uphill foundation, rather than distributing evenly to all braced wall panels as assumed in IRC seismic wall bracing provisions. To address this issue, a trigger was added to Section R301.2.2.6 requiring engineered design of hillside dwellings, now defined as irregular buildings.

Hillside dwellings were found to be vulnerable in the 1994 Northridge, California earthquake. 117 significantly damaged hillside dwellings of typical light-frame wood construction were identified in reconnaissance reporting, with an additional 40 damaged buildings utilizing post and beam foundations. 15 dwellings were reported to have collapsed with another 15 near collapse.

The slope trigger (Item 8.1) is used to limit applicability of this irregularity to dwellings that are on sites with a significant slope. Averaging the grade along the side of the dwelling is intended to focus on the overall elevation drop across the dwelling and not trigger the irregularity based only on limited areas of steeper slope. For most dwellings this criterion will be evaluated by looking at the grade elevation on each side of the building. For large and complex dwellings, additional "sides" will need to be evaluated.



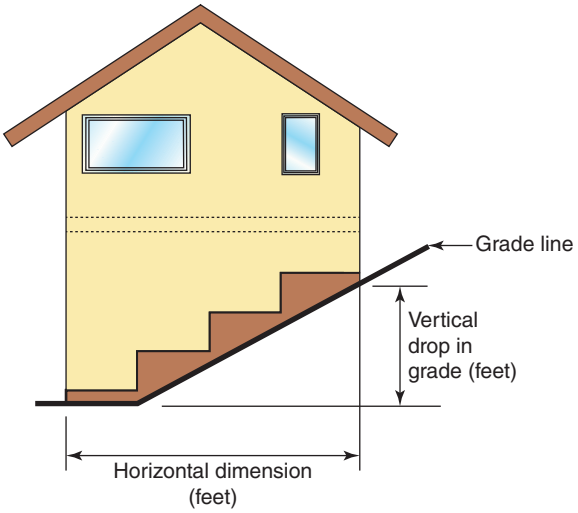
Seismic forces across the slope cause the building to rotate.



Seismic forces in the direction of the slope move the building downhill causing the center of the foundation to bend or flex inward.

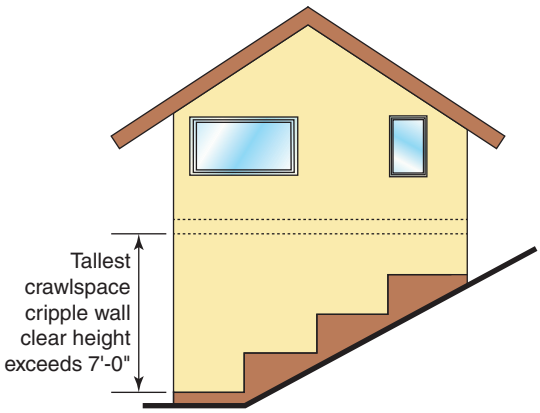
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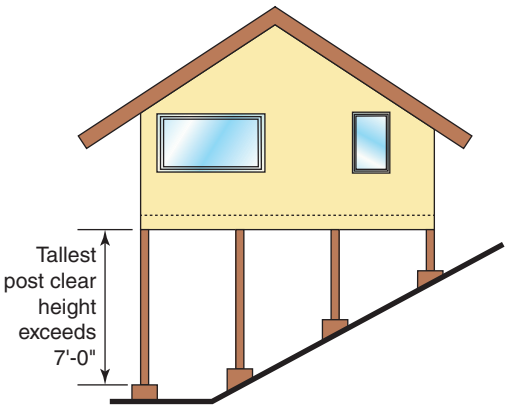


Determine slope by dividing the elevation change by the slope.

A second trigger considers cripple wall height. A cripple wall height or post height greater than seven feet tall triggers an engineered design (Item 8.2). Lastly, where a basement area is less than 50 percent finished and not sheathed with interior finish (Item 8.3), engineering of the bracing system is required. Interior finish stiffens walls, increasing a building's ability to resist earthquake forces. All three triggers must be met before a dwelling is deemed irregular. These triggers were observed as points at which damage and displacements of uphill foundations appear to significantly increase the likelihood of building collapse.



Cripple wall clear height.



Post clear height.

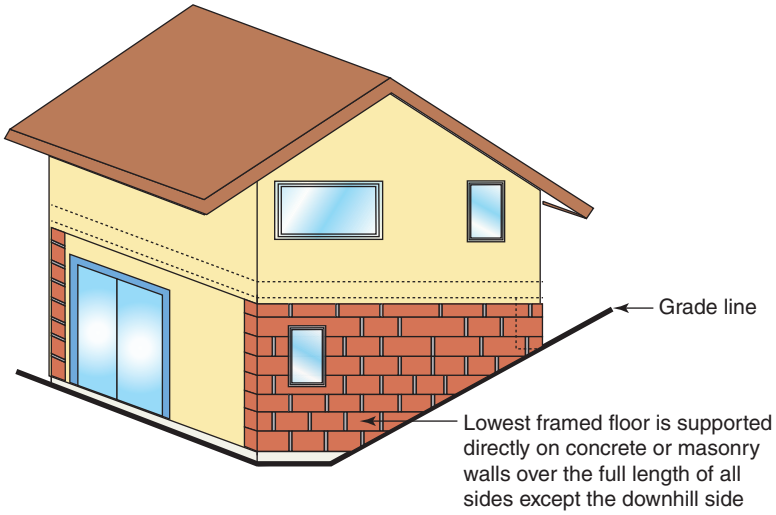
The exception exempts dwellings that have full-height concrete or masonry walls. For a dwelling with a simple rectangular floor plan, full-height concrete or masonry walls would need to occur on three sides (excluding the downhill side) to qualify for the exception. For a more complex dwelling configuration, additional concrete or masonry walls would be required to qualify. Dwellings with doors and windows in the

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concrete or masonry walls still qualify for the exception. In all dwellings, the concrete or masonry walls need to conform to applicable IRC provisions. A basement described in the exception could have a wood cripple wall as the downhill side exterior building wall.



Basement with masonry walls on three sides.

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R301.2.2.10

Seismic Anchorage of Water Heaters

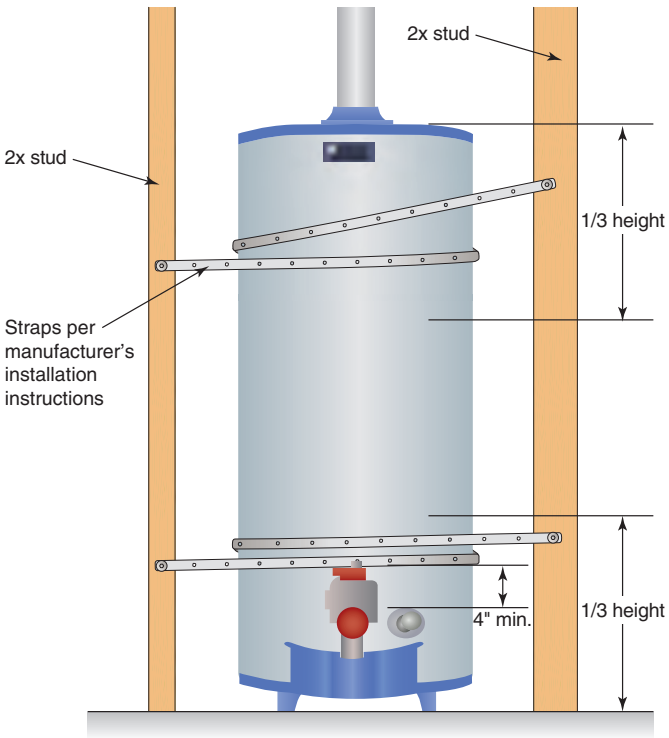
CHANGE TYPE: Modification

CHANGE SUMMARY: Water heaters and thermal storage units in Townhouses in SDC C must be anchored.

2021 CODE TEXT: **R301.2.2.10 Anchorage of water heaters.** In Seismic Design Categories D_0, D_1 and D_2, and in townhouses in Seismic Design Category C, water heaters and thermal storage units shall be anchored against movement and overturning in accordance with Section ~~M1307~~ M1307.2 or P2801.8.

CHANGE SIGNIFICANCE: Section M1307.2, Anchorage of appliances, defines appliances as both water heaters and thermal storage tanks. The section applies not only to Seismic Design Categories (SDC) D_0, D_1 and D_2 but also to townhouses in SDC C. For consistency, Section R301.2.2.10 now requires both water heaters and thermal storage units to be anchored in SDC C (for townhouses only) and SDC D_0, D_1 and D_2 while a reference is added to the appropriate plumbing section.

Anchorage is required because a water heater can move around a floor or off a platform during an earthquake. Due to their weight, water heaters can cause damage by falling and be a flood hazard. If gas-powered, movement of a water heater may break a gas line, leading to a fire. Thermal storage units, similar to electric water heaters, consist of a tank of water heated by solar collectors. A thermal storage tank may be located on a roof, in a garage, attic or crawl space. This tank presents the same fall and flood hazard as an electric water heater and must also be anchored against movement during an earthquake.



Anchorage of water heater.

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CHANGE TYPE: Clarification

R301.3
Story Height

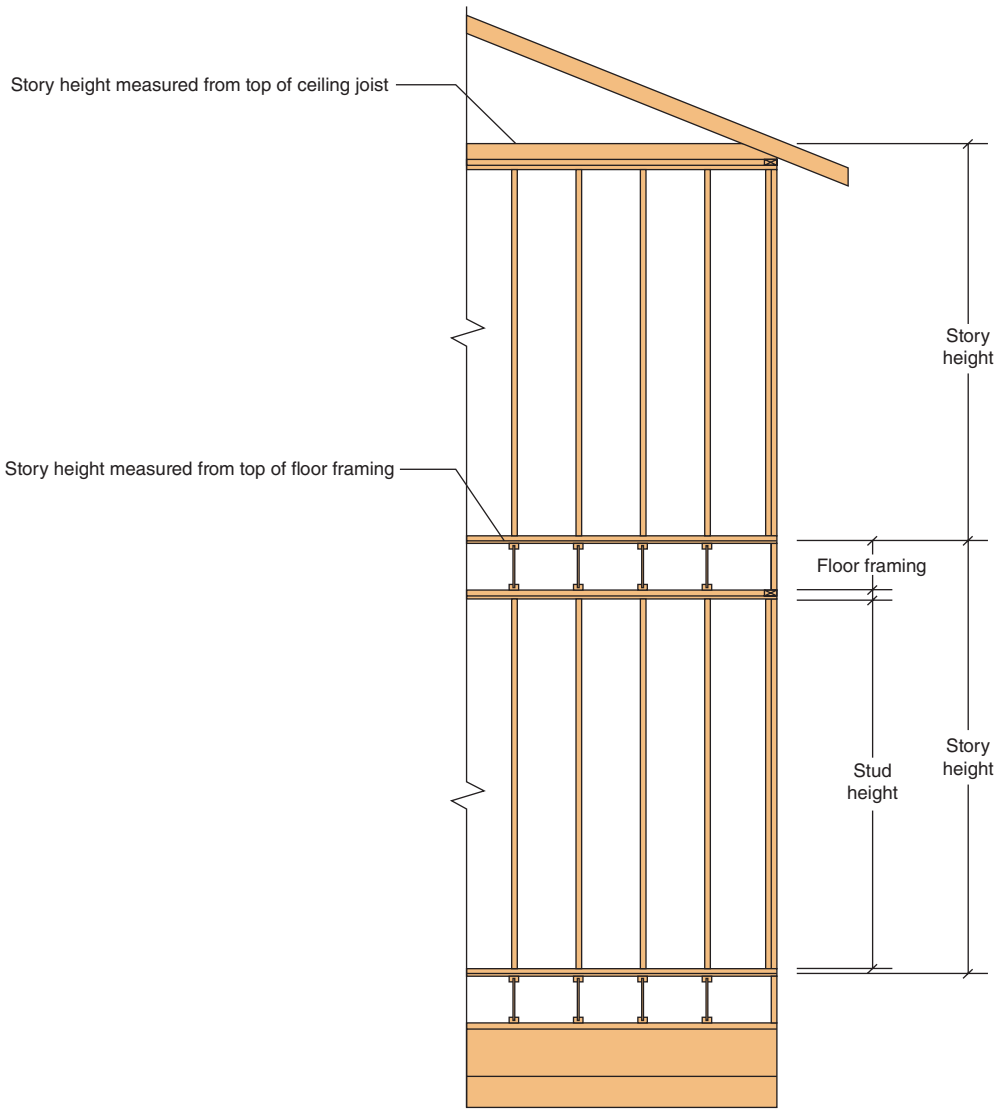
CHANGE SUMMARY: Maximum story height for wood wall framing is 13 feet 7 inches when the exception requirements are met.

2021 CODE TEXT:

R301.3 Story height. The wind and seismic provisions of this code shall apply to buildings with story heights not exceeding the following:

1. For wood wall framing, the story height shall not exceed 11 feet 7 inches (3531 mm) and the laterally unsupported bearing wall stud height permitted by Table R602.3(5).

Exception: A story height not exceeding 13 feet 7 inches (4140 mm) is permitted provided the maximum wall stud clear height does not exceed 12 feet (3658 mm), the wall studs are in accordance with



Story height vs. stud height.

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Exception 2 or Exception 3 of Section R602.3.1 or an engineered design is provided for the wall framing members, and wall bracing for the building is in accordance with Section R602.10. Studs shall be laterally supported at the top and bottom plate in accordance with Section R602.3.

2. For cold-formed steel wall framing, the story height shall be not more than 11 feet 7 inches (3531 mm) and the unsupported bearing wall stud height shall be not more than 10 feet (3048 mm).
3. For masonry walls, the story height shall be not more than 13 feet 7 inches (4140 mm) and the bearing wall clear height shall be not more than 12 feet (3658 mm).

Exception: An additional 8 feet (2438 mm) of bearing wall clear height is permitted for gable end walls.

4. For insulating concrete form walls, the maximum story height shall not exceed 11 feet 7 inches (3531 mm) and the maximum unsupported wall height per story as permitted by Section R608 tables shall not exceed 10 feet (3048 mm).
5. For structural insulated panel (SIP) walls, the story height shall be not more than 11 feet 7 inches (3531 mm) and the bearing wall height per story as permitted by Section R610 tables shall not exceed 10 feet (3048 mm).

For walls other than wood-framed walls, ~~individual~~ walls or wall studs shall be permitted to exceed these limits as permitted by Chapter 6 ~~provisions~~, provided that the story heights of this section are not exceeded. An engineered design shall be provided for the wall or wall framing members where the limits of Chapter 6 are exceeded. Where the story height limits of this section are exceeded, the design of the building, or the noncompliant portions thereof, to resist wind and seismic loads shall be in accordance with the *International Building Code*.

CHANGE SIGNIFICANCE: Section R301.3 is updated to address confusion with story height provisions. In the 2003 and 2006 IRC, Section R301.3 allowed wood-frame buildings to have maximum bearing wall stud heights of 10 feet supporting floor framing not exceeding 16 inches in depth. An exception allowed a maximum bearing wall stud height of 12 feet provided an engineered design for the wall was provided for everything other than wind and seismic wall bracing, which could be determined per Section R602.10 with adjustment factors to increase the bracing amounts for taller walls.

In the 2009 IRC, revision of Section R301.3 allowed floor framing members (e.g., i-joists or trusses) deeper than 16 inches to be used if bearing wall stud heights were less than 10 feet. This was accomplished by specifying an overall story height limit of 11 feet 7 inches, based on the sum of a 10 feet 0 inch tall stud, two top and one bottom plate, and 16-inch deep floor framing. This limit superseded the exception which allowed bearing wall studs up to 12 feet tall with wall bracing per Section R602.10, also conflicting with the 12-foot bearing wall height limit for masonry walls.

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In the 2015 IRC, this section was revised again by deleting the 11 feet 7 inches story height limit from Section R301.3 and placing it in each individual subsection to which it applied. This addressed the conflict with masonry walls but did not correct the conflict with Section R602.10. The exception for bearing wall studs up to 12 feet was deleted due to concern that code users would double-count adjustment factors for wall bracing. However, no correction was provided for the conflict between story height limits and wall bracing provisions.

A new Table R602.3(6) was added to the 2018 IRC allowing bearing wall stud heights up to 12 feet for limited conditions. The conflict between story height limits, wall bracing provisions and the new table was not addressed. The new provisions relied on the last paragraph of Section R301.3, which stated that individual walls or wall studs could exceed the limits of Section R301.3 when story heights were not exceeded.

The 2021 IRC restores the exception allowing bearing wall stud clear heights to be increased to 12 feet without engineering, provided compliance with Section R602.10 for wall bracing is met. Additionally, one of the two exceptions to 10-foot bearing wall heights in Section R602.3.1 is applicable, including the exception leading to Table R602.3(6). The story height exceptions provide a critical link to provisions allowing a stud height up to 12 feet without engineering. The engineering requirement for studs in tall walls not otherwise complying with one of the Section R602.3.1 exceptions is maintained for gravity and out-of-plane loads.

Section R602.3.1 limits studs above 10 feet in height to lower snow load regions. The ground snow load limit for Exception 2 is 25 pounds per square foot while the limit in Exception 3 is 30 pounds per square foot.

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R302.2

Townhouses

CHANGE TYPE: Modification

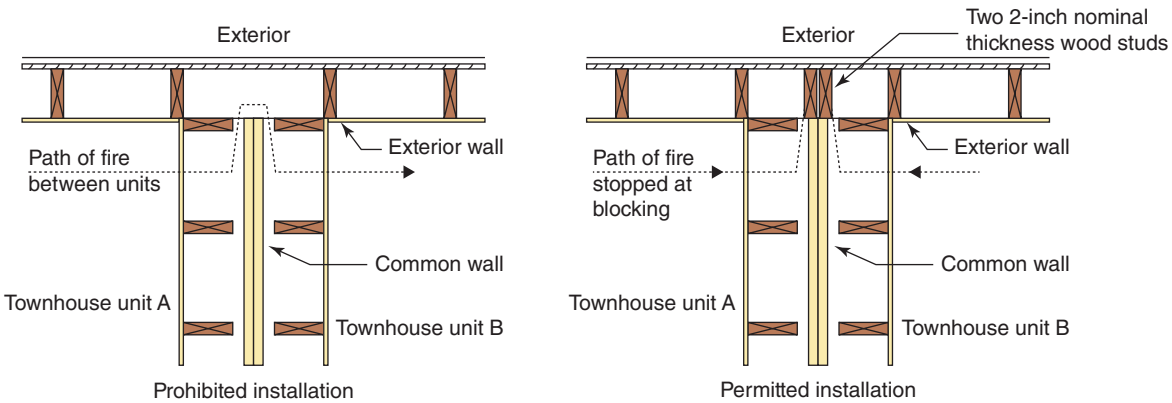
CHANGE SUMMARY: Common walls separating townhouses are permitted to terminate at the inside of exterior walls where the prescribed fireblocking is provided.

2021 CODE: **R302.2 Townhouses.** Walls separating townhouse units shall be constructed in accordance with Section R302.2.1 or R302.2.2 and shall comply with Sections 302.2.3 through 302.2.5.

R302.2.1 Double walls. Each townhouse unit shall be separated from other townhouse units by two 1-hour fire-resistance-rated wall assemblies tested in accordance with ASTM E119, UL 263 or Section ~~703.3~~ 703.2.2 of the *International Building Code*.

R302.2.2 Common walls. Common walls separating ~~townhouses~~ townhouse units shall be assigned a fire-resistance rating in accordance with Item 1 or 2~~.~~ and shall be rated for fire exposure from both sides. Common walls shall extend to and be tight against the exterior sheathing of the exterior walls, or the inside face of exterior walls without stud cavities, and the underside of the roof sheathing. The common wall shared by two ~~townhouses~~ townhouse units shall be constructed without plumbing or mechanical equipment, ducts or vents, other than water-filled fire sprinkler piping, in the cavity of the common wall. ~~The wall shall be rated for fire exposure from both sides and shall extend to and be tight against exterior walls and the underside of the roof sheathing.~~ Electrical installations shall be in accordance with Chapters 34 through 43. Penetrations of the membrane of common walls for electrical outlet boxes shall be in accordance with Section R302.4.

1. Where ~~a fire~~ an automatic sprinkler system in accordance with Section P2904 is provided, the common wall shall be not less than a 1-hour fire-resistance- rated wall assembly tested in accordance with ASTM E119, UL 263 or Section ~~703.3~~ 703.2.2 of the *International Building Code*.



Common wall extending to the inside of the exterior wall.

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2. Where ~~a fire~~ an automatic sprinkler system in accordance with Section P2904 is not provided, the common wall shall be not less than a 2-hour fire- resistance-rated wall assembly tested in accordance with ASTM E119, UL 263 or Section ~~703.3~~ 703.2.2 of the *International Building Code*.

Exception: Common walls are permitted to extend to and be tight against the inside of the exterior walls if the cavity between the end of the common wall and the exterior sheathing is filled with a minimum of two 2-inch nominal thickness wood studs.

R302.2.3 Continuity. The fire-resistance-rated wall or assembly separating ~~townhouses~~ townhouse units shall be continuous from the foundation to the underside of the roof sheathing, deck or slab. The fire-resistance rating shall extend the full length of the wall or assembly, including wall extensions through and separating attached enclosed accessory structures.

R302.2.4 Parapets for townhouses. Parapets constructed in accordance with Section R302.2.5 shall be constructed for townhouses as an extension of exterior walls or common walls separating townhouse units in accordance with the following:

Items 1 through 3. *No changes to text.*

R302.2.6 Structural independence. Each ~~individual~~ townhouse unit shall be structurally independent.

Exceptions:

1. Foundations supporting exterior walls or common walls.
2. Structural roof and wall sheathing from each unit fastened to the common wall framing.
3. Nonstructural wall and roof coverings.
4. Flashing at termination of roof covering over common wall.
5. ~~Townhouses~~ Townhouse units separated by a common wall as provided in Section R302.2.2, Item 1 or 2.
6. Townhouse units protected by a fire sprinkler system complying with Section P2904 or NFPA 13D.

CHANGE SIGNIFICANCE: Section R302.2 has been updated to incorporate the new definition of "townhouse unit" and the revised definition of "townhouse." The terms had sometimes been used interchangeably and inconsistently. In this context, a townhouse is a building that contains three or more dwelling units, now referred to as "townhouse units." The definition of building has also been updated to directly reference townhouses.

There are two recognized methods for the fire-resistant separation between townhouse units: either two 1-hour rated walls or a common wall with a 1-hour rating with fire sprinkler protection or a 2-hour rating without sprinklers. At issue has been the termination point of the common wall at the intersection with the exterior wall. The code language has been somewhat ambiguous in stating that the common wall must extend to and be tight against exterior walls. To some, this meant that the

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common wall had to extend through the wall to a termination point at the exterior wall sheathing, while others took it to mean a termination point at the interior side of the exterior wall. For typical frame cavity walls, the language has been revised to require the common wall to extend to and be tight against the exterior sheathing of the exterior wall to block the passage of fire from one townhouse unit to the next. A new exception allows the fire-resistance-rated wall to terminate against the interior side of the exterior wall provided at least two 2-inch nominal thickness wood studs fill the cavity in the exterior wall. Because the code language is very specific as to the fireblocking material, other types of fireblocking to fill this gap would not be allowed unless approved under the alternative methods provisions in Section R104.11.

Where two 1-hour fire-resistance-rated walls are used as the separation, structural independence related to fire resistance is required for each townhouse unit. Some exceptions to this rule appear in Section R302.2.6, including the application of exterior sheathing and finish materials. A new exception strikes the structural independence rule if the townhouse units are protected with a fire sprinkler system complying with Section P2904 or NFPA 13D. This adds another sprinkler incentive to the code to elevate the safety of IRC buildings in those areas of the country that do not adopt the sprinkler provisions of the model code, which require sprinklers in all dwellings and townhouses.

Common walls for separating townhouse units enjoy an advantage in that structural independence is not required. However, the code does add some other conditions regarding common walls; specifically, plumbing and mechanical piping, equipment, ducts and vents are not allowed in the common wall. In a new exception, the code now permits water filled sprinkler piping to be in the common wall based on the added safety provided by sprinklers outweighing any negative impact on the effectiveness of the rated common wall. Allowing common fire sprinkler piping to protect multiple townhouse units in a townhouse building can significantly reduce installation costs, and the provision is consistent with the IBC, which allows penetration of townhouse separation walls in any townhouse that does not exceed the height and area limits. See Sections R302.4.1 and R302.4.2 for additional information on sprinkler piping penetrations of fire-resistance-rated assemblies.

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R302.3

Two-Family Dwelling Separation

CHANGE TYPE: Modification

CHANGE SUMMARY: The prescribed fire-resistance-rated separation between two dwelling units in a single building is not affected by the presence of a lot line between the units.

2021 CODE: **R302.3 Two-family dwellings.** Dwelling units in two-family dwellings shall be separated from each other by wall and floor assemblies having not less than a 1-hour fire-resistance rating where tested in accordance with ASTM E119, UL 263 or Section ~~703.3~~ 703.2.2 of the *International Building Code*. Such separation shall be provided regardless of whether a lot line exists between the two dwelling units or not. Fire-resistance-rated floor/ceiling and wall assemblies shall extend to and be tight against the exterior wall, and wall assemblies shall extend from the foundation to the underside of the roof sheathing.

Exceptions:

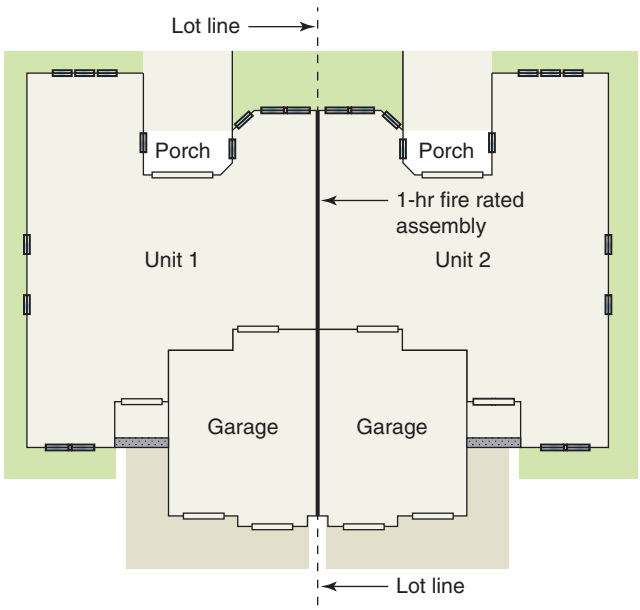
1. A fire-resistance rating of 1/2 hour shall be permitted in buildings equipped throughout with an automatic sprinkler system installed in accordance with ~~NFPA 13~~ Section P2904.
2. Wall assemblies need not extend through attic spaces where the ceiling is protected by not less than 5/8-inch (15.9 mm) Type X gypsum board, an attic draft stop constructed as specified in Section R302.12.1 is provided above and along the wall assembly separating the dwellings and the structural framing supporting the ceiling is protected by not less than 1/2- inch (12.7 mm) gypsum board or equivalent.



Photo courtesy of herreid/iStock/Getty Images Plus/Getty Images

Two-family dwelling.

CHANGE SIGNIFICANCE: Unlike townhouse unit separations, two-family dwellings (duplexes) only require a 1-hour fire-resistance-rated separation between dwelling units. It has been debated whether a lot line between



Two-family dwelling separated by lot line and 1-hr fire-resistant separation.

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the dwelling units (which is common in some areas of the country and not common in others) impacts this separation requirement. The question has been whether the lot line means that the wall at the separation is considered to be an exterior wall that needs to meet the provisions of Section R302.1, resulting in two 1-hour walls at the lot line. In some jurisdictions, the answer was yes. Further, in some cases with a separating lot line, the interpretation has been that the building is no longer a two-family dwelling, but two separate detached single-family dwellings, each requiring a 1-hour wall at the lot line. In other jurisdictions, the answer was no: a duplex is a duplex no matter if the dwelling units are divided by a lot line. The reasoning behind this approach was that the fire does not know if there is a lot line there and only the 1-hour separation applies. The change to this section intends to end the debate and clarify the application of this separation. The intent of the new language is that a fire-resistance rating need never be greater than 1 hour, whether there is a lot line between dwelling units or not. For the lot line question, this brings the two-family dwelling provisions into agreement with the townhouse provisions. If the townhouse has fire sprinkler protection, a common 1-hour wall has been acceptable even if there was a lot line between townhouse units. If the exterior wall provisions in Section R302.1 were applied to townhouses, the 1-hour common wall would not be allowed.

Presumably, this change to the code allowing a 1-hour separation when there is a lot line between duplex dwelling units is meant to apply to the exception as well. The exception permits a draft stop to separate the attics of the dwelling units if other fire-resistance requirements are satisfied.

Another exception to the 1-hour separation requirement for two-family dwellings has allowed the rating to be reduced to ½ hour if a full NFPA 13 sprinkler system was installed. This exception has not been used nor would it be used because of the extra cost associated with a full NFPA 13 system typically associated with commercial structures. The cost would far outweigh any savings realized from reducing the rating from 1 hour to ½ hour. As another incentive to install a sprinkler system for areas of the country that do not adopt the IRC sprinkler provisions, a dwelling sprinkler system installed in accordance with Section P2904 or NFPA 13D now can be used to reduce the rating to ½ hour.

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R302.4

Dwelling Unit Rated Penetrations

CHANGE TYPE: Clarification

CHANGE SUMMARY: Water-filled fire sprinkler piping of any approved material joins the list of metal penetrating items that do not require a firestop system provided the annular space is filled with the prescribed materials.

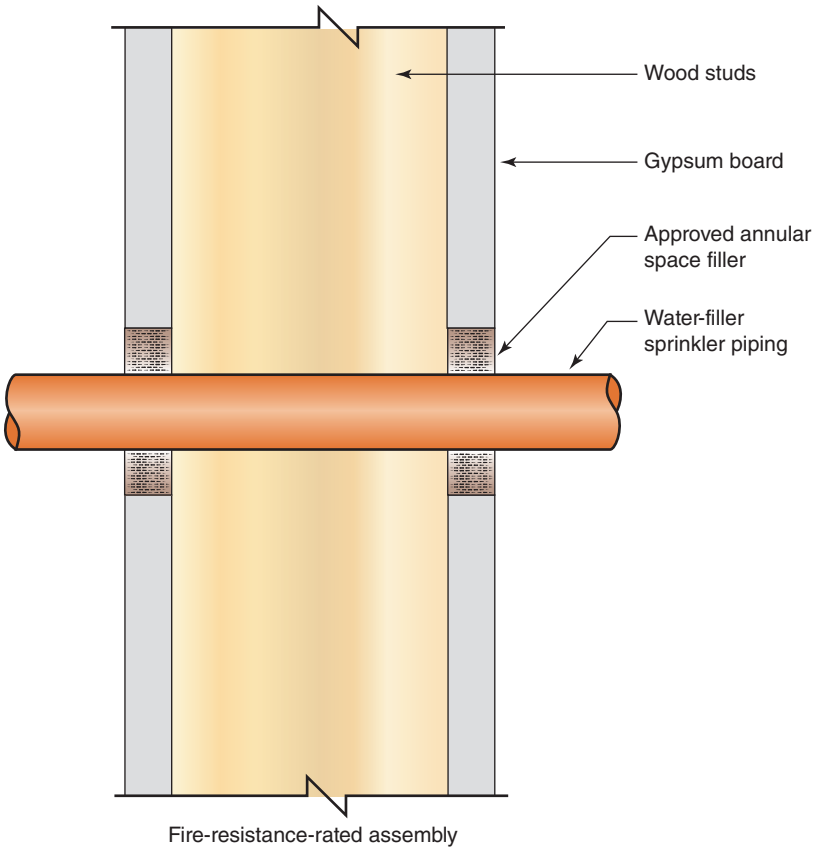
2021 CODE: **R302.4.1 Through penetrations.** Through penetrations of fire-resistance-rated wall or floor assemblies shall comply with Section R302.4.1.1 or R302.4.1.2.

Exceptions:

1. Where the penetrating items are steel, ferrous or copper pipes, tubes or conduits, the annular space shall be protected as follows:

   ~~1.~~ 1.1 In concrete or masonry wall or floor assemblies, concrete, grout or mortar shall be permitted where installed to the full thickness of the wall or floor assembly or the thickness required to maintain the fire-resistance rating, provided that both of the following are complied with:

      ~~1.1~~ 1.1.1. The nominal diameter of the penetrating item is not more than 6 inches (152 mm).



Water-filled fire sprinkler piping penetrating a fire-rated assembly.

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~~1.2~~ 1.1.2. The area of the opening through the wall does not exceed 144 square inches (92 900 mm).

~~2.~~ 1.2. The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E119 or UL 263 time temperature fire conditions under a positive pressure differential of not less than 0.01 inch of water (3 Pa) at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.

2. The annular space created by the penetration of water-filled fire sprinkler piping, provided that the annular space is filled using a material complying with item 1.2 of Exception 1.

R302.4.2 Membrane penetrations. Membrane penetrations shall comply with Section R302.4.1. Where walls are required to have a fire-resistance rating, recessed fixtures shall be installed so that the required fire-resistance rating will not be reduced.

Exceptions:

1. **and 2.** *No changes to text.*
3. The annular space created by the penetration of a fire sprinkler or water-filled fire sprinkler piping, provided that ~~it~~ the annular space is covered by a metal escutcheon plate.
4. *No changes to text.*

CHANGE SIGNIFICANCE: When items such as pipes or ducts penetrate one or both sides of the fire-resistance-rated wall assembly separating dwelling units, both the penetrating item and the space around it must be protected to maintain the integrity of the fire-resistant assembly. In general, penetrations by metal pipe require that the space around the pipe be filled with approved materials to prevent the passage of flame and hot gases. Other penetrating materials, such as plastic pipe, must be protected by an approved penetration fire-stop system. Such a system often consists of intumescent material that expands when heated by fire conditions, filling the penetration as the plastic pipe melts and preserving the fire-resistance rating of the wall assembly.

Listed nonmetallic fire sprinkler piping is ignition resistant and will not sustain combustion. The IRC now permits water-filled fire sprinkler piping to penetrate a fire-resistance-rated membrane or both membranes of a through penetration without a listed firestop system provided that the annular space is filled using an approved material. This matches the installation requirements for metal piping penetrations. Exception 1.2 of Section R302.4.1 sets the criteria for the material filling the annular space of the membrane or through penetration.

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R302.5

Dwelling-Garage Opening Protection

CHANGE TYPE: Clarification

CHANGE SUMMARY: Doors between the garage and residence must be self-latching.

2021 CODE: **R302.5 Dwelling-garage opening and penetration protection.** Openings and penetrations through the walls or ceilings separating the dwelling from the garage shall be in accordance with Sections R302.5.1 through R302.5.3.

R302.5.1 Opening protection. Openings from a private garage directly into a room used for sleeping purposes shall not be permitted. Other openings between the garage and residence shall be equipped with solid wood doors not less than 1 3/8 inches (35 mm) in thickness, solid or honeycomb-core steel doors not less than 1 3/8 inches (35 mm) thick, or 20-minute fire-rated doors. Doors shall be self-latching and equipped with a self-closing or an automatic-closing device.

CHANGE SIGNIFICANCE: To provide some minimum protection against the spread of a fire that originates in the attached garage, the IRC has always required some fire resistance for the separation between the garage and dwelling unit. Typically, this requirement is satisfied with the application of regular 1/2-inch gypsum board on the garage side of the separation. This separation is not a fire-resistant-rated assembly, but simply a layer of approved material installed on the garage side to provide some resistance to fire that originates in the garage and slows spread into the dwelling unit. Similarly, the code does not require a fire-resistant-rated door assembly for the opening between the garage and residence. Instead, the IRC prescribes the type and thickness of the door or requires a 20-minute rating for the door slab. The requirement for self-closing devices introduced in the 2012 IRC intended that the door



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Door from garage to house must be self-closing and self-latching.

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return to a closed position after opening to address concerns related to increased fuel loads in garages, and the potential for fire and the related toxic combustion byproducts to migrate into the dwelling unit. Although Sections R302.5 and R302.6 are primarily concerned with fire resistance, the decision to place self-closing devices in the code was also intended to prevent carbon monoxide from the exhaust of vehicles operating in a garage from entering the dwelling unit. Having a closed door between the garage and residence supplements the safeguards of required smoke and carbon monoxide alarms. Self-closing devices are typically spring-loaded hinges or door closers. An automatic closing device is also permitted but is not typically seen in one- and two- family dwellings.

New to the 2021 edition, the code adds that the self-closing door must also be self-latching. In this case the smooth operation of the door and strength of the self-closing device need to be sufficient for the latch to engage and the door to be secured. Self-latching was judged to be as important as self-closing. Air pressures caused by a fire could cause doors without a self-latching device to overpower the closing device and push open. The provision for dwelling-garage opening protection is consistent with the premise that closed doors limit the spread and impact of residential fires and addresses the increased fire hazard in garages.

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R303.1
Mechanical Ventilation

CHANGE TYPE: Clarification

CHANGE SUMMARY: A local exhaust system is an acceptable substitute for natural ventilation in kitchens.

2021 CODE: **R303.1 Habitable rooms.** Habitable rooms shall have an aggregate glazing area of not less than 8 percent of the floor area of such rooms. Natural ventilation shall be through windows, skylights, doors, louvers or other approved openings to the outdoor air. Such openings shall be provided with ready access or shall otherwise be readily controllable by the building occupants. The openable area to the outdoors shall be not less than 4 percent of the floor area being ventilated.

Exceptions:

1. ~~The~~ For habitable rooms other than kitchens, the glazed areas need not be openable where the opening is not required by Section R310 and a whole-house mechanical ventilation system or a mechanical ventilation system capable of producing 0.35 air changes per hour in the habitable rooms is installed in accordance with Section M1505.
2. For kitchens, the glazed areas need not be openable where the opening is not required by Section R310 and a local exhaust system is installed in accordance with Section M1505.
3. ~~2.~~ The glazed areas need not be installed in rooms where Exception 1 is satisfied and artificial light is provided that is capable of producing an average illumination of 6 footcandles (65 lux) over the area of the room at a height of 30 inches (762 mm) above the floor level.



Photo courtesy of ALEAIMAGE/iStock/Getty Images Plus/Getty Images

Local exhaust mechanical ventilation for a kitchen substitutes for an openable window.

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~~3.~~4. Use of sunroom and patio covers, as defined in Section R202, shall be permitted for natural ventilation if in excess of 40 percent of the exterior sunroom walls are open, or are enclosed only by insect screening.

R303.4 Mechanical ventilation. ~~Where the air infiltration rate of a dwelling unit is 5 air changes per hour or less where tested with a blower door at a pressure of 0.2 inch w.c. (50 Pa) in accordance with Section N1102.4.1.2, the dwelling unit~~ Buildings and dwelling units complying with Section N1102.4.1 shall be provided with ~~whole-house~~ mechanical ventilation in accordance with Section M1505~~.4~~, or with other approved means of ventilation.

CHANGE SIGNIFICANCE: To provide flexibility in satisfying the ventilation air requirements, the code adds some options for mechanical ventilation. Prior to the 2012 edition, the IRC provided an option for mechanical ventilation systems capable of producing 0.35 air changes per hour (ACH) or whole-house mechanical ventilation systems where the prescribed natural ventilation was not provided. In the 2012 IRC, the first option was deleted in favor of the whole house mechanical ventilation system covered in the mechanical provisions of Chapter 15. The 2021 code reintroduces the option for 0.35 ACH for room-based mechanical ventilation systems, which are especially useful for additions or remodels. The code also now specifically recognizes that a local exhaust system (e.g., a kitchen exhaust hood) is an acceptable substitute for natural ventilation in kitchens. This is consistent with provisions in Chapter 15 that recognize kitchens have different ventilation requirements than other habitable rooms. The intent is to clarify that local exhaust, not whole-house mechanical ventilation that could be located in a far corner of the house, is needed for kitchens to ensure that cooking pollutants generated in the kitchen are captured and exhausted at their source. The IRC sets installation requirements for kitchen exhaust but has not previously required a range hood. The intent of the change to the exceptions in Section R303.1 is to require local mechanical exhaust in the kitchen if natural ventilation through openable windows and doors is not provided.

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R305.1
Ceiling Height

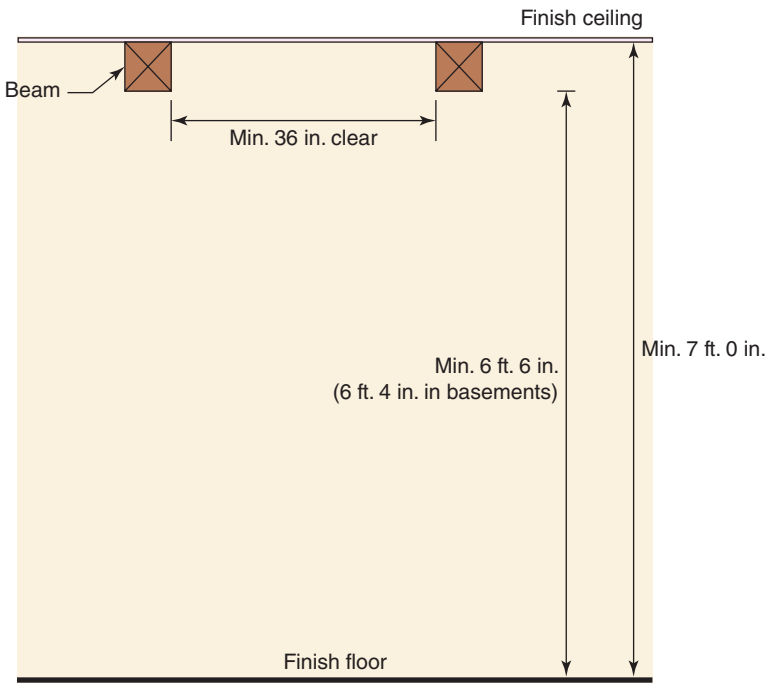
CHANGE TYPE: Modification

CHANGE SUMMARY: The minimum ceiling height is reduced to 6 feet 6 inches under beams spaced at least 36 inches apart.

2021 CODE: **R305.1 Minimum height.** Habitable space, hallways and portions of basements containing these spaces shall have a ceiling height of not less than 7 feet (2134 mm). Bathrooms, toilet rooms and laundry rooms shall have a ceiling height of not less than 6 feet 8 inches (2032 mm).

Exceptions:

1. For rooms with sloped ceilings, the required floor area of the room shall have a ceiling height of not less than 5 feet (1524 mm) and not less than 50 percent of the required floor area shall have a ceiling height of not less than 7 feet (2134 mm).
2. The ceiling height above bathroom and toilet room fixtures shall be such that the fixture is capable of being used for its intended purpose. A shower or tub equipped with a showerhead shall have a ceiling height of not less than 6 feet 8 inches (2032 mm) above an area of not less than 30 inches (762 mm) by 30 inches (762 mm) at the showerhead.
3. Beams, girders, ducts or other obstructions in basements containing habitable space shall be permitted to project to within 6 feet 4 inches (1931 mm) of the finished floor.
4. Beams and girders spaced apart not less than 36 inches (914 mm) in clear finished width shall project not more than 78 inches (1981 mm) from the finished floor.



Habitable space ceiling heights.

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CHANGE SIGNIFICANCE: Prior to the 2009 edition of the IRC, an exception to the general rule for a minimum ceiling height of 7 feet allowed beams to project 6 inches below that ceiling height provided they were spaced at least 4 feet apart. That language was removed in the 2009 code because there was consensus that the minimum ceiling height of 7 feet was reasonable to be maintained under spaced beams. At that time, portions of unfinished basements could have beams, girders and ducts with a minimum ceiling height of 6 feet 4 inches. In the 2015 IRC, that exception was expanded to include these projections in all spaces in basements including habitable space.

Although the new exception sets a maximum projection from the floor, the intent of the language in the code is to allow beams to project from the ceiling such that the base of the beam is at least 6 feet 6 inches above the floor. The minimum finish-to-finish horizontal dimension between the beams is 36 inches. The exception would not be applicable to basements as the code already permits a ceiling height reduction to 6 feet 4 inches for beams, girders and ductwork in basements. The new exception is a result of concern expressed that the size of beams and girders has increased in recent years with the advent of engineered lumber and open floor plans, and that a ceiling height of 7 feet was not always achievable. The height of 6 feet 6 inches was chosen based on the clear height dimension of the one required egress door measured from the threshold to the underside of the head stop. The code does not regulate the dimensions of other doors in the house, but typically they maintain a clear height exceeding 6 feet 6 inches.

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R308.4.5

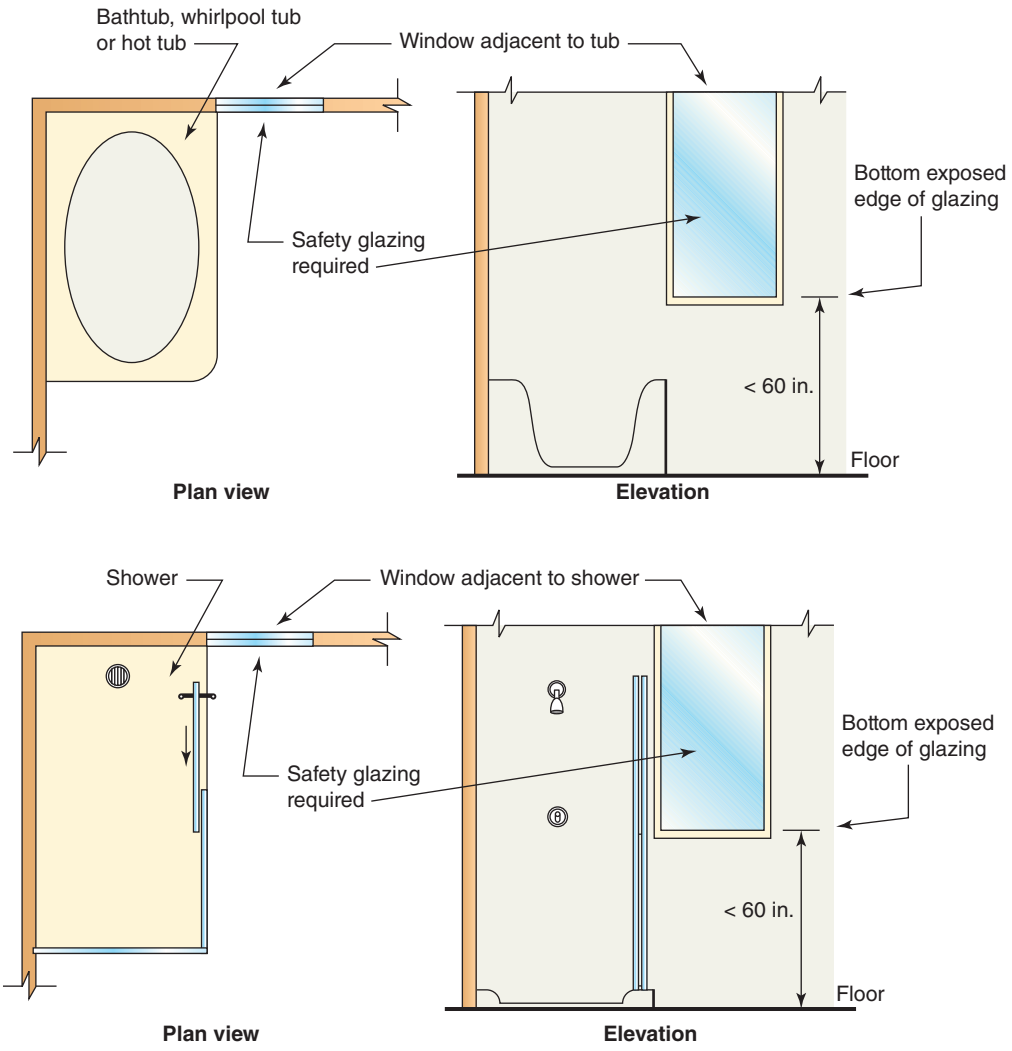
Glazing and Wet Surfaces

CHANGE TYPE: Clarification

CHANGE SUMMARY: The language addressing glazing in walls, enclosures or fences near tubs, showers and swimming pools has replaced the word "facing" with the words "adjacent to" for those elements related to wet surfaces.

2021 CODE: **R308.4.5 Glazing and wet surfaces.** Glazing in walls, enclosures or fences containing or ~~facing~~ adjacent to hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and indoor or outdoor swimming pools where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) measured vertically above any standing or walking surface shall be considered to be a hazardous location. This shall apply to single glazing and each pane in multiple glazing.

Exception: Glazing that is more than 60 inches (1524 mm), measured horizontally ~~and in a straight line~~, from the water's edge of a bathtub, hot tub, spa, whirlpool or swimming pool or from the edge of a shower, sauna or steam room.



Glazing adjacent tubs and showers.

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CHANGE SIGNIFICANCE: Glazing installed in the vicinity of tubs, showers and swimming pools is considered to be in a hazardous location because of the increased likelihood of slips and falls on wet surfaces, with the potential for injury from falling into and breaking the glass. Therefore, the code requires that glazing installed in these locations must be safety glazing. As with all of the hazardous locations identified in Section R308.4, changes to the language in this section over several code development cycles have attempted to make the provisions more objectively measurable and easier to understand.

There has been some debate as to the proper interpretation and application of the glazing provisions related to wet surfaces. It has been clear that glass enclosing tubs, showers, spas and swimming pools (to name the common items under consideration) has to be safety glazing unless meeting the minimum height above the walking surface. Less clear is the application to glazing that is located some distance horizontally from these fixtures and areas. The code has generally established a zone that is within 60 inches horizontally of the water's edge (the edge of a shower) as a potentially wet surface and hazardous location. The 60-inch measurement originated in the early editions of the code where it was applied to swimming pools to create a 60-inch buffer zone between the water and standard glazing. The 60-inch horizontal measurement relating to tubs and showers first appeared in the 2009 edition of the IRC. The safety glazing rules for swimming pools and tubs and showers were merged in the 2012 edition of the code. Part of the ongoing confusion is that, at least since the 2012 edition, the 60-inch horizontal measurement is written as an exception to the main rule.

It follows that various interpretations are not always in agreement. For example, a majority of code users have determined that glazing within 60 inches in any direction requires safety glazing, unless there is some barrier in place to separate the wet surface from the glazing. Others have said that only the glazing that faces the tub, shower or swimming pool is regulated in that 60-inch zone and exclude glazing that is perpendicular and not enclosing the fixture. This change intends to remedy these differences by using the word "adjacent" rather than "facing" to describe the location of the glazing. This is similar to language used to describe glazing adjacent to the bottom stair landing. For stairs, the term adjacent and the 60-inch dimension appear together in the main code section with text accompanied by a figure to clarify the application.

The intent of the change to Section R308.4.5, Glazing and Wet Surfaces, is to apply the horizontal measurement provision in the same way as the bottom stair landing in Section R308.4.7. A person is just as likely to slip and fall to the side as a a person is to fall forward. Depending on how the word "adjacent" is interpreted, there may again be some disagreement as to the application. However, the intent is to protect occupants from falling into glass in any orientation when they are in the slippery area within 60 inches of the tub or shower or the other described areas.

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R308.6

Skylight Glass Retention Screens

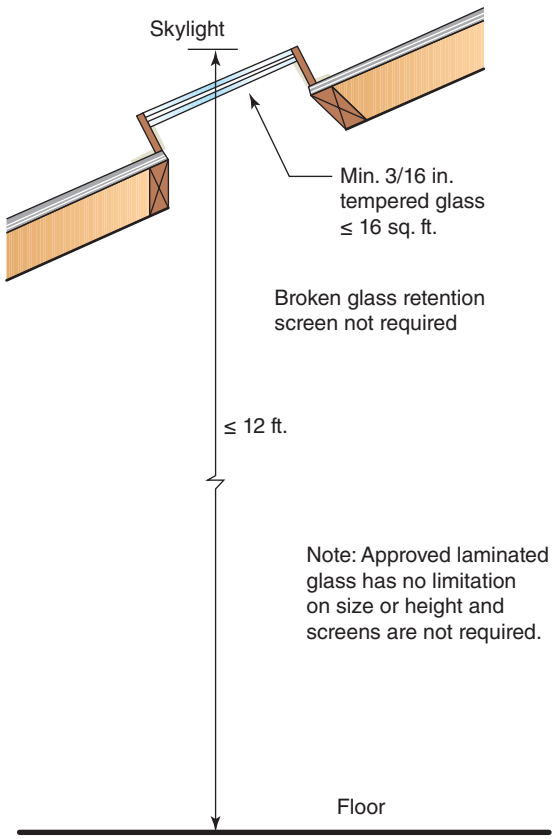
CHANGE TYPE: Clarification

CHANGE SUMMARY: New terminology clarifies the broken glass retention screen requirements for skylights.

2021 CODE: **R308.6.2 Materials.** Glazing materials shall be limited to the following:

1. Laminated glass with not less than a 0.015-inch (0.38 mm) polyvinyl butyral interlayer for glass panes 16 square feet (1.5 m^2) or less in area located such that the highest point of the glass is not more than 12 feet (3658 mm) above a walking surface; for higher or larger sizes, the interlayer thickness shall be not less than 0.030 inch (0.76 mm).
2. Fully tempered glass.
3. Heat-strengthened glass.
4. Wired glass.
5. Approved rigid plastics.

R308.6.3 Screens, general. For fully tempered or heat-strengthened glass, a ~~retaining~~ broken glass retention screen meeting the requirements of Section R308.6.7 shall be installed below the full area of the glass, except for fully tempered glass that meets ~~either~~ condition 1 or 2 listed in Section R308.6.5.

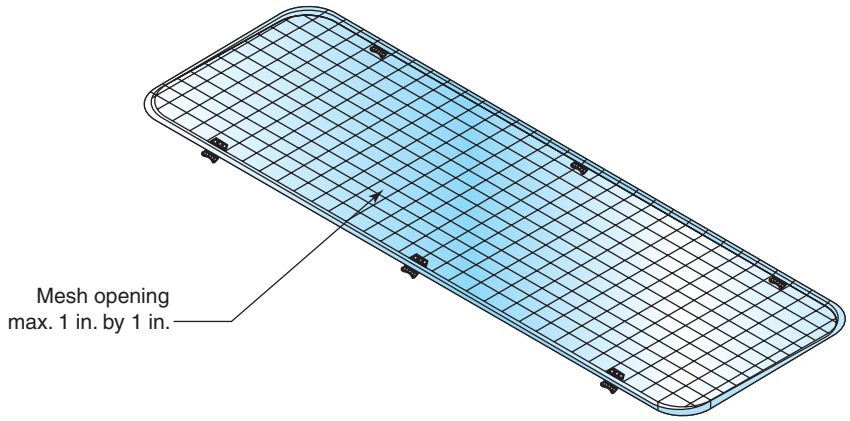


Broken glass retention screens are not required for laminated glass or when meeting the size, height and material limitations for tempered glass.

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Broken glass retention screen.

R308.6.4 Screens with multiple glazing. Where the inboard pane is fully tempered, heat-strengthened or wired glass, a ~~retaining~~ broken glass retention screen meeting the requirements of Section R308.6.7 shall be installed below the full area of the glass, except for ~~either condition~~ Condition 1 or 2 listed in Section R308.6.5. Other panes in the multiple glazing shall be of any type listed in Section R308.6.2.

R308.6.5 Screens not required. Screens shall not be required where laminated glass complying with item 1 of Section R308.6.2 is used as single glazing or the inboard pane in multiple glazing. Screens shall not be required where fully tempered glass is used as single glazing or the inboard pane in multiple glazing and either of the following conditions are met:

1. The glass area is 16 square feet (1.49 m^2) or less; the highest point of glass is not more than 12 feet (3658 mm) above a walking surface; the nominal glass thickness is not more than 3/16 inch (4.8 mm); and, ~~(~~for multiple glazing only~~)~~, the other pane or panes are fully tempered, laminated or wired glass.
2. The glass area is greater than 16 square feet (1.49 m^2); the glass is sloped 30 degrees (0.52 rad) or less from vertical; and the highest point of glass is not more than 10 feet (3048 mm) above a walking surface.

R308.6.7 Screen characteristics. The screen and its fastenings shall: be capable of supporting twice the weight of the glazing~~.~~ ; be firmly and substantially fastened to the framing members~~.~~; be installed within 4 inches (102mm) of the glass; and have a mesh opening of not ~~more~~ greater than 1 inch by 1 inch (25 mm by 25 mm).

CHANGE SIGNIFICANCE: Previous language related to the installation of "retaining" screens below unit skylights has caused some confusion and occasionally misinterpretation resulting in the installation of screens where they were not required. In some cases, skylight manufacturers have been asked to intervene to ensure that unsightly, unnecessary screens are not installed in these instances. Furthermore, in some instances, an optional skylight installation is removed from submitted plans due to misinterpretation at the plan review stage. In reality, glass retention screens

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are rarely required in IRC buildings and are never required if qualifying laminated glass is used in the skylight. The previous code language addressed qualifying laminated glass by simple omission from the sections dealing with screens. It was this omission that seemed to create some confusion within the industry. The added sentence in Section R308.6.5 states directly that permitted laminated glass does not require retention screens.

To further clarify the application, the terminology has been modified to fully describe the purpose of the screens as broken glass retention screens. This is to ensure readers do not confuse them with insect screens or fall protection screens, which are physically different and will not serve as effective retention screens. The hazard being addressed is to retain larger pieces of broken glass from falling on and injuring occupants.

Changes to Section R308.6.7 addressing the physical characteristics of the retention screens, if required, are consistent with the language in IBC Section 2405.3. None of the changes to the code text affect the long-standing requirements, but simply clarify the provisions to ensure more consistent enforcement.

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R310.1

Emergency Escape and Rescue Opening Required

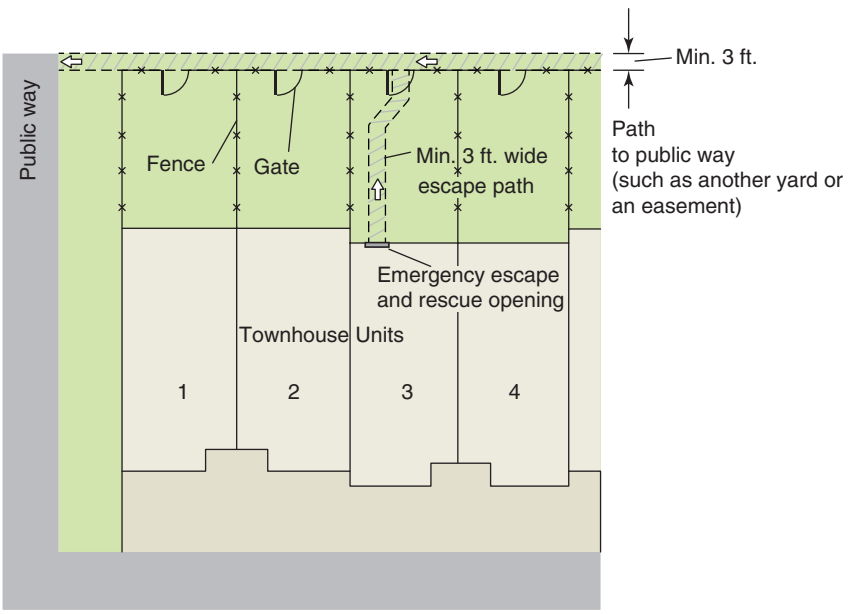
CHANGE TYPE: Clarification

CHANGE SUMMARY: Emergency escape and rescue openings require a clear 36-inch-wide path to a public way. Operation requirements have been clarified.

2021 CODE: R310.1 Emergency escape and rescue opening required. Basements, habitable attics and every sleeping room shall have not less than one operable emergency escape and rescue opening. Where basements contain one or more sleeping rooms, an emergency escape and rescue opening shall be required in each sleeping room. Emergency escape and rescue openings shall open directly into a public way, or to a yard or court having a minimum width of 36 inches (914 mm) that opens to a public way.

Exceptions:

1. Storm shelters and basements used only to house mechanical equipment not exceeding a total floor area of 200 square feet (18.58 m^2).
2. Where the dwelling unit or townhouse unit is equipped with an automatic sprinkler system installed in accordance with Section P2904, sleeping rooms in basements shall not be required to have emergency escape and rescue openings provided that the basement has one of the following:
   - 2.1. One means of egress complying with Section R311 and one emergency escape and rescue opening.
   - 2.2. Two means of egress complying with Section R311.
3. A yard shall not be required to open directly into a public way where the yard opens to an unobstructed path from the yard to the public way. Such path shall have a width of not less than 36 inches (914 mm).



Min. 3-ft. wide path required from an emergency escape and rescue opening to the public way.

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R310.1.1 Operational constraints and opening control devices. Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys, tools or special knowledge. Window opening control devices and fall prevention devices complying with ASTM F2090 shall be permitted for use on windows serving as a required emergency escape and rescue opening and shall be not more than 70 inches (178 cm) above the finished floor ~~shall comply with ASTM F2090~~.

CHANGE SIGNIFICANCE: Emergency escape and rescue openings have always been one of the most important fire- and life-safety provisions of the code. Although the provisions have been revised each code cycle, the basic concept to provide a secondary means out of a building in an emergency have held steady since the first edition of the IRC in 2000.

The openings have always been required in sleeping rooms. Originally required in basements with habitable space, beginning with the 2006 code they have been required in all basements, with some minor exceptions based on use. The 2006 edition also introduced the requirement to provide direct access from an emergency escape and rescue opening to the public way or to a yard or court that opens to a public way. The intent has been to connect directly to the outdoors so that travel through another room or inside space is not necessary. The code has not previously prescribed the width of the path of travel, instead relying on more of a performance provision that a path be adequate to travel to a public way. New language in the 2021 code requires a path not less than 36 inches in width for travel to the public way. The code does stipulate that the yard is not required to open directly into a public way provided it opens to an unobstructed path (typically another yard) that leads to the public way. The new path width requirement also applies to emergency escape and rescue openings under decks, porches and cantilevers as discussed in Section R310.2 in this publication.

The code clarifies that window opening control devices and fall prevention devices in compliance with ASTM F2090, *Standard Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms* are approved for use on emergency escape and rescue windows. New text limits the height of the release mechanisms to 70 inches above the finished floor. These devices are used to prevent children from falling out of windows where the bottom of the opening exceeds 6 feet above the ground outside, as covered in Section R312. Provisions are placed in this section as a reminder to code users that these devices are acceptable for escape and rescue applications.

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R310.2

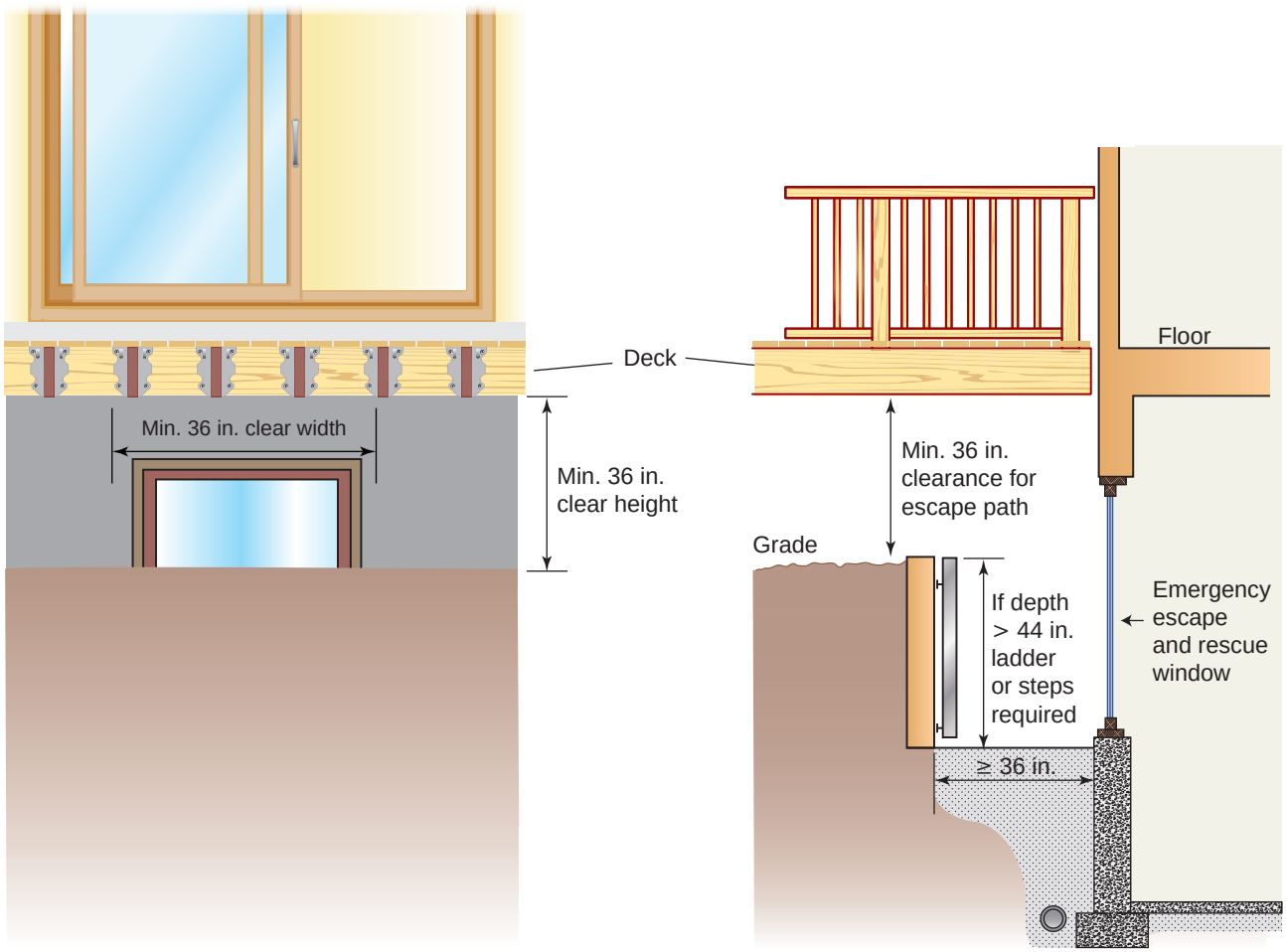
Emergency Escape and Rescue Openings

CHANGE TYPE: Modification

CHANGE SUMMARY: Emergency escape openings under decks, porches and cantilevers require a path not less than 36 inches wide. Opening dimensions have been clarified.

2021 CODE: **R310.2 Emergency escape and rescue openings.** Emergency escape and rescue openings shall have minimum dimensions ~~as specified in this section~~ in accordance with Sections R310.2.1 through R310.2.4.

R310.2.1 Minimum ~~opening area~~ size. Emergency and escape rescue openings shall have a net clear opening of not less than 5.7 square feet (0.530 m^2). ~~The net clear opening dimensions required by this section shall be obtained by the normal operation of the emergency escape and rescue opening from the inside. The net clear height of the opening shall be not less than 24 inches (610 mm) and the net clear width shall be not less than 20 inches (508 mm).~~



Section at deck facing house

Cross section of area well below deck

Minimum width and height for emergency escape path below a deck or porch.

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~~Exception:~~ ~~Grade floor openings or below-grade openings shall have a net clear opening area of not less than~~ The minimum net clear opening for grade-floor emergency escape and rescue openings shall be 5 square feet (0.465 m^2).

R310.2.2 Minimum dimensions. The minimum net clear opening height dimension shall be 24 inches (610 mm). The minimum net clear opening width dimension shall be 20 inches (508 mm). The net clear opening dimensions shall be the result of normal operation of the opening.

~~R310.2.2~~ R310.2.3 ~~Window sill height~~ Maximum height from floor. ~~Where a window is provided as the emergency~~ Emergency escape and rescue ~~opening,~~ openings ~~it~~ shall have ~~a sill height of not more than~~ the bottom of the clear opening not greater than 44 inches (1118 mm) above the floor.~~; where the sill height is below grade, it shall be provided with a window well in accordance with Section R310.2.3.~~

~~R310.2.4~~ R310.2.4 Emergency escape and rescue openings under decks ~~and~~, porches and cantilevers. Emergency escape and rescue openings installed under decks ~~and~~, porches and cantilevers shall be fully openable and provide a path not less than 36 inches (914 mm) in height and 36 inches (914 mm) in width to a yard or court.

CHANGE SIGNIFICANCE: Most of the changes to Section R310.2, with a couple of exceptions, are editorial and organizational in nature.

The minimum net clear opening area (5.7 square feet) and the minimum opening dimensions (20 inches in width and 24 inches in height) are placed in separate sections. The exception for a grade floor opening allowing a minimum area of 5.0 square feet has been clarified and matches the revised definition, now titled "Grade Floor Emergency Escape and Rescue Opening." The code previously stated that the exception applied to grade floor openings and below grade openings, not recognizing that "grade floor opening" was a defined term in the code. There was some question as to whether a "below grade opening" could be deeper than 44 inches below grade (a dimension from the definition of grade floor opening) and still take advantage of the size reduction. To make the connection clear, the definition has been revised and the exception in Section R310.2.1 has been placed in the section text and applies only to an opening meeting the defined term "Grade Floor Emergency Escape and Rescue Opening."

Consistent with several other changes (e.g., Definitions and Sections R310 and R312) in the 2021 IRC related to measurements from the floor to window openings, references to sills and window sills have been removed in favor of dimensions measured to the clear opening of the window. Such is the case with Section R310.2.4 where the title has been changed from "Window sill height" to "Maximum height from floor." The revised text clarifies that the measurement for the maximum height of 44 inches for an emergency escape window is from the finished floor to the bottom of the clear opening. Interestingly, this measurement language appeared in the 2012 IRC but was inadvertently dropped from the 2015 and 2018 editions.

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The code has specifically permitted emergency escape and rescue openings under decks and porches in previous editions. A minimum height of 36 inches has been required for the path under the deck or porch to the yard. New to the 2021 IRC, openings under floor cantilevers are also allowed and the path to the yard must have a minimum width of 36 inches in addition to the 36-inch height requirement.

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R310.3, R310.4

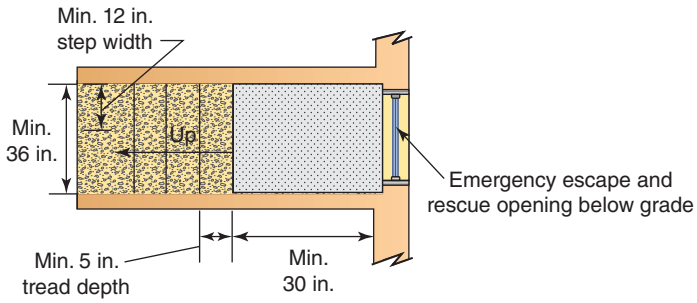
Area Wells for Emergency Escape and Rescue Openings

CHANGE TYPE: Modification

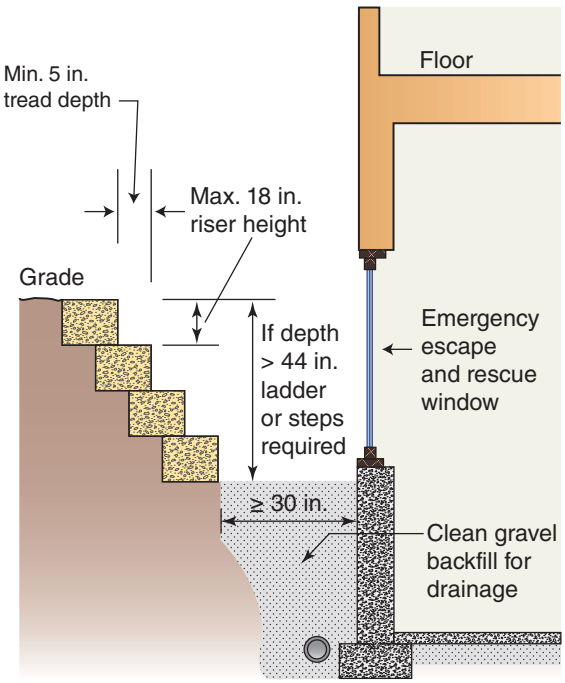
CHANGE SUMMARY: The provisions for window wells and area wells serving emergency escape and rescue openings have been merged into one section for area wells.

2021 CODE: **R310.3 Emergency escape and rescue doors.** Where a door is provided as the required emergency escape and rescue opening, it shall be a side-hinged door or a ~~slider. Where the opening is below the adjacent grade, it shall be provided with an area well.~~ sliding door.

~~**R310.3.1 Minimum door opening size.** The minimum net clear height opening for any door that serves as an emergency and escape rescue opening shall be in accordance with Section R310.2.1.~~



Plan view



Area well with steps

Section

Step dimensions for area wells exceeding 44 inches in depth.

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~~**R310.3.2 Area wells.** Area wells shall have a width of not less than 36 inches (914 mm). The area well shall be sized to allow the emergency escape and rescue door to be fully opened.~~

~~**R310.3.2.1 Ladder and steps.** Area wells with a vertical depth greater than 44 inches (1118 mm) shall be equipped with a permanently affixed ladder or steps usable with the door in the fully open position. Ladders or steps required by this section shall not be required to comply with Section R311.7. Ladders or rungs shall have an inside width of not less than 12 inches (305 mm), shall project not less than 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center vertically for the full height of the exterior stairwell.~~

~~**R310.3.2.2 Drainage.** Area wells shall be designed for proper drainage by connecting to the building's foundation drainage system required by Section R405.1 or by an approved alternative method.~~

> ~~**Exception:** A drainage system for area wells is not required where the foundation is on well-drained soil or sand-gravel mixture soils in accordance with the United Soil Classification System, Group I Soils, as detailed in Table R405.1.~~

R310.4 Area wells. An emergency escape and rescue opening where the bottom of the clear opening is below the adjacent grade shall be provided with an area well in accordance with Sections R310.4.1 through R310.4.4.

~~**R310.2.3**~~ **R310.4.1 ~~Window wells.~~ Minimum size.** The horizontal area of the ~~window~~ area well shall be not less than 9 square feet (0.9 m^2), with a horizontal projection and width of not less than 36 inches (914 mm). The ~~area~~ size of the ~~window~~ area well shall allow the emergency escape and rescue opening to be fully opened.

> **Exception:** The ladder or steps required by Section ~~R310.2.3.1~~ R310.2.4.2 shall be permitted to encroach not more than 6 inches (152 mm) into the required dimensions of the ~~window~~ area well.

~~**R310.2.3.1**~~ **R310.4.2 Ladder and steps.** ~~Window~~ Area wells with a vertical depth greater than 44 inches (1118 mm) shall be equipped with ~~a~~ an approved permanently affixed ladder or steps. The ladder or steps ~~usable with~~ shall not be obstructed by the emergency escape and rescue opening where the window or door is in the ~~fully~~ open position. Ladders or steps required by this section shall not be required to comply with Section R311.7. ~~Ladders or rungs shall have an inside width of not less than 12 inches (305 mm), shall project not less than 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center vertically for the full height of the window well.~~

R310.4.2.1 Ladders. Ladders and rungs shall have an inside width of not less than 12 inches (305 mm), shall project not less than 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center vertically for the full height of the area well.

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R310.4.2.2 Steps. Steps shall have an inside width of at least 12 inches (305 mm), a minimum tread depth of 5 inches (127 mm) and a maximum riser height of 18 inches (457 mm) for the full height of the area well.

~~R310.2.3.2~~ R310.4.3 Drainage. ~~Window~~ Area wells shall be designed for proper drainage by connecting to the building's foundation drainage system required by Section R405.1 ~~or by an approved alternative method~~.

> **Exception:** A drainage system for ~~window~~ area wells is not required where the foundation is on well-drained soil or sand-gravel mixture soils in accordance with the United Soil Classification System, Group I Soils, as detailed in Table R405.1.

~~R310.4~~ R310.4.4 Bars, grilles, covers and screens. Where bars, grilles, covers, screens or similar devices are placed over emergency escape and rescue openings, ~~area wells~~ bulkhead enclosures, or ~~window~~ area wells that serve such openings, the minimum net clear opening size shall comply with Sections ~~R310.2.1~~ R310.2 through ~~R310.2.3,~~ R310.2.2 and ~~such~~ R310.4.1. Such devices shall be releasable or removable from the inside without the use of a key, or tool, ~~special knowledge~~ or force greater than that required for the normal operation of the escape and rescue opening.

CHANGE SIGNIFICANCE: As part of the significant overhaul of Section R310, Sections R310.3 and R310.4 in the 2021 IRC consolidate and reorganize provisions for doors, window wells, area wells and related items, such as covers, ladders and steps. Section R310.3 now only covers doors that are used for emergency escape and rescue openings. Doors were specifically added to Section R310 in the 2015 edition of the code to reassure users that doors, which typically far exceed the required opening dimensions, are permitted for emergency escape and rescue. The door must be a side-hinged or sliding door.

Section R310.4 covers area wells, merging all the previous provisions for window wells and area wells. It is a general scoping paragraph that clarifies that the bottom of an emergency escape and rescue opening lower than the adjacent grade triggers the requirements for an area well. For below-grade emergency escape and rescue openings, an area well is required whether the opening is a door or a window. The term "window well" is no longer used in the provisions for emergency escape and rescue openings.

The significant technical change to the area well provisions serving either a door or a window is the addition of dimension requirements for steps. When the area well is more than 44 inches deep, the code requires either a ladder or steps for the occupant to safely climb from the area well in an emergency situation. Language confirming that the ladder or steps can encroach up to 6 inches into the required area well dimensions has been retained as an exception. The code still emphasizes that ladder or steps must be usable with the door or window in the open position. The code has always been very specific about ladder dimensions but silent on the step dimensions other than to say that they were not required to comply with the stair provisions in Section R311.7. The step dimensions for width and riser now parallel those for ladders and the tread depth is the minimum width for alternating tread devices and ships ladders in Sections R311.7.11 and R311.7.12. The minimum inside width is 12 inches

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with a minimum tread depth of 5 inches and a maximum riser height of 18 inches. There are many manufactured area (window) well units of various materials on the market with steps built in that meet these dimension requirements.

Changes to the area well requirements include:

- Section R310.3: The last sentence about area wells is deleted as redundant since the criteria for area wells is specifically addressed later in Section 310.4.
- Sections R310.3.2, R310.3.2.1 and R310.3.2.2: The separate area well requirements for doors are deleted. Window wells and area wells are merged into the area well provisions of Section R310.4.
- Section R310.4.1: The new title and revisions to the text for area well dimensions provide consistent terminology.
- Section R310.4.2: This section states when a ladder or steps are required. The sentence about the window not obstructing the steps or ladder is a safety feature that has been retained.
- Sections R310.4.2.1 and R310.4.2.2: The dimensions for ladders and steps have been moved into separate sections. The step dimensions are new as discussed above.
- Section R310.4.3: Since the code always allows approved alternative methods, the last phrase for an alternative means of area well drainage has been deleted.
- Section R310.4.4: The provisions for bars, grilles, covers and screens over area wells have been revised to coordinate with other sections. The term "special knowledge" has been removed from the operational constraints because it allows for too broad an interpretation. (Note that the term has been retained in Section R310.2.1 for operation of emergency escape and rescue openings.)

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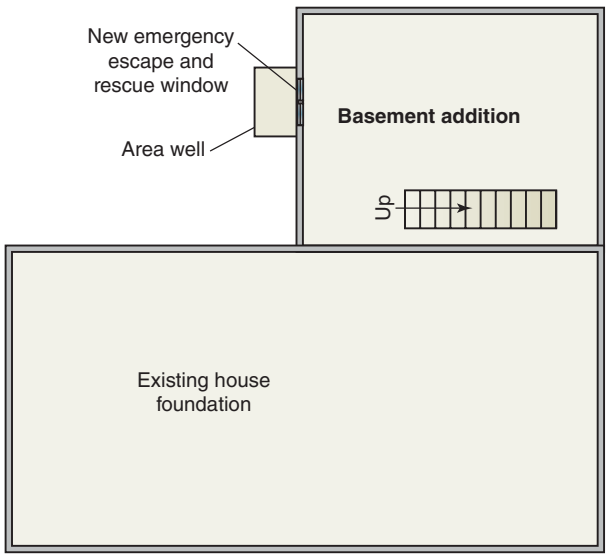
R310.5, R310.6, R310.7

Emergency Escape and Rescue Openings in Existing Buildings

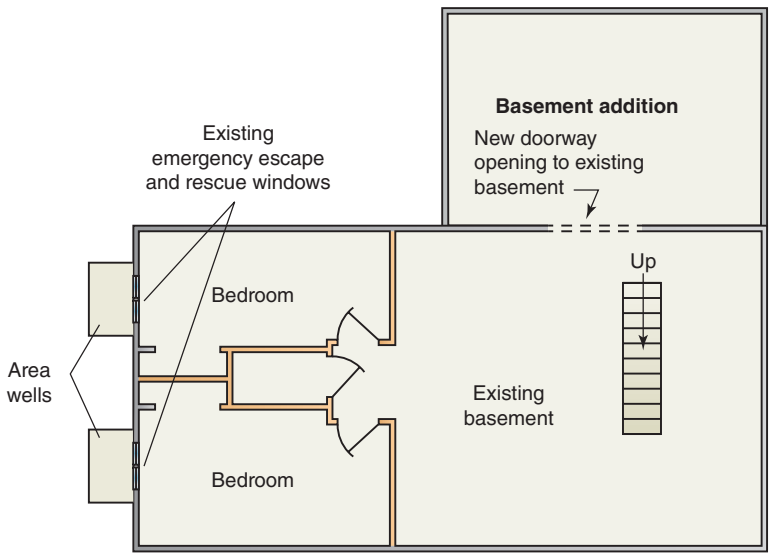
CHANGE TYPE: Modification

CHANGE SUMMARY: Opening dimensions have been reduced for emergency escape and rescue openings for a basement remodel, basement addition and for a change of occupancy.

2021 CODE: ~~**R310.2.5**~~ **R310.5 Replacement windows for emergency escape and rescue openings.** Replacement windows installed in buildings meeting the scope of this code shall be exempt from ~~the maximum~~

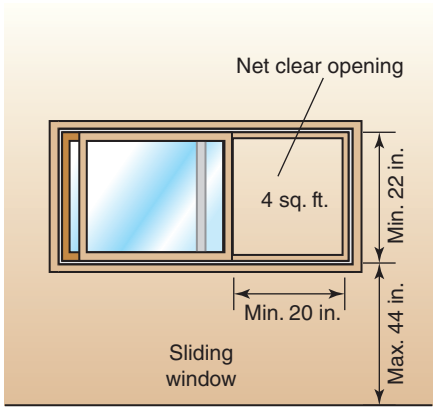


Basement addition with required emergency escape and rescue opening



Basement addition with opening to existing basement

Access to an emergency escape and rescue opening is required for basement additions.



Reduced opening dimensions for emergency escape and rescue openings serving a basement addition or for a change of occupancy.

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~~sill height requirements of Section R310.2.2 and the requirements of Section R310.2.1~~ Sections R310.2 and R310.4.4, provided that the replacement window meets the following conditions:

1. The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window is of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.
2. The replacement window is not part of a change of occupancy.

~~R310.5~~ R310.6 Dwelling additions. Where dwelling additions contain sleeping rooms, an emergency escape and rescue opening shall be provided in each new sleeping room. Where dwelling additions have basements, an emergency escape and rescue opening shall be provided in the new basement.

Exceptions:

1. An emergency escape and rescue opening is not required in a new basement that contains a sleeping room with an emergency escape and rescue opening.
2. An emergency escape and rescue opening is not required in a new basement where there is an emergency escape and rescue opening in an existing basement that is accessed from the new basement.
3. An operable window complying with Section 310.7.1 shall be acceptable as an emergency escape and rescue opening.

~~R310.6~~ R310.7 Alterations or repairs of existing basements. ~~An emergency escape and rescue opening is not required where existing basements undergo alterations or repairs.~~ **~~Exception:~~** New sleeping rooms created in an existing basement shall be provided with emergency escape and rescue openings in accordance with Section R310.1. Other than new sleeping rooms, where existing basements undergo alterations or repairs an emergency escape and rescue opening is not required.

Exception: An operable window complying with Section 310.7.1 shall be acceptable as an emergency escape and rescue opening.

R310.7.1 Existing emergency escape and rescue openings. Where a change of occupancy would require an emergency escape and rescue opening in accordance with Section 310.1, operable windows serving as the emergency escape and rescue opening shall comply with the following:

1. An existing operable window shall provide a minimum net clear opening of 4 square feet (0.38 m^2) with a minimum net clear opening height of 22 inches (559 mm) and a minimum net clear opening width of 20 inches (508 mm).
2. A replacement window where such window complies with both of the following:
   2.1 The replacement window meets the size requirements in Item 1.

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2.2 The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.

CHANGE SIGNIFICANCE: The provisions for replacing existing windows in locations requiring an emergency escape and rescue opening have been relocated from Section R310.2.5 to their own Section R310.5. Changes to the text are editorial. The section title has changed to clarify that it is about emergency escape and rescue openings. The exemptions and criteria for replacement windows remain the same, but information has been shifted as part of the reorganization. When replacing windows in an existing dwelling unit, such as in a bedroom where an emergency escape and rescue opening is required, the intent is that the replacement window is no less safe than the existing window. The replacement must be the manufacturer's largest standard size window that will fit within the existing opening and be of the same operating style as the existing window or equivalent.

Section R310.6 deals with requirements for dwelling additions. The previous language requiring an emergency escape and rescue opening for new bedrooms and for a new basement that is part of the addition has been retained. A new Exception 3 references new Section R310.7.1 providing that the emergency escape and rescue opening can be reduced in size to a clear area not less than 4 square feet with a minimum height of 22 inches and minimum width of 20 inches.

Section R310.7 regarding alterations or repairs of existing basements has been restructured to clarify the application. Only if new sleeping rooms are added to an existing basement does an emergency escape and rescue opening need to be installed. Previously, this was written as an exception, but is more appropriately placed in the general rule. Otherwise, remodeling of an existing basement does not retroactively trigger the installation of an emergency escape opening as is required for new basements. A new exception addresses a situation where a new sleeping room is being created in an existing basement and there is an existing window in that new bedroom area. The code now allows some compromise on the opening size of this existing window by referencing a new provision in Section R310.7.1. In this case, the net clear opening area needs to be at least 4 square feet (rather than 5 square feet for a new grade floor opening) with a minimum height of 22 inches (rather than 24 inches for a new installation) and a minimum width of 20 inches.

Section R310.7.1 deals with existing windows where there is a change of occupancy and an emergency escape and rescue opening is required. In this case, the builder can take advantage of the reduced opening size of 4 square feet for the existing opening. While this section is specific to changes of occupancy, it is also referenced for new additions and for alterations to existing basements as discussed previously. A change of use or occupancy is unusual in the IRC unless the building is changed to a use governed by the IBC, in which case R310.7.1 would not apply – the building would need to comply with the IBC under changes of use or occupancy. A change of use under the IRC typically involves changing from a townhouse unit to a live/work unit or changing a single-family dwelling to a bed and breakfast operation. The new provisions are based on language in the *International Existing Building Code* (IEBC).

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R311.7, R311.8

Stairways and Ramps

CHANGE TYPE: Clarification

CHANGE SUMMARY: The provisions of Sections R311.7 and R311.8 apply only to stairways and ramps within or serving a building, porch or deck.

2021 CODE: **R202 STAIRWAY.** One or more flights of stairs, either interior or exterior, with the necessary landings and connecting platforms to form a continuous and uninterrupted passage from one level to another ~~within or attached to a building, porch or deck~~.

R311.7 Stairways. Where required by this code or provided, stairways shall comply with this section.

Exceptions:

1. Stairways not within or attached to a building, porch or deck
2. Stairways leading to non-habitable attics
3. Stairways leading to crawl spaces.



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Stairways attached to porches and decks must meet the requirements of Section R311.7.

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R311.8 Ramps. Where required by this code or provided, ramps shall comply with this section.

Exception: Ramps not within or attached to a building, porch or deck.

CHANGE SIGNIFICANCE: Scoping language has been added to Section R311.7 Stairways and R311.8 Ramps to clarify that the associated elements apply when they are within or attached to a building, porch or deck. Previously, similar language was found in Section R202 in the definition of a stairway as being "within or attached to a building, porch or deck." The definition has been changed to delete the scoping language and place it in Section R311. The definition now matches the IBC definition for consistency. The new text in Section R311 clarifies the intent and matches what has been common practice in most parts of the country. Stair safety is equally important to occupants of the dwelling whether it is an interior or exterior stair associated with the dwelling or if it is a stair that serves a deck or porch on any side of the house. Some voiced concern that because the stair provisions were located in the means of egress section of the code, that only those stairs leading to or from the one required exterior egress door were being regulated. That has never been the intent and the scoping is now clear.

There are now three exceptions to the stairway provisions in Section R311.7. The first, as discussed above, states that stairways that are not within or attached to a building, porch or deck are not regulated by this section. Exceptions 2 and 3 exempt stairs leading to nonhabitable attics and crawl spaces. This now specifically allows the common practice of providing a ladder to crawl spaces and a drop-down ladder/stair device for accessing a nonhabitable attic area.

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R311.7.7

Stairway and Landing Walking Surface

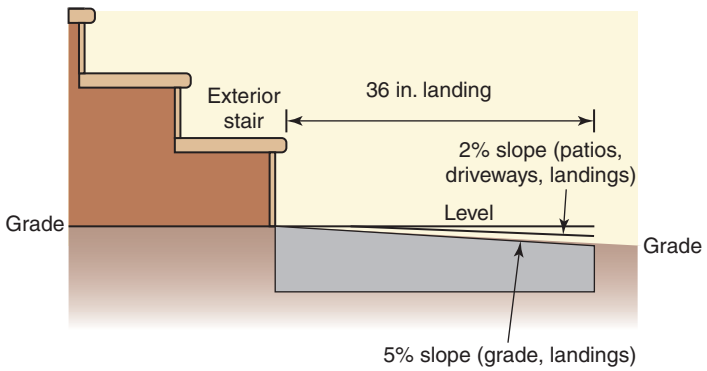
CHANGE TYPE: Modification

CHANGE SUMMARY: A new exception allows steeper slopes for exterior landings that also serve to drain surface water away from the building.

2021 CODE: **R311.7.7 Stairway walking surface.** The walking surface of treads and landings of stairways shall be sloped not steeper than one unit vertical in 48 ~~inches~~ units horizontal (2-percent slope).

> **Exception:** Where the surface of a landing is required elsewhere in the code to drain surface water, the walking surface of the landing shall be sloped not steeper than 1 unit vertical in 20 units horizontal (5-percent slope) in the direction of travel.

CHANGE SIGNIFICANCE: The code regulates the slope of the ground (grade) and impervious surfaces, such as concrete patios, to provide minimum drainage requirements to direct surface water away from the structure. Section R401.3 generally requires a minimum slope for finish grade of 6-inch fall in the first 10 feet away from the building. This is a minimum 5 percent average slope. Impervious surfaces, such as concrete or brick paving, are more efficient at draining water and the code reduces the minimum slope accordingly to 2 percent or 2 inches fall in 10 feet. Sections R311.3 and R311.7.7 set maximum slopes for interior and exterior landings and stairs to provide comfortable and safe walking surfaces, and still provide drainage for exterior surfaces. The new exception addresses a concern that there are situations where the minimum slope for drainage might conflict with the maximum slope allowed for an exterior landing. In other words, the installation would require a steeper slope than is permitted for a landing when the landing is part of the drainage platform. Another possible installation difficulty would be to achieve a minimum slope of 2 percent for drainage while matching that with a maximum slope of 2 percent for walking, precision that may present some challenges. To satisfy the surface water drainage requirements under these circumstances, an exterior landing will now be permitted to slope as much as the minimum required for finish grade (ground) of 5 percent slope. This 5 percent also matches the maximum slope for an accessible route in the accessibility provisions of Chapter 11 of the IBC.



5 percent slope is permitted for landings that are required to provide drainage away from the dwelling.

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R312.2
Window Fall Protection

CHANGE TYPE: Clarification

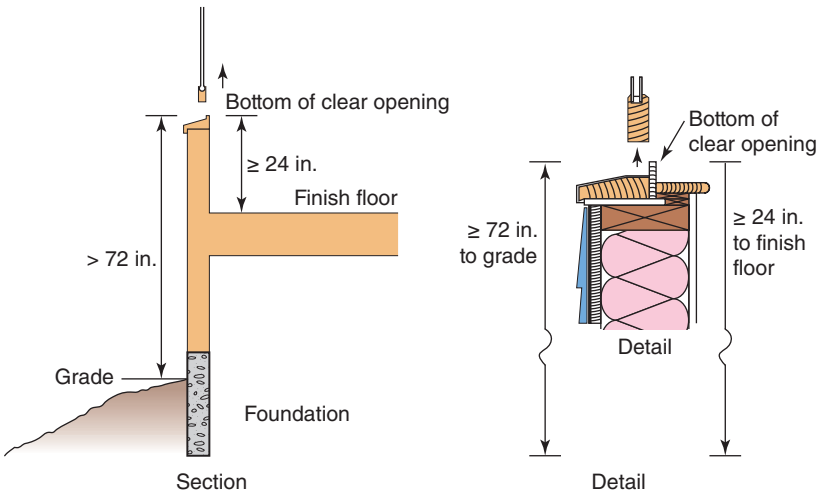
CHANGE SUMMARY: The revised language clarifies that measurements for determining the need for fall protection are taken to the bottom of the clear opening of the window.

2021 CODE: **R312.2 Window fall protection.** Window fall protection shall be provided in accordance with Sections R312.2.1 and R312.2.2.

R312.2.1 Window ~~sills~~ opening height. In dwelling units, where the ~~top~~ bottom of the ~~sill~~ clear opening of an operable window opening is located less than 24 inches (610 mm) above the finished floor and greater than 72 inches (1829 mm) above the finished grade or other surface below on the exterior of the building, the operable window shall comply with one of the following:

1. Operable window openings will not allow a 4-inch-diameter (102 mm) sphere to pass through where the openings are in their largest opened position.
2. Operable windows are provided with window opening control devices or fall prevention devices that comply with ASTM F2090.
3. ~~Operable windows are provided with window opening control devices that comply with Section R312.2.2.~~

R312.2.2 ~~Window opening control devices.~~ Emergency escape and rescue openings. ~~Window opening control devices shall comply with ASTM F2090. The~~ Where an operable window serves as an emergency escape and rescue opening, a window opening control device or fall prevention device, after operation to release the control device or fall prevention device allowing the window to fully open, shall not reduce the net clear opening area of the window unit to less than the area required by Sections R310.2.1 and R310.2.2.



Measurements for window fall protection are taken to the bottom of the clear opening.

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CHANGE SIGNIFICANCE: The provisions for window fall protection intend to reduce the number of injuries to children resulting from falls through windows. These provisions first appeared in the 2006 edition of the IRC. Since then, the height of the opening above grade deemed to pose a hazard has been greater than 72 inches. Where the height has exceeded 72 inches, the minimum height of the opening above the finished floor has been set at 24 inches, unless other protection, such as an opening control device, was provided. The wording, particularly how the measurements for this section are taken, have changed from time to time. In the original text, the section was titled "Window Sills" and the measurements were taken to the opening. In the 2015 edition, the language changed so the measurement was taken to the window sill. A sill, if it exists, is not necessarily the lowest point of the window opening. The reference to window sill in the title and the text has been removed and measurements are taken to the bottom of the clear opening.

The other change to this section relates to window opening control devices and fall prevention devices that have been alternates to the opening height requirements for child fall prevention. When used, these devices must be in compliance with ASTM F2090, *Standard Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms*. As the title indicates, these devices are approved for use on emergency escape and rescue windows when conforming to this standard. Changes to the code text are meant to clarify the use of these devices and emphasize that they are acceptable for use on emergency escape and rescue windows. Text for opening control devices and fall prevention devices being allowed for emergency escape and rescue windows also appears in Section R310.

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R314.3

Smoke Alarm Locations

CHANGE TYPE: Modification

CHANGE SUMMARY: A new location requirement for smoke alarms addresses high ceilings adjacent to hallways serving bedrooms.

2021 CODE: **R314.3 Location.** Smoke alarms shall be installed in the following locations:

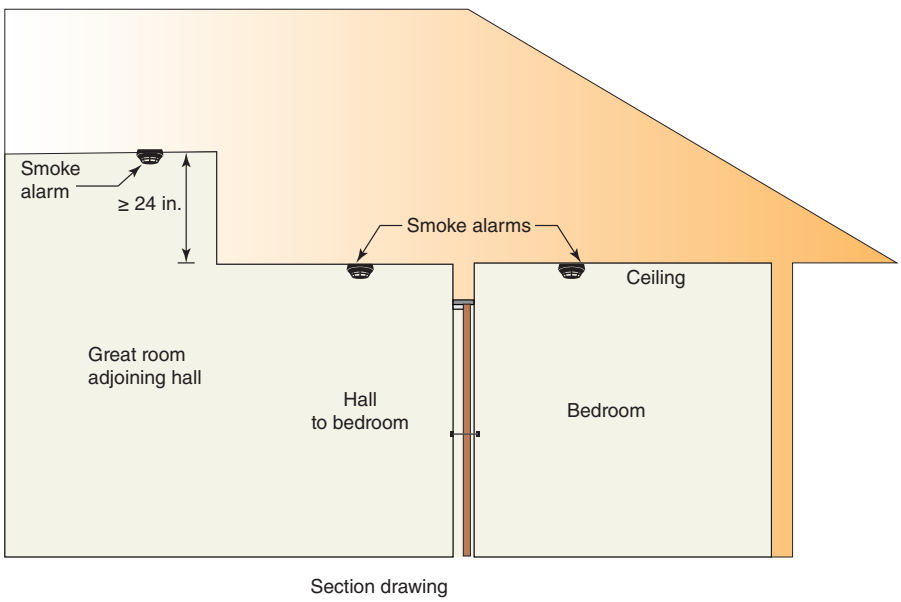
1. In each sleeping room.
2. Outside each separate sleeping area in the immediate vicinity of the bedrooms.
3. On each additional story of the dwelling, including basements and habitable attics and not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.
4. ~~Smoke alarms shall be installed not~~ Not less than 3 feet (914 mm) horizontally from the door or opening of a bathroom that contains a bathtub or shower unless this would prevent placement of a smoke alarm required by this section.
5. In the hallway and in the room open to the hallway in dwelling units where the ceiling height of a room open to a hallway serving bedrooms exceeds that of the hallway by 24 inches (610 mm) or more.

R314.3.1 Installation near cooking appliances. Smoke alarms shall not be installed in the following locations unless this would prevent placement of a smoke alarm in a location required by Section R314.3.



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Hallway serving bedrooms and adjacent higher ceiling both require smoke alarms.



Smoke alarm locations.

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1. Ionization smoke alarms shall not be installed less than 20 feet (6096 mm) horizontally from a permanently installed cooking appliance.
2. Ionization smoke alarms with an alarm-silencing switch shall not be installed less than 10 feet (3048 mm) horizontally from a permanently installed cooking appliance.
3. Photoelectric smoke alarms shall not be installed less than 6 feet (1828 mm) horizontally from a permanently installed cooking appliance.
4. Smoke alarms listed and marked "helps reduce cooking nuisance alarms" shall not be installed less than 6 feet (1828 mm) horizontally from a permanently installed cooking appliance.

CHANGE SIGNIFICANCE: Since its beginning, the IRC has required smoke alarms to be located in each bedroom, in the area adjacent to bedrooms (often a hallway), and on each level including basements. As an alternative to each level, where an open split-level design occurs, the code permits the smoke alarm on the upper level to serve both levels. This recognizes that smoke rises and the alarm on the upper level will react quickly to smoke that originates on the level below. A similar situation has prompted a change to the location requirements in the 2021 IRC. If the hallway serving the bedrooms opens to a great room with a high ceiling, the required smoke alarm in the hall may not sound immediately as smoke rises and accumulates at the upper ceiling of the great room. Previously, the code did not require a smoke alarm at the higher level. If the upper ceiling in this case is greater than 24 inches above the hall ceiling, the code now requires an additional smoke alarm on the upper ceiling in addition to the one in the hall. This will provide earlier notification for occupants to safely exit the building.

The 2015 edition of the IRC introduced measures to reduce nuisance alarms by requiring horizontal separation of smoke alarms from cooking appliances and bathrooms. The minimum separation requirements from permanently installed cooking appliances vary based on the type of smoke alarm installed. Ionization smoke alarms generally require a separation distance of 20 feet, but that distance may be reduced to 10 feet if the smoke alarm has an alarm-silencing switch. Photoelectric smoke alarms are less susceptible to activation by cooking vapors and are permitted to be located as close as 6 feet from a permanently installed cooking appliance. The intent is to regulate separation distance from built-in cook tops and ovens as well as stand-alone kitchen ranges.

Smoke alarms listed to the new edition of UL 217 (with an effective date of May 29, 2020) are required to pass tests designed to reduce nuisance alarms caused by residential cooking. New item 4 of Section R314.3.1 provides an additional option for the types of smoke alarms that can be used near cooking appliances, without changing the existing options. Smoke alarms that are identified as having resistance to common nuisance alarms from cooking sources are now permitted to be as close as 6 feet from the cooking appliance.

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R315.2.2

Carbon Monoxide Alarms

CHANGE TYPE: Modification

CHANGE SUMMARY: Repairs to an existing fuel-fired mechanical system now trigger the retroactive requirements for carbon monoxide alarms.

2021 CODE: **R315.2.2 Alterations, repairs and additions.** Where alterations, repairs or additions requiring a permit occur, the individual dwelling unit shall be equipped with carbon monoxide alarms located as required for new dwellings.

Exceptions:

1. Work involving the exterior surfaces of dwellings, such as the replacement of roofing or siding, or the addition or replacement of windows or doors, or the addition of a porch or deck.
2. Installation, alteration or repairs of plumbing ~~or mechanical~~ systems.
3. Installation, alteration or repairs of mechanical systems that are not fuel fired.

CHANGE SIGNIFICANCE: Requirements for carbon monoxide alarms were introduced in the 2009 edition of the IRC to reduce accidental injury and deaths from carbon monoxide poisoning. Because the source of unsafe levels of carbon monoxide in the home is typically from faulty operation of a fuel-fired furnace or water heater, or from the exhaust of an automobile, the provisions only apply to dwellings containing fuel-fired appliances or having an attached garage that communicates with



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Carbon monoxide alarm.

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Repair of a fuel-fired furnace.

the residence. Carbon monoxide accumulates in the body over time relative to its concentration in the air. Accordingly, carbon monoxide alarms sound an alarm based on the concentration of carbon monoxide and the amount of time that certain levels are detected, simulating an accumulation of the toxic gas in the body. High levels of carbon monoxide will trigger an alarm within a short time, while lower levels must be present over a longer time period for the alarm to sound. This design prevents false-positive alarms.

Because carbon monoxide poisoning deaths often occur when the occupants are sleeping, the IRC requires carbon monoxide alarms to be located in the areas outside of and adjacent to bedrooms. Similar to the smoke alarm provisions, carbon monoxide alarms are not only required in new dwellings but are also required in existing dwelling units when triggered by construction work on the existing dwelling, one of only two provisions in the code that are retroactive. When work requiring a permit occurs, alarms must be installed in the locations prescribed by the code. Matching the smoke alarm provisions, exterior work requiring a permit, such as roofing, siding, windows, doors, porches and decks, does not trigger the retroactive carbon monoxide alarm requirements.

The second exception to the retroactive provisions has exempted the installation, alteration or repairs of plumbing or mechanical systems. New to the 2021 IRC, alteration or repairs to mechanical systems are only exempt if they do not include fuel-fired equipment. Mechanical systems often include forced air units and water heaters that are fuel burning and therefore subject to carbon monoxide leakage in the event of faulty operation. Consensus was that fuel-fired equipment that is being altered, repaired or replaced and requires a permit should be subject to the carbon monoxide alarm provisions. The language for this exception has been changed to only apply to mechanical systems that are not fuel fired.

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R317.1

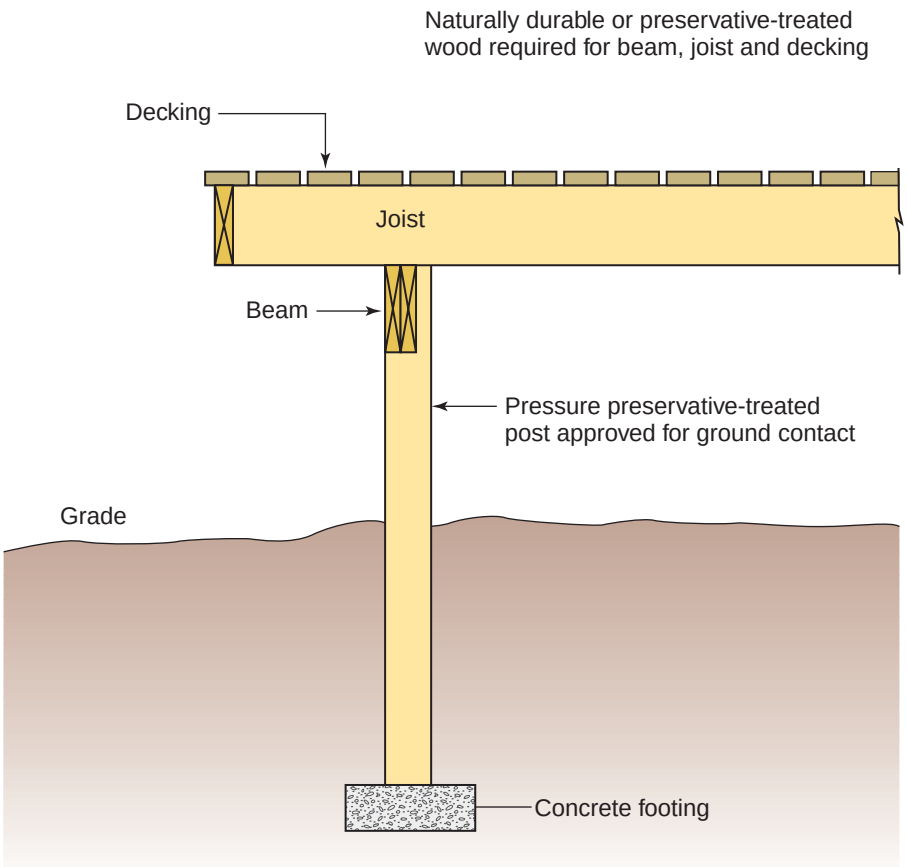
Protection of Wood Against Decay

CHANGE TYPE: Clarification

CHANGE SUMMARY: The provisions of Section R317.1 have been revised and reorganized for clarification.

2021 CODE: R317.1 Location required. Protection of wood and wood-based products from decay shall be provided in the following locations by the use of naturally durable wood or wood that is preservative-treated in accordance with AWPA U1.

1. ~~Wood joists or the bottom of a wood structural floor where closer than 18 inches (457 mm) or, wood girders where closer than 12 inches (305 mm) to the exposed ground , in~~ In crawl spaces or unexcavated area located within the periphery of the building foundation~~.~~, wood joists or the bottom of a wood structural floor where closer than 18 inches (457 mm) to exposed ground, wood girders where closer than 12 inches (305 mm) to exposed ground, and wood columns where closer than 8 inches (204 mm) to exposed ground.
2. Wood framing members, including columns, that rest directly on concrete or masonry exterior foundation walls and are less than 8 inches (203 mm) from the exposed ground.



Protection against decay for wood structural members exposed to the weather.

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3. Sills and sleepers on a concrete or masonry slab that is in direct contact with the ground unless separated from such slab by an impervious moisture barrier.
4. The ends of wood girders entering exterior masonry or concrete walls having clearances of less than ½ inch (12.7 mm) on tops, sides and ends.
5. Wood siding, sheathing and wall framing on the exterior of a building having a clearance of less than 6 inches (152 mm) from the ground or less than 2 inches (51 mm) measured vertically from concrete steps, porch slabs, patio slabs and similar horizontal surfaces exposed to the weather.
6. Wood structural members supporting moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, unless separated from such floors or roofs by an impervious moisture barrier.
7. Wood furring strips or other wood framing members attached directly to the interior of exterior masonry walls or concrete walls below grade except where an approved vapor retarder is applied between the wall and the furring strips or framing members.
8. Portions of wood structural members that form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where those members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering that would prevent moisture or water accumulation on the surface or at joints between members.

   Exception: Sawn lumber used in buildings located in a geographical region where experience has demonstrated that climatic conditions preclude the need to use naturally durable or preservative-treated wood where the structure is exposed to the weather.
9. Wood columns in contact with basement floor slabs unless supported by concrete piers or metal pedestals projecting at least 1 inch (25 mm) above the concrete floor and separated from the concrete pier by an impervious moisture barrier.

R317.1.1 Field treatment. *[No change]*

R317.1.2 Ground contact. *[No change]*

~~**R317.1.3 Geographical areas.** In geographical areas where experience has demonstrated a specific need, approved naturally durable or pressure-preservative-treated wood shall be used for those portions of wood members that form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where those members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering that would prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members typically include:~~

~~1. Horizontal members such as girders, joists and decking.~~
~~2. Vertical members such as posts, poles and columns.~~
~~3. Both horizontal and vertical members.~~

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~~**R317.1.4 Wood columns.** Wood columns shall be approved wood of natural decay resistance or approved pressure-preservative-treated wood.~~

~~**Exceptions:**~~

1. ~~Columns exposed to the weather or in basements where supported by concrete piers or metal pedestals projecting 1 inch (25 mm) above a concrete floor or 6 inches (152 mm) above exposed earth and the earth is covered by an approved impervious moisture barrier.~~
2. ~~Columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building where supported by a concrete pier or metal pedestal at a height more than 8 inches (203 mm) from exposed earth and the earth is covered by an impervious moisture barrier.~~
3. ~~Deck posts supported by concrete piers or metal pedestals projecting not less than 1 inch (25 mm) above a concrete floor or 6 inches (152 mm) above exposed earth.~~

~~**R317.1.5 Exposed glued-laminated timbers.** The portions of glued-laminated timbers that form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave or similar covering shall be pressure treated with preservative, or be manufactured from naturally durable or preservative-treated wood.~~

CHANGE SIGNIFICANCE: The provisions for protection of wood against decay have not changed significantly for many code editions. This update accomplishes a much-needed overhaul. There is no intent to significantly change the technical content of Section R317, only to clarify the requirements, clean up some errors in syntax, and correct some misleading text. The revised text more accurately reflects the way this section has been applied.

The following is a summary of the changes:

- Section R317.1 Item 1: The wording is rearranged for readability. Similar to floor framing and girders, columns are given a required clearance from exposed earth in crawl spaces, which is generally consistent with former Exception 2 to Section R317.1.4. The moisture barrier language related to columns in crawl spaces has been removed because that should be governed by the crawl space provisions in Section R408.
- Section R317.1 Item 2: This item now includes columns with other wood framing members since the columns Section R317.1.4 has been deleted.
- Section R317.1 Item 8: The language comes from the deleted Section R317.1.3 (Geographical areas), which seemed to require wood members exposed to the weather to be treated or naturally durable only if a need was demonstrated. The code now requires protection as the general rule and provides an exception for arid geographical regions where it has been demonstrated that the protection is not needed. Relocating this to the list of locations in R317.1 and providing an

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exception clarifies the requirement. The new exception also makes clear that it only applies to sawn lumber, not engineered wood products, which should be protected when exposed to the weather regardless of climate or geographic location, and manufacturers' recommendations require protection.

- Section R317.1 Item 9: This new item is necessary to preserve the reduced clearance for columns above basement floor slabs consistent with part of deleted Exception 1 to Section R317.1.4. It provides for as little as 1 inch of clearance if on a metal pedestal and 1 inch of clearance on a concrete pier if it is separated from the pier by an impervious moisture barrier, since concrete is porous and will allow wicking of moisture more readily.
- Section R317.1.3: The section has been deleted, and the text revised and moved to the new Item 8 of Section R317.1. The descriptors in Items 1 through 3 about horizontal and vertical members have been removed because they were considered to be commentary rather than code language.
- Section R317.1.4: This section has been deleted because it was unnecessarily confusing and contained errors in syntax, making it difficult to apply. The charging language seemed to require all columns, regardless of location (including interior locations), to be treated. That is not the intent of the code.
  - Exception 1: This deleted exception seemed to exempt all columns exposed to the weather, which was not the intent. The rest of Exception 1 had criteria which conflicted with the current IBC and also seemed to conflict with Exception 2.
  - Exception 2: This has been clarified and moved to revised Item 1 of Section R317.1.
  - Exception 3: This exception has been deleted because it seemed to exempt any deck posts that are supported by piers or pedestals extending 1 inch above concrete or 6 inches above exposed earth. Best practices dictate that any deck post exposed to the weather should be protected against decay regardless of clearance to a slab or ground.
- Section R317.1.5: This section has been deleted because glued laminated timber is covered under the scope of new Item 8 of Section R317.1 and the current language is therefore redundant.

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R320
Accessibility

CHANGE TYPE: Modification

CHANGE SUMMARY: The accessibility provisions for live/work units and owner-occupied lodging houses constructed under the IRC are clarified.

2021 CODE: R202 DEFINITIONS

LIVE/WORK UNIT. A dwelling unit or sleeping unit in which a significant portion of the space includes a nonresidential use that is operated by the tenant.

SLEEPING UNIT. A single unit that provides rooms or spaces for one or more persons, includes permanent provisions for sleeping and can include provisions for living, eating and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

SECTION R320
ACCESSIBILITY

R320.1 Scope. Where there are four or more dwelling units or sleeping units in a single structure, the provisions of Chapter 11 of the *International Building Code* for Group R-3 shall apply.

Exception: Owner-occupied lodging houses with five or fewer guestrooms are not required to be accessible.



Live/work units

Live/work units must comply with the accessibility requirements of the referenced sections in the IBC.

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~~**R320.1.1 Guestrooms.** A dwelling with guestrooms shall comply with the provisions of Chapter 11 of the International Building Code for Group R-3. For the purpose of applying the requirements of Chapter 11 of the *International Building Code,* guestrooms shall be considered to be sleeping units.~~

> ~~**Exception:** Owner-occupied lodging houses with five or fewer guestrooms constructed in accordance with the International Residential Code are not required to be accessible.~~

R320.2 Live/work units. In live/work units, the nonresidential portion shall be accessible in accordance with Sections 508.5.9 and 508.5.11 of the *International Building Code*. In a structure where there are four or more live/work units, the dwelling portion of the live/work unit shall comply with Section 1108.6.2.1 of the *International Building Code*.

CHANGE SIGNIFICANCE: The design and construction of facilities for accessibility for individuals with disabilities is covered in Chapter 11 of the IBC. In general, IRC buildings do not require accessibility and accessible features are optional. Section R320 provides that where there are four or more dwelling units or sleeping units in a single structure, the accessibility provisions of IBC Chapter 11 apply. This is applicable to townhouses with four or more townhouse units. However, exceptions in IBC Chapter 11 exempt multilevel dwelling units without elevators, meaning that in most cases townhouses are exempt from the accessibility requirements.

The new language in Section R320 intends to clarify the accessibility requirements as they apply to live/work units in townhouses and owner-occupied lodging houses with no more than five sleeping units (typically bed and breakfast establishments), both allowed to be constructed under the exceptions to the scope of the IRC. The existing language in the IRC has not only exempted these lodging houses from accessibility requirements, but also included some confusing text requiring accessibility for dwellings with guestrooms followed by an exception for those IRC lodging houses. The confusing language has been removed and the exemption for owner-occupied lodging houses with five or fewer guestrooms appears as an exception to the general rule on accessibility.

The second change to this section addresses accessibility for live/work units to correspond to the referenced provisions in Sections 508 and Chapter 11 of the IBC. The exception to the scope in the IRC has stated that live/work units in townhouses must comply with the live/work unit provisions in Section 508 in the IBC. The new language in the IRC intends to strengthen and emphasize that link. For example, a definition for live/work unit has been added to the IRC to correlate with the IBC definition. In new Section R320.2, the code repeats the IBC language that the nonresidential portion of the live/work unit shall be accessible. In addition, where there are four or more live/work units, the dwelling portion of the live/work unit needs to comply with Section 1108.6.2.1 of the IBC. While this would seem to imply mandatory rules related to accessibility (Type B units), the IBC again exempts multilevel dwelling units without elevators.

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R323
Storm Shelters

CHANGE TYPE: Addition

CHANGE SUMMARY: Added guidance on the design of storm shelters is placed in Section R323.

2021 CODE: R202 DEFINITIONS

STORM SHELTER. A building, structure or portion thereof, constructed in accordance with ICC 500 and designated for use during a severe wind-storm event, such as a hurricane or tornado.

R106.1.5 Information on storm shelters. Construction documents for storm shelters shall include the information required in ICC 500.

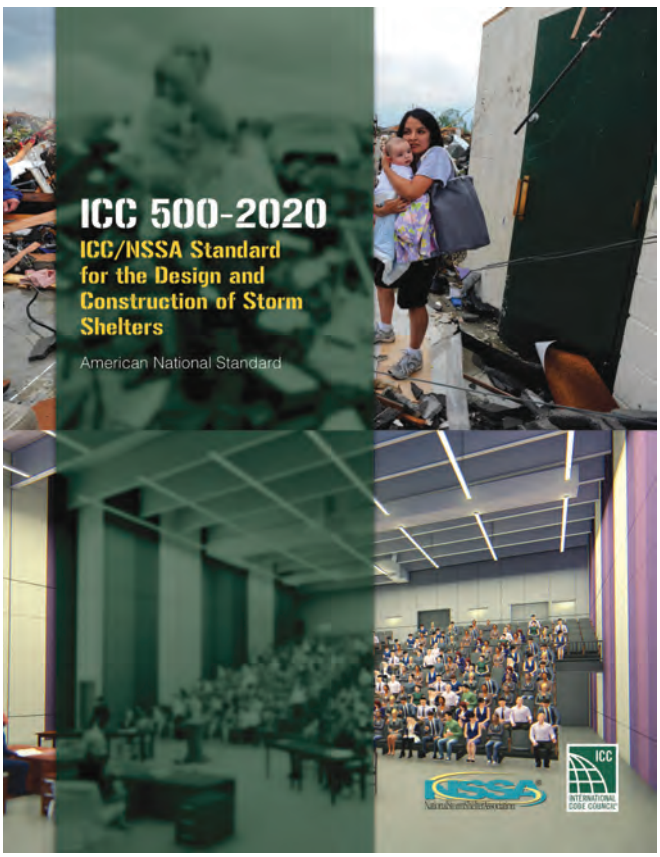
SECTION R323
STORM SHELTERS

R323.1 General. This section applies to storm shelters where constructed as separate detached buildings or where constructed as safe rooms within buildings for the purpose of providing refuge from storms that produce high winds, such as tornados and hurricanes. In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC ~~/NSSA~~-500.



Photo courtesy of sshepard/iStock/Getty Images Plus/ Getty Images

Exterior of storm shelter.



ICC 500.



Photo courtesy of Lex20/iStock/Getty Images Plus/ Getty Images

Single-family storm shelter.

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R323.1.1 Sealed documentation. The construction documents for all structural components and impact protective systems of the storm shelter shall be prepared and sealed by a registered design professional indicating that the design meets the criteria of ICC-500.

Exception: Storm shelters, structural components and impact-protective systems that are listed and labeled to indicate compliance with ICC-500.

CHANGE SIGNIFICANCE: Impact-protective systems of structures intended as residential storm shelters have failed prematurely when they do not meet the testing requirements of ICC 500 *Standard for the Design and Construction of Storm Shelters*. In some cases, the structures have been placed above ground where they were not designed for loads created by tornadoes or hurricanes. Reports of failures associated with residential storm shelters that are not designed and constructed in accordance with ICC 500 underscore the importance of these new provisions.

Failures have not occurred in residential shelters engineered and certified as residential storm shelters. The provisions of ICC 500 cannot be met by prescriptive methods in the IRC and require the expertise of a registered design professional.

Section R323.1 requires that storm shelters comply with ICC 500. By adding a definition of a storm shelter to the IRC, adding a requirement in Section R106, Construction documents, for details required by ICC 500 and a requirement for sealed plans providing structural and impact protection system design, these shelters should withstand tornadoes or hurricanes keeping deaths and injuries to a minimum. The exception in Section R323.1.1 allows listed and labelled shelter designs to be submitted without an individual design as these shelters have a third-party review process checking the design's resistance to high wind loads and impacts.

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R324.3

Photovoltaic Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: Building-integrated photovoltaic (BIPV) systems meeting the specified criteria do not require firefighter access pathways and setbacks.

2021 CODE: **R324.3 Photovoltaic systems.** Photovoltaic systems shall be designed and installed in accordance with Sections R324.3.1 through R324.7.1~~, NFPA 70~~ and the manufacturer's installation instructions. The electrical portion of solar PV systems shall be designed and installed in accordance with NFPA 70.

R324.3.1 Equipment listings. Photovoltaic panels and modules shall be listed and labeled in accordance with UL 1703 or with both UL 61730-1 and UL 61730-2. Inverters shall be listed and labeled in accordance with UL 1741. Systems connected to the utility grid shall use inverters listed for utility interaction. Mounting systems listed and labeled in accordance with UL 2703 shall be installed in accordance with the manufacturer's installation instructions and their listings.

R324.5 Building-integrated photovoltaic systems. Building-integrated photovoltaic (BIPV) systems that serve as roof coverings shall be designed and installed in accordance with Section R905.

R324.5.1 Photovoltaic shingles. Photovoltaic shingles shall comply with Section R905.16.

R324.5.2 Fire classification. Building-integrated photovoltaic systems shall have a fire classification in accordance with Section R902.3.

R324.5.3 BIPV roof panels. BIPV roof panels shall comply with Section R905.17.

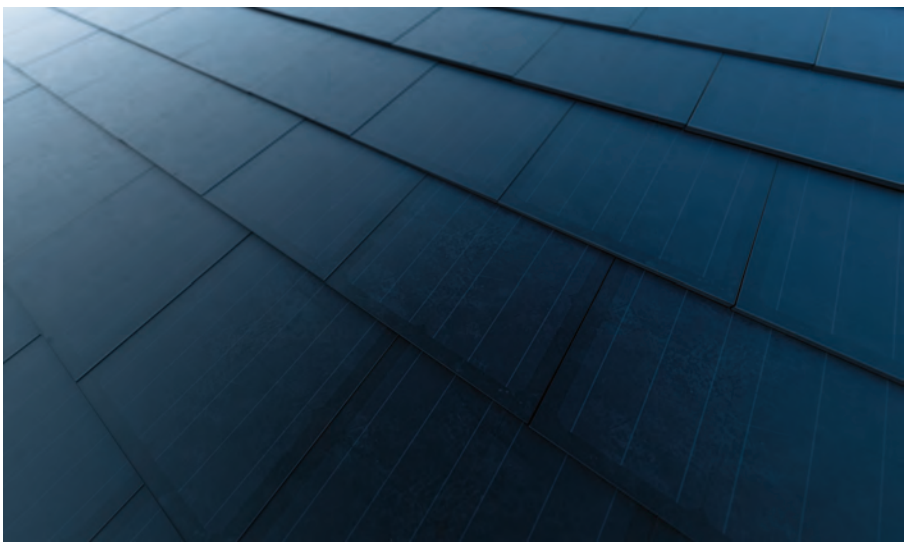


Photo courtesy of Petmal/iStock/Getty Images Plus/ Getty Images

Building-integrated photovoltaic system.

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R324.6 Roof access and pathways. Roof access, pathways and setback requirements shall be provided in accordance with Sections R324.6.1 through R324.6.2.1. Access and minimum spacing shall be required to provide emergency access to the roof, to provide pathways to specific areas of the roof, provide for smoke ventilation opportunity areas, and to provide emergency egress from the roof.

Exceptions:

1. Detached, nonhabitable structures, including but not limited to detached garages, parking shade structures, carports, solar trellises and similar structures, shall not be required to provide roof access.
2. Roof access, pathways and setbacks need not be provided where the code official has determined that rooftop operations will not be employed.
3. These requirements shall not apply to roofs with slopes of two units vertical in 12 units horizontal (17-percent slope) or less.
4. BIPV systems listed in accordance with Section 690.12(B) (2) of NFPA 70, where the removal or cutting away of portions of the BIPV system during firefighting operations have been determined to not expose a firefighter to electrical shock hazards.

~~R324.6.2.2~~ R324.6.3 Emergency escape and rescue openings. Panels and modules installed on dwellings shall not be placed on the portion of a roof that is below an emergency escape and rescue opening. A pathway not less than 36 inches (914 mm) wide shall be provided to the emergency escape and rescue opening.

Exception: BIPV systems listed in accordance with Section 690.12(B)(2) of NFPA 70, where the removal or cutting away of portions of the BIPV system during firefighting operations have been determined to not expose a firefighter to electrical shock hazards.

R905.16.4 Material standards. Photovoltaic shingles shall be listed and labeled in accordance with UL ~~1703~~ 7103 or with both UL 61730-1 and UL 61730- 2.

R905.17.5 Material standards. BIPV roof panels shall be listed and labeled in accordance with UL ~~1703~~ 7103 or with both UL 61730-1 and UL 61730-2.

CHANGE SIGNIFICANCE: Photovoltaic (PV) solar energy systems offer property owners the ability to generate their own electricity and, in many cases, sell excess electricity back to the utility provider. These PV systems have proliferated in recent years and are now commonly seen on rooftops of residential buildings in many areas of the country.

The roof access and pathway provisions for firefighters first appeared in the 2018 IRC. Access, pathways and ridge setbacks are provided so firefighters can perform manual ventilation by cutting one or more holes in a building roof and other rooftop activities as necessary. The provisions do not apply to detached garages and similar buildings or to dwellings with

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low-slope roofs of 2:12 or less. There is also a provision that exempts dwellings where the building official has determined that the fire department will not perform rooftop operations for that property.

The technology of solar roofs has been advancing with new materials and methods, particularly in the area of BIPV systems. Unlike conventional PV panel systems mounted above the roof surface, BIPV systems are integrated into the finished roof surface, and do not present significant trip hazards or physical obstacles to equipment. There are BIPV systems available today that have been shown through testing to not present electrical hazards to firefighters even when cutting into them during ventilation operations. The code now recognizes these safety features in two new exceptions to the firefighter access and occupant emergency escape rooftop pathways. Where listed to the recognized standard that determines that the BIPV materials do not expose a firefighter to electrical shock hazards including during cutting operations, the requirement to provide for access and pathways has been deleted. Similarly, a clear pathway is no longer required below an emergency escape and rescue opening where these BIPV systems are installed. The BIPV is the roof surface that provides the walking surface similar to other conventional roofing materials.

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R326

Habitable Attics

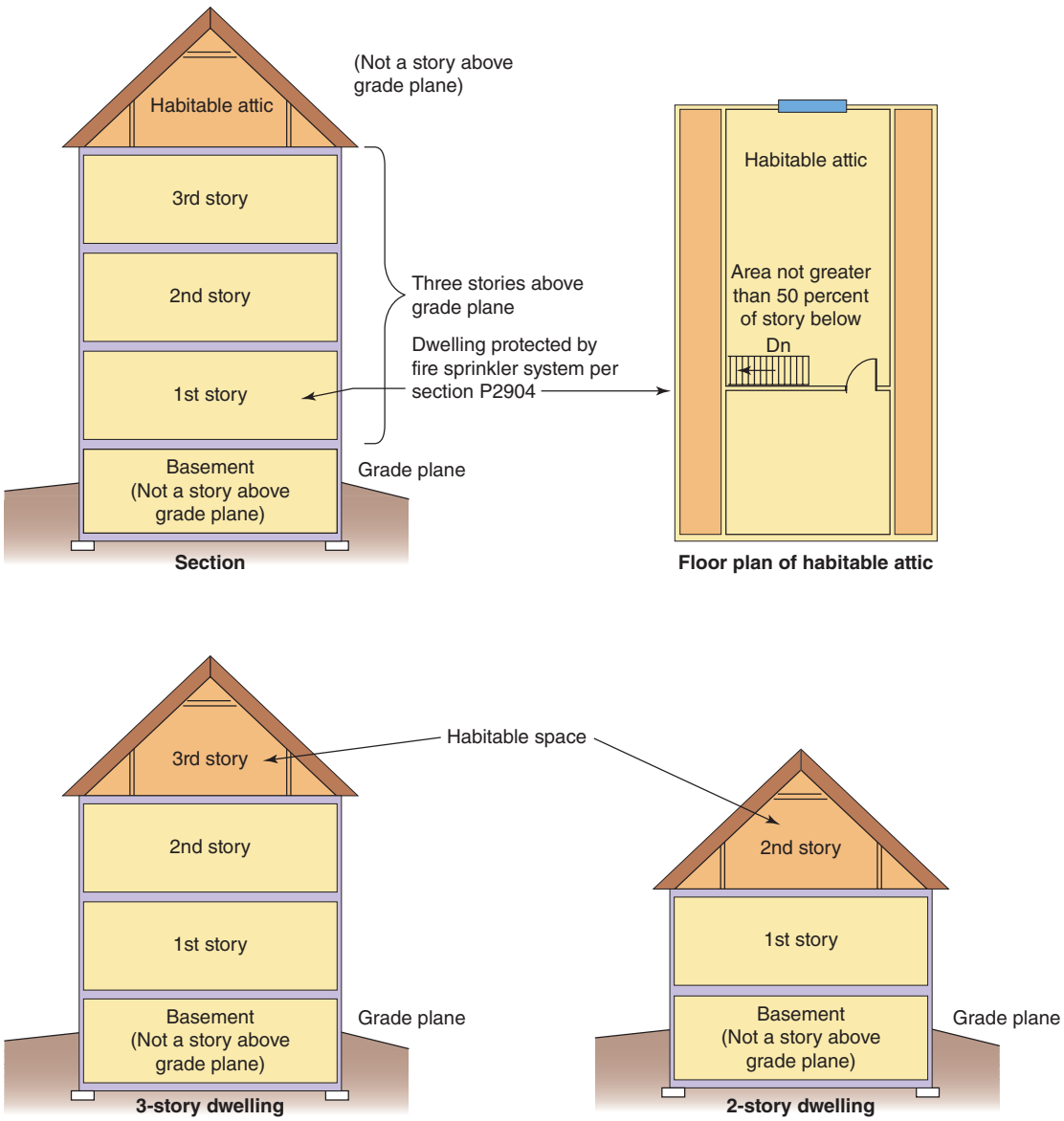
CHANGE TYPE: Modification

CHANGE SUMMARY: The habitable attic provisions have been placed in new Section R326 and new restrictions limit their area and require an automatic fire sprinkler system.

2021 CODE: **R325.1 General.** Mezzanines shall comply with Sections R325 through R325.5. ~~Habitable attics shall comply with Section R325.6.~~

~~**R325.6 Habitable attic.** A habitable attic shall not be considered a story where complying with all of the following requirements:~~

~~1. The occupiable floor area is not less than 70 square feet (17 m), in accordance with Section R304.~~



Dwellings meeting the IRC limit of 3 stories above grade plane.

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~~2. The occupiable floor area has a ceiling height in accordance with Section R305.~~

~~3. The occupiable space is enclosed by the roof assembly above, knee walls (if applicable) on the sides and the floor-ceiling assembly below.~~

~~4. The floor of the occupiable space shall not extend beyond the exterior walls of the floor below.~~

SECTION R326
HABITABLE ATTICS

R326.1 General. Habitable attics shall comply with Sections R326.2 and R326.3.

R326.2 Minimum Dimensions. A habitable attic shall have a floor area in accordance with Section R304 and a ceiling height in accordance with Section R305.

R326.3 Story Above Grade Plane. A habitable attic shall be considered a story above grade plane.

Exception: A habitable attic shall not be considered to be a story above grade plane provided that the habitable attic meets all of the following:

1. The aggregate area of the habitable attic is either of the following:
   1.1 Not greater than one-third of the floor area of the story below.
   1.2 Not greater than one-half of the floor area of the story below where the habitable attic is located within a dwelling unit equipped with a fire sprinkler system in accordance with Section P2904.
2. The occupiable space is enclosed by the roof assembly above, knee walls, if applicable, on the sides and the floor-ceiling assembly below.
3. The floor of the habitable attic does not extend beyond the exterior walls of the story below.
4. Where a habitable attic is located above a third story, the dwelling unit or townhouse unit shall be equipped with a fire sprinkler system in accordance with Section P2904.

R326.4 Means of Egress. The means of egress for habitable attics shall comply with the applicable provisions of Section R311.

CHANGE SIGNIFICANCE: The term "habitable attic" first appeared in the definitions of the 2009 edition of the IRC. Although finishing off habitable space in an attic was not unheard of, the origin of the term "habitable attic" is unclear and it may have been created for use in the IRC. By definition, an "attic" is unfinished space, and it is not considered to be occupiable or habitable. The only purpose for introducing the term "habitable attic" was to add another usable level to a dwelling constructed under the IRC in addition to the maximum height in stories prescribed by the code. Since its introduction, a habitable attic has not been considered

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a story and has been permitted in addition to the maximum three stories above grade plane as allowed by the scope of the code. Where a dwelling or townhouse had a basement that was not a story above grade plane, identifying the top level as a habitable attic in addition to the three stories above grade plane created five usable or habitable levels. This has been a design option to benefit the designer, builder and property owner in constructing taller buildings under the IRC. There is at least a perceived advantage to building under the IRC as opposed to the IBC. Perhaps the biggest issue comes down to the installation of a fire sprinkler system, which is required in both model codes. The sprinkler provisions of the IRC have been amended out of local ordinances in many parts of the United States. Where a builder perceived an advantage to building under the IRC provisions rather than those of the IBC, a habitable attic may have provided that flexibility.

In most parts of the country, three-story houses are unusual and those exceeding three stories are rarer still. However, in some urban areas of the country, space for new construction is limited and it is desirable to build a taller building (or add to the height of an existing building) on a smaller footprint.

In the code editions since the 2009 IRC, the rules for a habitable attic have remained consistent and changes have been mostly editorial. Technical requirements have been removed from the definition and placed in a section near the end of Chapter 3. The space has had to meet the minimum room area and ceiling height for habitable spaces and be enclosed by the roof assembly and floor/ceiling assembly of the attic. The code has also required habitable attics to have a smoke alarm and an emergency escape and rescue opening.

Concern was expressed that the added habitable space above the third story creates a fire- and life-safety hazard for occupants because of the height above fire department access and the maximum reach of standard 35-foot extension ladders that may be used in a fire department response. Discussion has also centered around the differences between the IRC and IBC. The IBC does not have provisions for a "habitable attic." As in the IRC, an "attic" in the IBC is unfinished and is not occupiable or habitable space. If the attic is converted to habitable space, it is no longer an attic but becomes habitable space on another story because it then meets the definition of story. The addition of habitable attic in the 2009 IRC was purposeful in that it was adding an option to the IRC to avoid being under the scope of the IBC. There was no intent for the provisions in the two codes to match.

New to the 2021 IRC, Section R326.3 states that a habitable attic is a story above grade plane. The exceptions retain the concept of a habitable attic being allowed above the third story and not being considered a story above grade plane with further restrictions. This option is available only if the dwelling unit is protected with a fire sprinkler system in accordance with Section P2904 or NFPA 13D, and the "aggregate" area of the habitable attic does not exceed one-half of the area of the story below. These additional requirements are thought to mitigate the life-safety concerns for occupants in these taller buildings.

The limitation on "aggregate" area for a habitable attic is borrowed from the mezzanine provisions (which also have very limited use under the IRC but, like habitable attics, may be used to build taller buildings since they are not considered a story). Unlike mezzanines, attics typically match the area of the story below. Presumably the intent, though not

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stated, is that this 50 percent limitation only applies to the habitable area of the attic and that "aggregate" means the combined area of habitable space on that level. For example, storage areas and areas that do not meet the minimum ceiling height requirements are not considered habitable space and would not be included in the 50 percent calculation. On the other hand, the area of the story below would include both habitable space and other spaces for calculation purposes. Exception 1.1 (one-third area limitation) has no application because it applies to a building without fire sprinklers and sprinklers are required in all cases where a habitable attic is above the third story and is not considered a story. This conflict occurs because there were multiple public comments to the initial code change proposal that were approved at the public comment hearings.

The new code language presents the option to call habitable space in the attic above a one-story or two-story house a "habitable attic" but there is no advantage to doing so as a design option. As in previous editions of the IRC, including the editions before the term habitable attic was introduced to the code, and as is done in the IBC, when an attic of a one- or two-story house is finished into habitable space, it is no longer an attic and becomes habitable space. Whether or not it is considered a story is no longer an issue.

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PART 3

Building Construction

Chapters 4 through 10

- **Chapter 4** Foundations
- **Chapter 5** Floors
- **Chapter 6** Wall Construction
- **Chapter 7** Wall Covering
- **Chapter 8** Roof-Ceiling Construction
- **Chapter 9** Roof Assemblies
- **Chapter 10** Chimneys and Fireplaces

No changes addressed

Chapters 4 through 10 address the prescriptive methods for building foundations, floor construction, wall construction, wall coverings, roof construction, roof assemblies, chimneys, and fireplaces. Concrete, masonry, and wood foundations; retaining walls; supporting soil properties; surface drainage; and foundation dampproofing and drainage are found in Chapter 4. Chapters 5, 6, and 8 contain the construction provisions for floors and decks, walls, and roofs, respectively, with most of the provisions addressing light-frame construction. Chapter 7 addresses interior finishes, such as drywall and plaster installations, and exterior wall coverings, including water-resistive barriers, flashings, siding, and veneer, to provide a durable weather-resistant exterior. Chapter 9 covers the various waterproof roof assemblies, including roofing underlayment, roof eave ice barrier, flashings, asphalt shingles, and other roof coverings. Site-built masonry fireplaces and chimneys as well as prefabricated fireplaces and chimneys, including their weather-tight roof terminations, are addressed in the provisions of Chapter 10. ■

TABLE R403.1(1)
Footings Below Light-Frame Construction

R406.2
Foundation Waterproofing

R408.8
Vapor Retarder in Crawlspaces

R506.2.3
Vapor Retarders Under Concrete Slabs

R507
Deck Loads

R507.3
Deck Footings

R507.4
Deck Posts

R507.5
Deck Beams

R507.6
Deck Joists

R507.7
Decking

R507.10
Exterior Guards

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TABLE R602.3(1)
Fasteners – Roof and Wall

TABLE R602.3(1)
Fasteners – Roof Sheathing

TABLE R602.3(2)
Alternate Attachments

R602.9
Cripple Walls

R602.10.1.2
Location of Braced Wall Lines

R602.10.2.2
Location of Braced Wall Panels (BWPs)

R602.10.3(1)
Bracing for Winds

TABLE R602.10.3(3)
Seismic Wall Bracing

TABLE R602.10.3(4)
Adjustment Factors – Seismic

R602.10.6.5
Stone and Masonry Veneer

R609.4.1
Garage Doors

R702.7
Vapor Retarders

R703.2, R703.7.3
Water-Resistive Barriers

TABLE R703.8.4(1)
Veneer Attachment

R703.11.2
Vinyl Siding Installation Over Foam Plastic Sheathing

R704
Soffits

R802
Wood Roof Framing

TABLE R802.5.2(1)
Heel Joint Connections

R802.6
Rafter and Ceiling Joist Bearing

TABLE R804.3
CFS Roof Framing Fasteners

R905.4.4.1
Metal Roof Shingle Wind Resistance

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Table R403.1(1)

Footings Below Light-Frame Construction

CHANGE TYPE: Modification

CHANGE SUMMARY: Tables R403.1(1), (2) and (3) are revised to more accurately reflect current practice.

2021 CODE TEXT:

TABLE R403.1(1) Minimum Width and Thickness for Concrete Footings for Light-Frame Construction (inches) [a, b, c, d]

Ground Snow Load or Roof Live Load	Story and Type of Structure with Light Frame	Load Bearing Value of Soil (psf)					
		1500	2000	2500	3000	3500	4000
20 psf Roof Live Load or 25 psf Ground Snow Load	1 story - slab on grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - with crawl space	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - plus basement	16 × 6 / ~~18 × 6~~	12 × 6 / ~~14 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - slab on grade	13 × 6 / ~~12 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - with crawl space	15 × 6 / ~~16 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - plus basement	19 × 6 / ~~22 × 6~~	14 × 6 / ~~16 × 6~~	12 × 6 / ~~13 × 6~~	12 × 6	12 × 6	12 × 6
	3 story - slab on grade	16 × 6 / ~~14 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story - with crawl space	18 × 6 / ~~19 × 6~~	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story - plus basement	22 × 7 / ~~25 × 8~~	16 × 6 / ~~19 × 6~~	13 × 6 / ~~15 × 6~~	12 × 6 / ~~13 × 6~~	12 × 6	12 × 6
30 psf	1 story - slab on grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - with crawl space	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - plus basement	16 × 6 / ~~19 × 6~~	12 × 6 / ~~14 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - slab on grade	13 × 6 / ~~12 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - with crawl space	16 × 6 / ~~17 × 6~~	12 × 6 / ~~13 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - plus basement	19 × 6 / ~~23 × 6~~	14 × 6 / ~~17 × 6~~	12 × 6 / ~~14 × 6~~	12 × 6	12 × 6	12 × 6
	3 story - slab on grade	16 × 6 / ~~15 × 6~~	14 × 6 / ~~12 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	3 story - with crawl space	19 × 6 / ~~20 × 6~~	14 × 6 / ~~15 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	3 story - plus basement	22 × 7 / ~~26 × 8~~	16 × 6 / ~~20 × 6~~	13 × 6 / ~~16 × 6~~	12 × 6 / ~~13 × 6~~	12 × 6	12 × 6

(*continues*)

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TABLE R403.1(1) (*continued*)

Ground Snow Load or Roof Live Load	Story and Type of Structure with Light Frame	Load Bearing Value of Soil (psf)					
		1500	2000	2500	3000	3500	4000
50 psf	1 story - slab on grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - with crawl space	14 × 6 ~~16 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - plus basement	18 × 6 ~~21 × 6~~	13 × 6 ~~16 × 6~~	12 × 6 ~~13 × 6~~	12 × 6	12 × 6	12 × 6
	2 story - slab on grade	15 × 6 ~~14 × 6~~	13 × 6 ~~12 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - with crawl space	17 × 6 ~~19 × 6~~	13 × 6 ~~14 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - plus basement	21 × 7 ~~25 × 7~~	15 × 6 ~~19 × 6~~	12 × 6 ~~15 × 6~~	12 × 6	12 × 6	12 × 6
	3 story - slab on grade	18 × 6 ~~17 × 6~~	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story - with crawl space	20 × 6 ~~22 × 6~~	15 × 6 ~~17 × 6~~	12 × 6 ~~13 × 6~~	12 × 6	12 × 6	12 × 6
	3 story - plus basement	24 × 8 ~~28 × 9~~	18 × 6 ~~21 × 6~~	14 × 6 ~~17 × 6~~	12 × 6 ~~14 × 6~~	12 × 6	12 × 6
70 psf	1 story - slab on grade	14 × 6 ~~12 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - with crawl space	16 × 6 ~~18 × 6~~	12 × 6 ~~13 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	1 story - plus basement	19 × 6 ~~24 × 7~~	14 × 6 ~~18 × 6~~	12 × 6 ~~14 × 6~~	12 × 6	12 × 6	12 × 6
	2 story - slab on grade	17 × 6 ~~16 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story - with crawl space	19 × 6 ~~21 × 6~~	14 × 6 ~~16 × 6~~	12 × 6 ~~13 × 6~~	12 × 6	12 × 6	12 × 6
	2 story - plus basement	22 × 7 ~~27 × 9~~	17 × 6 ~~20 × 6~~	13 × 6 ~~16 × 6~~	12 × 6 ~~14 × 6~~	12 × 6	12 × 6
	3 story - slab on grade	20 × 6 ~~19 × 6~~	15 × 6 ~~14 × 6~~	12 × 6	12 × 6	12 × 6	12 × 6
	3 story - with crawl space	22 × 7 ~~25 × 7~~	16 × 6 ~~18 × 6~~	13 × 6 ~~15 × 6~~	12 × 6	12 × 6	12 × 6
	3 story - plus basement	24 × 8 ~~30 × 10~~	19 × 6 ~~23 × 6~~	15 × 6 ~~18 × 6~~	13 × 6 ~~15 × 6~~	12 × 6 ~~13 × 6~~	12 × 6

a. ~~Interpolation allowed.~~ Linear interpolation of footing width is permitted between the soil bearing pressures in the table. Extrapolation is not ~~allowed~~ permitted.

b. ~~Based on 32-foot-wide house with load-bearing center wall that carries half of the tributary attic, and floor framing. For every 2 feet of adjustment to the width of the house, add or subtract 2 inches of footing width and 1 inch of footing thickness (but not less than 6 inches thick).~~ The table is based on the following conditions and loads: Building width: 32 feet; Wall height: 9 feet; Basement wall height: 8 feet; Dead loads: 15 psf roof and ceiling assembly, 10 psf floor assembly, 12 psf wall assembly; Live loads: Roof and ground snow loads as listed, 40 psf first floor, 30 psf second and third floors. Footing sizes are calculated assuming a clear span roof/ceiling assembly and an interior bearing wall or beam at each floor.

c. Where the building width perpendicular to the wall footing is greater than 32 feet, the footing width shall be increased by 2 inches and footing depth shall be increased by 1 inch for every 4 feet of increase in building width.

(*continues*)

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TABLE R403.1(1) (*continued*)

d. Where the building width perpendicular to the wall footing is less than 32 feet, a 2 inch decrease in footing width and 1 inch decrease in footing depth is permitted for every 4 feet of decrease in building width, provided the minimum width is 12 inches (304.8 mm) and minimum depth is 6 inches (152.4 mm).

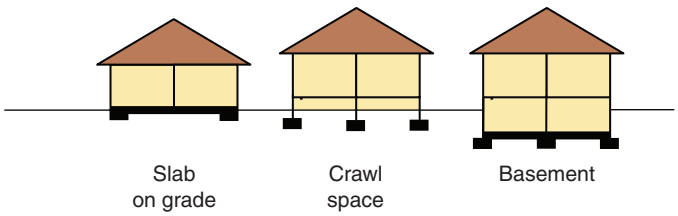


TABLE R403.1(2) Minimum Width and Thickness for Concrete Footings for Light-Frame Construction with Brick Veneer or Lath And Plaster (inches)[a, b, c, d]

GROUND SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH BRICK VENEER	LOAD-BEARING VALUE OF SOIL (psf)					
		1500	2000	2500	3000	3500	4000

TABLE R403.1(3) Minimum Width and Thickness for Concrete Footings with Cast-In-Place Concrete or ~~Fully~~ Partially Grouted Masonry Wall Construction (inches)[a, b, c, d]

GROUND SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH CMU OR CONCRETE	LOAD-BEARING VALUE OF SOIL (psf)					
		1500	2000	2500	3000	3500	4000

(For changes to Tables R403.1(2) and R403.1(3) please see the 2021 IRC)

CHANGE SIGNIFICANCE: Designers using Tables R403.1(1), (2) or (3), minimum width and thickness for concrete footings, introduced in the 2015 *International Residential Code* (IRC), have found in certain instances footing widths required by the table to be different than those required by previous editions of the IRC. In fact, due to conservative assumptions for the tables, some footing widths were wider than an engineering analysis



Stem wall and interior footings.

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would suggest necessary. A review of underlying calculations found minimum widths and thicknesses where load assumptions were incorrect. Therefore, changes to the tables were proposed for the *2021 International Residential Code*.

Revised assumptions and calculations for concrete footing tables include the following:

1. Application of roof snow load rather than ground snow load to the roof. The actual roof snow load per ASCE 7, unadjusted by any other factors, is 70 percent of the ground snow load or 20 pounds per square foot, whichever is greater. Consistent with Chapter 8 rafter tables, a thermal factor (C_t) of 1.1 per ASCE 7 is also applied to roof snow load calculations.
2. A 100-pound per square foot (psf) load was previously used for above-grade concrete or masonry walls, representing a solid or fully grouted 8-inch CMU wall. Such walls are more likely to be either 8-inch CMU grouted at 48 inches on center or 8-inch insulated concrete forms, both of which impose only a 55 pound per square foot load. This change affects Table R403.1(3) for footings under above-grade concrete or CMU walls.
3. Previous calculations used the ASCE 7 load combination applying a 0.75 factor for concurrent roof/snow and floor live loads, ignoring load combinations that apply to just a roof/attic live load, just a snow load, or just a floor live load. These additional load combinations apply for a single-story building and for interior footings.
4. Calculations were formerly based on tributary width, yet footnote b added 2 inches of footing width for every 2 feet of additional building width. For a building with interior concrete footings, the tributary width is half the distance between footings, not half the entire building width. As a result of confusing building and tributary width, footnote b potentially doubled the additional footing width for buildings wider than 32 feet.

In many cases, revised footing widths in the 2021 IRC are more consistent with historic practice, while still technically justified under engineering standards and accepted practices. There are a few cases for houses on weaker soils (1500 psf and 2000 psf soil bearing strength) with slab-on-grade or crawlspace foundations, where a revised assumption of clear-spanning roof trusses led to a slight increase to footing widths.

Footnote b allowing adjustment of footing width and depth is now divided into two footnotes. Footnote c requires an increase in footing width and depth when the building width perpendicular to a wall footing exceeds 32 feet. Footnote d permits, but does not require, a decrease in footing width and depth for a building width narrower than 32 feet.

Example: Footing Size with Variable Building Width

A single-family home has the following attributes:

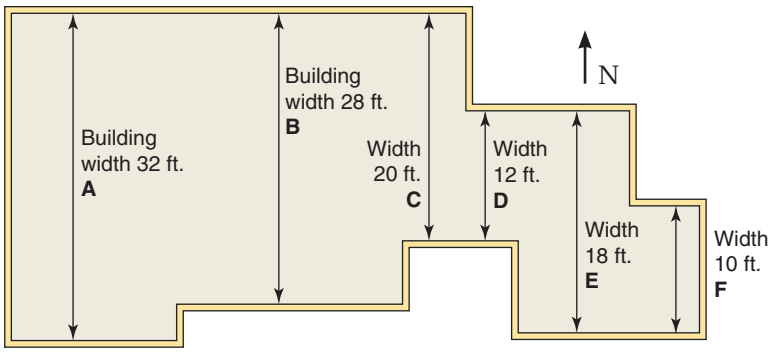
- Two-story
- Gable roof
- Crawl space foundation
- Thirty psf ground snow load

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- 1500 psi soil capacity assumed
- Building width varies between 12 and 32 feet
- Clear-span trusses at 24 inches on center
- Center-bearing floors



For building widths A – F, the tributary length is:

A. Tributary length = 16 ft
B. Tributary length = 14 ft
C. Tributary length = 10 ft
D. Tributary length = 6 ft
E. Tributary length = 9 ft
F. Tributary length = 5 ft

For building widths A–F, the worst case footing size is a 16 × 6 footing for a 32-foot building width. The footing could be reduced to 12 × 6 where applicable on the north and south walls of the building.

Footings support building loads which include the weight of the building (dead loads), live loads (people and furnishings) and environmental loads, for example snow. Exterior bearing walls carry roof loads based on an assumption of a clear-span roof, such as a truss, which means the roof's tributary area is calculated based on half the building width. With an assumption of a center-bearing wall or beam carrying the load from floor joists or trusses, the tributary area for floors is based on one-quarter of the building width.

Gable-end exterior walls carry only the weight of nonload-bearing walls and the roof load from one-half of the truss or rafter spacing. In the example, the truss spacing is 24 inches on-center so the roof load tributary width is only 1 foot. Gable-end walls will typically never need more than the 12 × 6 minimum footing size.

For a hip roof, it is reasonable to measure the building width perpendicular to the wall from the peak of the hip (where it connects to the ridge) to the end wall—in other words, the length of the longest hip truss or rafter.

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R406.2

Foundation Waterproofing

CHANGE TYPE: Deletion

CHANGE SUMMARY: Six-mil polyvinyl chloride and polyethylene fabrics are removed from the list of approved waterproofing materials.

2021 CODE TEXT: **R406.2 Concrete and masonry foundation waterproofing.** In areas where a high water table or other severe soil-water conditions are known to exist, exterior foundation walls that retain earth and enclose interior spaces and floors below grade shall be waterproofed from the higher of (a) the top of the footing or (b) 6 inches (152 mm) below the top of the basement floor, to the finished grade. Walls shall be waterproofed in accordance with one of the following:

1. Two-ply hot-mopped felts.
2. Fifty-five-pound (25 kg) roll roofing.
3. ~~Six-mil (0.15 mm) polyvinyl chloride.~~
4. ~~Six-mil (0.15 mm) polyethylene.~~
5. Forty-mil (1 mm) polymer-modified asphalt.
6. Sixty-mil (1.5 mm) flexible polymer cement.



Photo courtesy of corridor91/iStock/Getty Images Plus/Getty Images

Approved waterproofing material.

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7. One-eighth inch (3 mm) cement-based, fiber-reinforced, waterproof coating.
8. Sixty-mil (1.5 mm) solvent-free liquid-applied synthetic rubber.

All joints in membrane waterproofing shall be lapped and sealed with an adhesive compatible with the membrane.

Exception: Organic-solvent-based products such as hydrocarbons, chlorinated hydrocarbons, ketones and esters shall not be used for ICF walls with expanded polystyrene form material. Use of plastic roofing cements, acrylic coatings, latex coatings, mortars and pargings to seal ICF walls is permitted. Cold-setting asphalt or hot asphalt shall conform to Type C of ASTM D449. Hot asphalt shall be applied at a temperature of less than 200°F (93°C).

CHANGE SIGNIFICANCE: Waterproofing is the formation of a durable and impervious barrier designed to prevent water from entering a specific building envelope section, generally the foundation. To be effective, a waterproofing system consists of durable and continuous materials applied to all foundation areas that will be subjected to ground water. During backfill, materials containing debris, frost, sharp stones or rocks may scrape along the foundation tearing thinner waterproofing materials.

Section R406.2 is amended by deleting Items 3 and 4 from the list of approved products that can be used as a waterproofing material. Six-mil polyvinyl chloride and polyethylene products have not proven to possess the thickness or strength to be effective and durable in this application. These materials are likely to rip or tear allowing water behind the waterproofing material, trapping moisture behind undamaged fabric and potentially creating issues for the building interior.

Other products approved as waterproofing materials are made of heavier materials more resistant to damage or displacement during backfill, with minimum 1/8-inch or 40-mil (approximately 3/64-inch) thickness.

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R408.8

Vapor Retarder in Crawlspaces

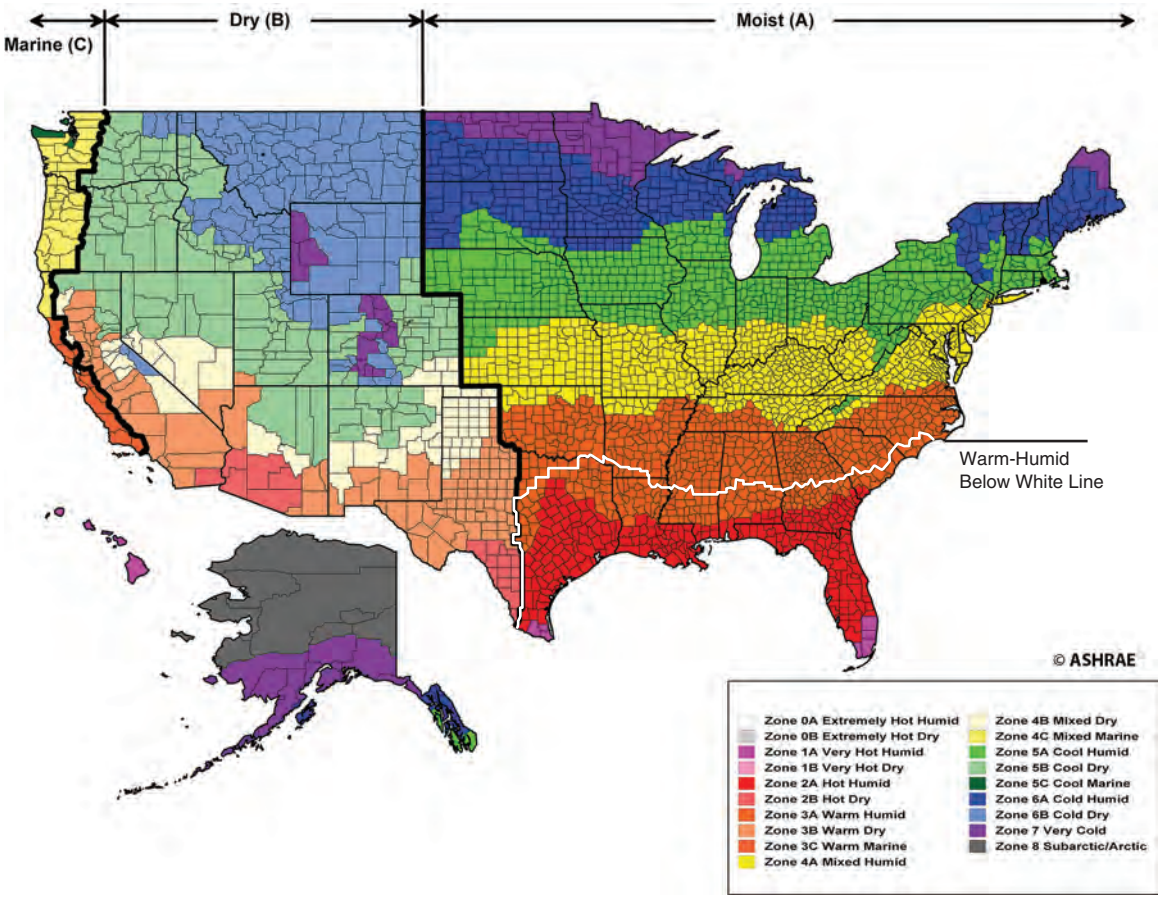
CHANGE TYPE: Addition

CHANGE SUMMARY: Where exposed to grade in a crawl space, a Class I or II vapor retarder is required on exposed air permeable insulation between floor joists in Climate Zones 1A, 2A and 3A.

2021 CODE TEXT: **R408.8 Under-floor vapor retarder.** In Climate Zones 1A, 2A, and 3A below the warm-humid line, a continuous Class I or II vapor retarder shall be provided on the exposed face of air permeable insulation installed between the floor joists and exposed to the grade in the under-floor space. The vapor retarder shall have a maximum water vapor permeance of 1.5 perms when tested in accordance with Procedure B of ASTM E96.

Exception: The vapor retarder shall not be required in unvented crawl spaces constructed in accordance with Section R408.3.

CHANGE SIGNIFICANCE: New Section R408.8 addresses issues with moisture accumulation in floors above vented crawl spaces in warm-humid climates. Water vapor migrating from vented crawl spaces or post and beam foundations toward cooler and drier indoor spaces may cause mold, mildew and decay within floor assemblies, especially where



Locations where vapor retarder is required under floor joists.

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an impermeable floor covering or underlayment is used, as moisture can condense and be trapped within the wood subfloor. Such moisture problems have been observed even where crawl spaces are constructed in accordance with the IRC, with properly sized and located ventilation openings.

This section requires a Class I or Class II vapor retarder on the exposed face of air-permeable insulation materials installed between floor framing members above the crawl space. The vapor retarder can be a separate layer of material or incorporated as part of the insulation. Examples include foil facing on fiberglass batts, polyisocyanurate rigid foam, or a 6-mil polyethylene sheet applied over permeable insulation along the base of floor joists, I-joists or trusses.

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R506.2.3

Vapor Retarders Under Concrete Slabs

CHANGE TYPE: Modification

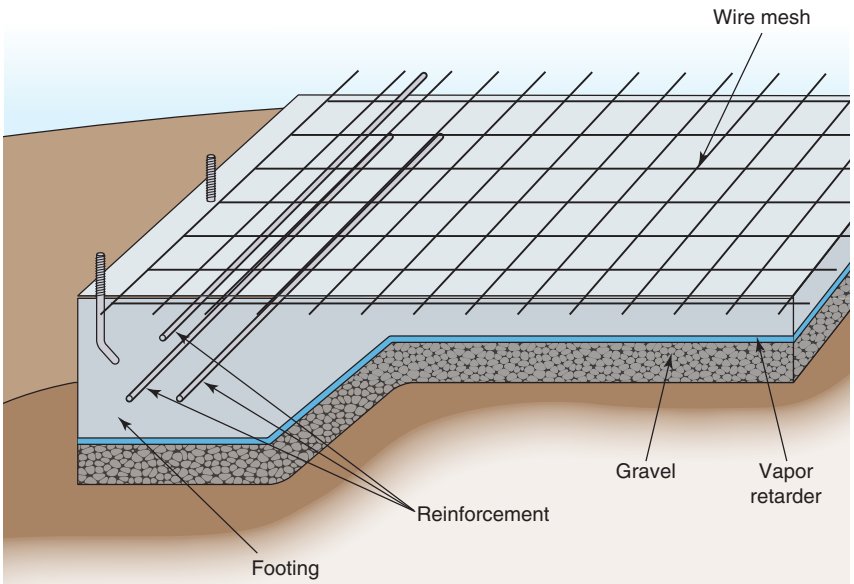
CHANGE SUMMARY: Thicker vapor retarders are now required below slabs-on-grade.

2021 CODE TEXT: **R506.2.3 Vapor retarder.** A minimum ~~6-mil~~ 10-mil (~~0.006~~ 0.010 inch; ~~152 µm~~ 0.254 mm) ~~polyethylene or approved~~ vapor retarder conforming to ASTM E1745 Class A requirements with joints lapped not less than 6 inches (152 mm) shall be placed between the concrete floor slab and the base course or the prepared subgrade where a base course does not exist.

Exception: The vapor retarder is not required for the following:

1. Garages, utility buildings and other unheated accessory structures.
2. For unheated storage rooms having an area of less than 70 square feet (6.5 m) and carports.
3. Driveways, walks, patios and other flatwork not likely to be enclosed and heated at a later date.
4. Where approved by the building official, based on local site conditions.

CHANGE SIGNIFICANCE: Water vapor migrating from the ground into spaces such as vented crawlspaces and open foundation systems or through concrete slabs on ground toward cooler and drier indoor spaces may cause mold, mildew and decay, as condensed moisture is trapped indoors. Thin membranes on the ground can be torn during construction allowing moisture to migrate up into the house.



Vapor retarder laid between subgrade and concrete.

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Section R506.2.3 requires a vapor retarder between a concrete slab and the top of underlying soil or gravel. The vapor retarder is now required to be a minimum of 10-mil thickness and may be any material that meets ASTM E1745 Class A requirements. The greater thickness offers increased resistance to moisture transmission and provides increased durability during and after installation.

The updated minimum vapor retarder requirements now meet American Concrete Institute (ACI) recommendations as well. ACI 302.1, *Guide to Concrete Floor and Slab Construction*, requires a below slab vapor retarder to meet the requirements of ASTM E1745, *Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs*.

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R507
Deck Loads

CHANGE TYPE: Modification

CHANGE SUMMARY: Deck design is now based on live and snow loads.

2021 CODE TEXT: **R507.1 Decks.** Wood-framed decks shall be in accordance with this section. Decks shall be designed for the live load required in Section R301.5 or the ground snow load indicated in Table R301.2, whichever is greater. For decks using materials and conditions not prescribed in this section, refer to Section R301.

CHANGE SIGNIFICANCE: *International Residential Code* (IRC) prescriptive deck provisions historically have only assumed a 40 psf live load and 10 psf dead load for all components in the deck. However, a significant portion of the population in the United States lives in areas where the ground snow load exceeds the live load in Table R301.5, Minimum Uniformly Distributed Live Loads.

For the 2021 IRC, a deck is now either designed for a 40 pounds per square foot (psf) live load or for the ground snow load listed in a jurisdiction's table of climatic and geographic design criteria (Table R301.2). This



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Snow on deck.

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requires use of whichever load is higher. Updated lumber tables consider ground snow loads of 50, 60 and 70 psf while allowing interpolation between loads.

For snow loading, an increase in wood strength is accounted for using a load duration factor from the *National Design Specification (NDS) for Wood Construction*. While deck geometry and nearby structures can cause drifting, these effects are outside the scope of IRC deck tables. Similarly, elevated decks have snow loads less than the ground snow load based on ASCE 7, but this reduction is not included to provide simpler tables.

Note that when comparing the *2021 International Building Code* (IBC) and the 2021 IRC, minimum deck live loads will be 1.5 times the associated room live load per the 2021 IBC. For a sleeping room, this will be 1.5 × 30 psf or 45 psf. For all other residential areas, the deck live load will be 1.5 × 40 psf or 60 psf. In the IRC, for decks accessed from any room, the minimum live load remains 40 psf.

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R507.3
Deck Footings

CHANGE TYPE: Modification

CHANGE SUMMARY: Clarifications are made for freestanding deck footing exceptions and a tributary area of 5 psf is added to the deck footing size table.

2021 CODE TEXT: **R507.3 Footings.** Decks shall be supported on concrete footings or other approved structural systems designed to accommodate all loads in accordance with Section R301. Deck footings shall be sized to carry the imposed loads from the deck structure to the ground as shown in Figure R507.3. ~~The footing depth shall be in accordance with Section R403.1.4.~~

~~Exception~~ Exceptions:

1. Footings shall not be required for free ~~Free~~-standing decks consisting of joists directly supported on grade over their entire length.
2. Footings shall not be required for freestanding decks that meet all of the following criteria:
   - **2.1.** The joists bear directly on precast concrete pier blocks at grade without support by beams or posts,
   - **2.2.** The area of the deck does not exceed 200 square feet (18.6 m^2),



Footings for buried pressure-treated deck posts.

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2.3. The walking surface is not more than 20 inches (508 mm) above grade at any point within 36 inches (914 mm) measured horizontally from the edge.

TABLE R507.3.1 Minimum Footing Size for Decks

LIVE OR GROUND SNOW LOAD[b] (psf)	TRIBUTARY AREA (sq. ft.)	SOIL BEARING CAPACITY[a,c,d]								
		1500[e] psf			2000[e] psf			≥ 3000[e] psf		
		Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness[f] (inches)	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness[f] (inches)	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness[f] (inches)
40	5	7	8	6	7	8	6	7	8	6
	20	10	12	6	9	9	6	7	8	6
	40	14	16	6	12	14	6	10	12	6
50	5	7	8	6	7	8	6	7	8	6
	20	11	13	6	10	11	6	8	9	6
	40	15	17	6	13	15	6	11	13	6
60	5	7	8	6	7	8	6	7	8	6
	20	12	14	6	11	12	6	9	10	6
70	5	7	8	6	7	8	6	7	8	6
	20	12	14	6	11	13	6	9	10	6

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m^2, 1 pound per square foot = 0.0479 kPa.

a. Interpolation permitted; extrapolation not permitted.
b. Based on highest load case: Dead + Live or Dead + Snow.
c. ~~Assumes minimum square footing to be 12 inches × 12 inches × 6 inches for 6 × 6 post.~~ Footing dimensions shall allow complete bearing of the post.
d. If the support is a brick or CMU pier, the footing shall have a minimum 2-inch projection on all sides.
e. Area, in square feet, of deck surface supported by post and footings.
f. Minimum thickness shall only apply to plain concrete footings.

(Deleted text not shown for clarity: values in tables that did not change are not shown for brevity.)

CHANGE SIGNIFICANCE: Footing exceptions for freestanding decks have been clarified. In the first exception, joists supported on grade do not require footings. In the second exception, a small deck low to the ground may use concrete piers as footings directly supporting deck joists (no beams or posts). The exception limits these decks to 200 square feet and a height to the top of the deck of 20 inches above grade.

Table R507.3.1, minimum footing size for decks, is expanded to offer a minimum footing size decreased from a 12-inch by 12-inch square in the 2018 IRC to a smaller 7-inch by 7-inch square or 8-inch round footing in the 2021 IRC based on a new 5 psf tributary area. The former limit of a 12-inch by 12-inch footing was significantly oversized for small areas such as stairs or landings. The smaller tributary area also allows for some precast concrete solutions for small landings and porches.

Updated footnote c clarifies that the footing must be wide enough to allow complete bearing of the post. New footnote f states that minimum footing thickness is based on plain concrete. A thinner reinforced footing may be possible with calculations.

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CHANGE TYPE: Modification

R507.4
Deck Posts

CHANGE SUMMARY: The deck post height table is expanded by adding the tributary area supported by a post and the wood species for determination of maximum post height.

2021 CODE TEXT: **R507.4 Deck posts.** For single-level ~~wood-framed~~ decks, ~~with beams sized in accordance with Table R507.5, deck~~ wood post size shall be in accordance with Table R507.4.

TABLE R507.4 Deck Post Height

Loads[b] (psf)	Post Species[c]	Post Size[d]	Tributary Area[g,h] (sq/ft.) 20	40	60	80	100	120	140	160
			Maximum Deck Post Height[a] (feet-inches)							
40 Live Load	Southern Pine	4 × 4	14-0	13-8	11-0	9-5	8-4	7-5	6-9	6-2
		4 × 6	14-0	14-0	13-11	12-0	10-8	9-8	8-10	8-2
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas Fir[e], Hem-fir[e], SPF[e]	4 × 4	14-0	13-6	10-10	9-3	8-0	7-0	6-2	5-3
		4 × 6	14-0	14-0	13-10	11-10	10-6	9-5	8-7	7-10
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	4 × 4	14-0	13-2	10-3	8-1	5-8	NP	NP	NP
		4 × 6	14-0	14-0	13-6	11-4	9-9	8-4	6-9	4-7
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	13-7	9-7
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
50 Ground Snow Load	Southern Pine	4 × 4	14-0	12-2	9-10	8-5	7-5	6-7	5-11	5-4
		4 × 6	14-0	14-0	12-6	10-9	9-6	8-7	7-10	7-3
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	13-4
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas Fir[e], Hem-fir[e], SPF[e]	4 × 4	14-0	12-1	9-8	8-2	7-1	6-2	5-3	4-2
		4 × 6	14-0	14-0	12-4	10-7	9-4	8-4	7-7	6-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	12-10
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	4 × 4	14-0	11-8	9-0	6-10	3-7	NP	NP	NP
		4 × 6	14-0	14-0	12-0	10-0	8-6	7-0	5-3	NP
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	10-8	2-4
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

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TABLE R507.4 (*continued*)

Loads[b] (psf)	Post Species[c]	Post Size[d]	Tributary Area[g,h] (sq/ft.) 20	40	60	80	100	120	140	160
			Maximum Deck Post Height[a] (feet-inches)							
60 Ground Snow Load	Southern Pine	4 × 4	14-0	11-1	8-11	7-7	6-7	5-10	5-2	4-6
		4 × 6	14-0	14-0	11-4	9-9	8-7	7-9	7-1	6-6
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	12-9	11-2
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas Fir[e], Hem-fir[e], SPF[e]	4 × 4	14-0	10-11	8-8	7-3	6-2	5-0	3-7	NP
		4 × 6	14-0	13-11	11-2	9-7	8-4	7-5	6-8	5-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	12-2	10-2
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	4 × 4	14-0	10-6	7-9	4-7	NP	NP	NP	NP
		4 × 6	14-0	13-7	10-9	8-9	7-0	4-9	NP	NP
		6 × 6	14-0	14-0	14-0	14-0	14-0	9-9	NP	NP
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
70 Ground Snow Load	Southern Pine	4 × 4	14-0	10-2	8-2	6-11	5-11	5-2	4-4	3-4
		4 × 6	14-0	12-11	10-5	8-11	7-10	7-1	6-5	5-10
		6 × 6	14-0	14-0	14-0	14-0	14-0	12-9	10-11	8-7
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas Fir[e], Hem-fir[e], SPF[e]	4 × 4	14-0	10-1	7-11	6-6	5-3	3-7	NP	NP
		4 × 6	14-0	12-10	10-3	8-9	7-7	6-8	5-10	4-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	12-2	9-9	5-9
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	4 × 4	14-0	9-5	6-5	NP	NP	NP	NP	NP
		4 × 6	14-0	12-6	9-8	7-7	5-3	NP	NP	NP
		6 × 6	14-0	14-0	14-0	14-0	10-8	NP	NP	NP
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa., NP = Not Permitted

a. Measured from the underside of the beam to the top of footing or pier.
b. 10 psf dead load. Snow load not assumed to be concurrent with live load.
c. No. 2 grade, wet service factor included.
d. Notched deck posts shall be sized to accommodate beam size in accordance with Section R507.5.2
e. Includes incising factor.
f. Incising factor not included.
g. Area, in square feet, of deck surface supported by post and footings.
h. Interpolation permitted. Extrapolation not permitted.

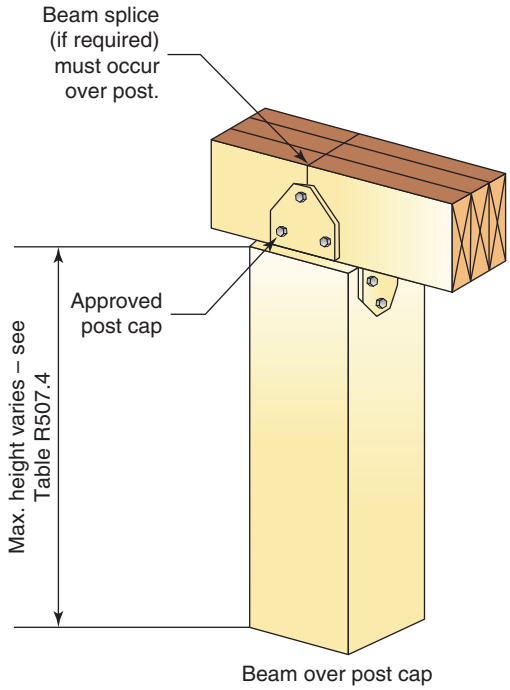
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CHANGE SIGNIFICANCE: Table R507.4, Maximum Deck Post Height, is greatly expanded to allow for a larger variety of post heights. By including consideration of tributary area supported by a post for smaller decks, porches and landings, the table allows greater heights with 4 × 4 and 4 × 6 posts. Having a maximum tributary area also defines an upper size limit for decks unless additional posts are added. Similar to deck footing size provisions, consideration for 50, 60 and 70 psf ground snow loads is

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Deck post maximum height varies.

provided. All tabulated wood species can attain the maximum post height of 14 feet with an 8 × 8 minimum nominal dimension or a maximum tributary area of 20 square feet. Southern pine, Douglas Fir, Hem-fir and Spruce-Pine-Fir posts with 6 × 6 minimum nominal dimensions can also achieve the 14-foot maximum for decks carrying a 40 psf live load.

Standard wood assumptions are shown in the footnotes. Lumber is assumed to be wet, of No. 2 grade and carry a 10 psf dead load. Some species require incising to provide appropriate preservative treatment retention levels.

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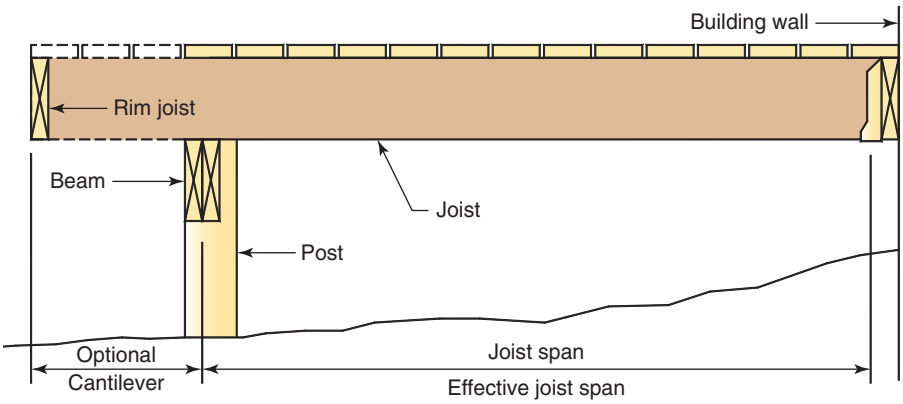
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R507.5
Deck Beams

CHANGE TYPE: Modification

CHANGE SUMMARY: The deck beam span table is split into multiple tables providing spans for given deck live or snow loads. Single and multi-ply spans as well as options for support of cantilevered deck joists are listed.

2021 CODE TEXT: **R507.5 Deck Beams.** Maximum allowable spans for wood deck beams, as shown in Figure R507.5, shall be in accordance with ~~Table R507.5.~~ Tables R507.5(1) through R507(4). Beam plies shall be fastened together with two rows of 10d (3-inch × 0.128-inch) nails minimum at 16 inches (406 mm) on center along each edge. Beams shall be permitted to cantilever at each end up to one-fourth of the ~~allowable~~ actual beam span. Deck beams of other materials shall be permitted where designed in accordance with accepted engineering practices.



Deck beam span.

TABLE R507.5(2) Maximum Deck Beam Span - 50 PSF Ground Snow Load[c]

		Effective Deck Joist Span Length[a,i,j] (feet)						
		6	8	10	12	14	16	18
Beam Species[d]	Beam Size[e]	Maximum Beam Span[a,b,f] (feet-inches)						
Southern Pine	1-2 × 6	4-6	3-11	3-6	3-2	2-11	2-9	2-7
	1-2 × 8	5-9	4-11	4-5	4-0	3-9	3-6	3-3
	1-2 × 10	6-9	5-10	5-3	4-9	4-5	4-2	3-11
	1-2 × 12	8-0	6-11	6-2	5-8	5-3	4-11	4-7
	2-2 × 6	6-8	5-9	5-2	4-9	4-4	4-1	3-10
	2-2 × 8	8-6	7-4	6-7	6-0	5-7	5-2	4-11
	2-2 × 10	10-1	8-9	7-10	7-1	6-7	6-2	5-10
	2-2 × 12	11-11	10-3	9-2	8-5	7-9	7-3	6-10
	3-2 × 6	7-11	7-2	6-6	5-11	5-6	5-1	4-10
	3-2 × 8	10-5	9-3	8-3	7-6	6-11	6-6	6-2
	3-2 × 10	12-8	10-11	9-9	8-11	8-3	7-9	7-3
	3-2 × 12	14-11	12-11	11-6	10-6	9-9	9-1	8-7

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TABLE R507.5(2) (*continued*)

Beam Species[d]	Beam Size[e]	Effective Deck Joist Span Length[a,i,j] (feet)						
		6	8	10	12	14	16	18
		Maximum Beam Span[a,b,f] (feet-inches)						
Douglas fir-larch[g], Hem-fir[g], Spruce-pine-fir[g]	1-2 × 6	4-0	3-5	2-11	2-7	2-4	2-2	2-0
	1-2 × 8	5-4	4-7	3-11	3-5	3-1	2-10	2-8
	1-2 × 10	6-7	5-8	4-11	4-5	4-0	3-8	3-5
	1-2 × 12	7-7	6-7	5-11	5-4	4-10	4-6	4-2
	2-2 × 6	6-0	5-2	4-7	4-2	3-10	3-5	3-2
	2-2 × 8	8-0	6-11	6-2	5-8	5-0	4-7	4-2
	2-2 × 10	9-9	8-5	7-7	6-11	6-4	5-10	5-4
	2-2 × 12	11-4	9-10	8-9	8-0	7-5	6-11	6-6
	3-2 × 6	7-6	6-6	5-9	5-3	4-11	4-7	4-4
	3-2 × 8	10-0	8-8	7-9	7-1	6-6	6-1	5-8
	3-2 × 10	12-3	10-7	9-6	8-8	8-0	7-6	7-0
	3-2 × 12	14-3	12-4	11-0	10-1	9-4	8-9	8-3
Redwood[h], Western cedars[h], Ponderosa pine[h], Red pine[h]	1-2 × 6	4-1	3-6	3-0	2-8	2-5	2-3	2-1
	1-2 × 8	5-2	4-6	4-0	3-6	3-2	2-11	2-9
	1-2 × 10	6-4	5-6	4-11	4-6	4-1	3-9	3-6
	1-2 × 12	7-4	6-4	5-8	5-2	4-10	4-6	4-3
	2-2 × 6	6-1	5-3	4-8	4-4	3-11	3-6	3-3
	2-2 × 8	7-8	6-8	5-11	5-5	5-0	4-8	4-3
	2-2 × 10	9-5	8-2	7-3	6-8	6-2	5-9	5-5
	2-2 × 12	10-11	9-5	8-5	7-8	7-2	6-8	6-3
	3-2 × 6	7-1	6-5	5-11	5-5	5-0	4-8	4-5
	3-2 × 8	9-4	8-4	7-5	6-10	6-4	5-11	5-7
	3-2 × 10	11-9	10-2	9-1	8-4	7-8	7-2	6-9
	3-2 × 12	13-8	11-10	10-7	9-8	8-11	8-4	7-10

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Interpolation allowed. Extrapolation is not allowed.
b. Beams supporting a single span of joists with or without cantilever.
c. Dead load = 10 psf, L/Δ = 360 at main span, L/Δ = 180 at cantilever. Snow load not assumed to be concurrent with live load.
d. No. 2 grade, wet service factor included.
e. Beam depth shall be equal to or greater than the depth of intersecting joist for a flush beam connection.
f. Beam cantilevers are limited to the adjacent beam's span divided by 4.
g. Includes incising factor.
h. Incising factor not included.
i. Deck joist span as shown in Figure R507.5
j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with R507.5(5).

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TABLE R507.5(5) Joist Span Factors for Calculating Effective Deck Joist Span [for use with footnote j in Tables R507.5(1), R507.5(2), R507.5(3) and R507.5(4)]

C/J[a]	Joist Span Factor
0 (no cantilever)	0.66
1/12 (0.87)	0.72
1/10 (0.10)	0.80
1/8 (0.125)	0.84
1/6 (0.167)	0.90
1/4 (0.250)	1.00

a. C = actual joist cantilever length (feet) J = actual joist span length (feet)

(Deleted table text not shown for clarity; to see Tables R507.5(1), (3) or (4) refer to the 2021 IRC.)

CHANGE SIGNIFICANCE: Similar to changes for deck post heights, there is a need to consider snow loads greater than 40 psf for deck beams. The 2018 IRC's prescriptive deck provisions only included a 40 psf live load and 10 psf dead load. Table R507.5, Deck beam span lengths, is replaced by four tables, R507.5(1) – (4), which account for 50, 60 and 70 psf ground snow load conditions. Single-ply spans are now listed for all wood species while there continue to be multi-ply span options for each wood species.

Maximum beam spans consider the load from tributary areas based on joist spans. In Tables R507.5(1)-(4), all deck joists are assumed to cantilever the allowable one-quarter of the joist back span past the supporting beam. This assumption is included in the calculated tributary area of the beam. When a beam supports a shorter joist cantilever, new Table R507.5(5) may be used to determine an effective joist span. When the joist cantilever is shorter than ¼ of the back span or there is no cantilever, the joist span may be decreased when determining the beam's maximum span. This allows the maximum beam span to increase due to the shorter effective joist span. Several examples are provided to illustrate the effective joist span:

Example 1:
A deck with a ground snow load of 50 psf is designed using two plies of Southern Pine 2 × 10.

Joist span is 12 feet and there is no cantilever.

- C – cantilever, J – joist
- C = 0 feet
- J = 12 feet
- Without footnote j, Table R507.5(2) limits the beam to a maximum span of 7'-1".

Applying the adjustment factor from footnote j and Table R507.5(5):

- C / J = 0 and the joist span factor is 0.66.
- An effective joist span can be calculated as 0.66 × 12' = 8".

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- The maximum beam span is 8'-9" per Table R507.5(2) because there is no cantilever.

Note: The beam span is not reduced by 0.66, rather the joist span is reduced by 0.66 to determine an effective joist span.

Example 2:
A deck with a ground snow load of 50 psf is designed using two plies of Southern Pine 2 × 10.

Joist span is 12 feet and there is a 12-inch cantilever.

- C – cantilever, J – joist
- C = 1 feet
- J = 12 feet
- Without footnote j, Table R507.5(2) limits the beam to a maximum span of 7'-1".

Applying the adjustment factor from footnote j and Table R507.5(5):

- C /J = 1/12 therefore the joist span factor is 0.72.
- An effective joist span can be calculated as 0.72 × 12' = 8'-8".
- A maximum beam span can be determined from Table R507.5(2) for a 10' effective joist span = 7'-10".
- Or by interpolating per footnote a, a beam span of 8'-5" is achieved as follows:

Maximum Beam Span (converted to inches):

	A	B	C
Effective joist span	8 ft. 96 in.	8 ft. 8 in. 104 in.	10 ft. 120 in.
Maximum beam span	105 in.	?	94 in.

To interpolate, subtract the number of inches between the 10 ft (column C) and 8 ft (column A) joist spans, which is 24 inches. The effective joist span in column B is 8 inches longer than the smaller span in column A, which is 8/24 or 1/3 the difference in lengths. Subtract beam span C from beam span A to get 11 inches. Multiply 11 inches by 1/3 to get 3.67 inches. Then take beam span A which is 105 inches and subtract 4 inches (rounded up from 3.67 inches). This gives a maximum beam span of 101" or 8'-5".

Maximum Beam Span

	A	B	C
Effective joist span	96 in.	104 in.	120 in.
Maximum beam span	105 in.	**101 in.** **8 ft. 5 in.**	94 in.

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Example 3:
A deck with a ground snow load of 50 psf is designed using two plies of Southern Pine 2 × 10.

Joist span is 12 feet and there is a 3-foot cantilever.

- C – cantilever, J – joist
- C = 3 feet
- J = 12 feet
- Without footnote j, Table R507.5(2) limits the beam to a maximum span of 7'-1".

Applying the adjustment factor from footnote j and Table R507.5(5):

- C /J = 3/12 or 1/4 and the joist span factor is 1.0.

Tabulated beam spans are based on a joist with a cantilever of 1/4 of the back span therefore the maximum beam span remains 7'-1".

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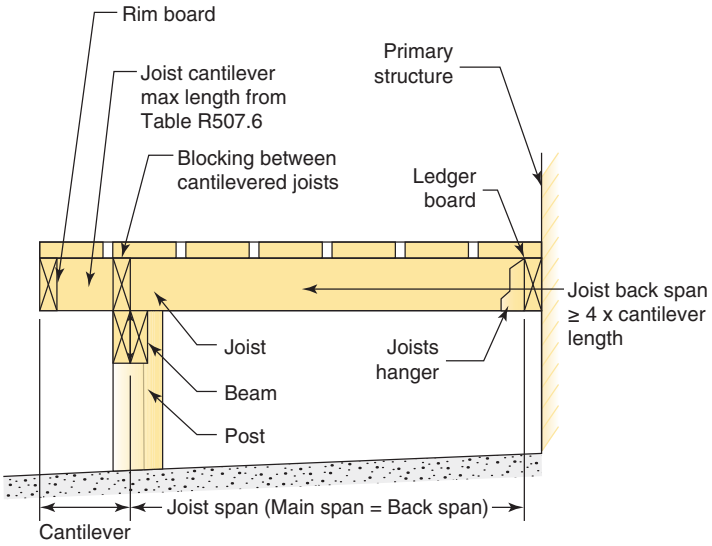
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R507.6
Deck Joists

CHANGE TYPE: Modification

CHANGE SUMMARY: Deck joist options are added for decks with large ground snow loads. Cantilever spans are now specifically based on maximum joist spans.

2021 CODE TEXT: **R507.6 Deck joists.** Maximum allowable spans for wood deck joists, as shown in Figure R507.6, shall be in accordance with Table R507.6. The maximum joist spacing shall be limited by the decking materials in accordance with Table R507.7. ~~The maximum joist cantilever shall be limited to one-fourth of the joist span or the maximum cantilever length specified in Table R507.6, whichever is less.~~



Joists with dropped beam.

TABLE R507.6 Maximum Deck Joist Spans

Load[a] (psf)	Joist Species[b]	Joist Size	Allowable Joist Span[c] (feet-inches) Joist Spacing (inches) 12	16	24	Maximum Cantilever[d] (feet-inches) Joist Back Span[g] (feet) 4	6	8	10	12	14	16	18
40 Live Load	Southern Pine	2 × 6	9-11	9-0	7-7	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	13-1	11-10	9-8	1-0	1-6	2-0	2-6	2-3	NP	NP	NP
		2 × 10	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-4	3-4	NP
		2 × 12	18-0	16-6	13-6	1-0	1-6	2-0	2-6	3-0	3-6	4-0	4-1
	Douglas Fir[e], Hem-fir[e], Spruce-Pine-Fir[e]	2 × 6	9-6	8-4	6-10	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	12-6	11-1	9-1	1-0	1-6	2-0	2-3	2-0	NP	NP	NP
		2 × 10	15-8	13-7	11-1	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP
		2 × 12	18-0	15-9	12-10	1-0	1-6	2-0	2-6	3-0	3-6	3-11	3-11
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	2 × 6	8-10	8-0	6-10	1-0	1-4	1-1	NP	NP	NP	NP	NP
		2 × 8	11-8	10-7	8-8	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	14-11	13-0	10-7	1-0	1-6	2-0	2-6	3-0	2-9	NP	NP
		2 × 12	17-5	15-1	12-4	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP

(*continues*)

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TABLE R507.6 (*continued*)

Load[a] (psf)	Joist Species[b]	Joist Size	Allowable Joist Span[c] (feet-inches) Joist Spacing (inches) 12	16	24	Maximum Cantilever[d] (feet-inches) Joist Back Span[g] (feet) 4	6	8	10	12	14	16	18
50 Ground Snow Load	Southern Pine	2 × 6	9-2	8-4	7-4	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	12-1	11-0	9-5	1-0	1-6	2-0	2-5	2-3	NP	NP	NP
		2 × 10	15-5	13-9	11-3	1-0	1-6	2-0	2-6	3-0	3-1	NP	NP
		2 × 12	18-0	16-2	13-2	1-0	1-6	2-0	2-6	3-0	3-6	3-10	3-10
	Douglas Fir[e], Hem-fir[e], Spruce-Pine-Fir[e]	2 × 6	8-10	8-0	6-8	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	11-7	10-7	8-11	1-0	1-6	2-0	2-3	NP	NP	NP	NP
		2 × 10	14-10	13-3	10-10	1-0	1-6	2-0	2-6	3-0	3-0	NP	NP
		2 × 12	17-9	15-5	12-7	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	2 × 6	8-3	7-6	6-6	1-0	1-4	1-1	NP	NP	NP	NP	NP
		2 × 8	10-10	9-10	8-6	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	13-10	12-7	10-5	1-0	1-6	2-0	2-6	2-9	NP	NP	NP
		2 × 12	16-10	14-9	12-1	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
60 Ground Snow Load	Southern Pine	2 × 6	8-8	7-10	6-10	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	11-5	10-4	8-9	1-0	1-6	2-0	2-4	NP	NP	NP	NP
		2 × 10	14-7	12-9	10-5	1-0	1-6	2-0	2-6	2-11	2-11	NP	NP
		2 × 12	17-3	15-0	12-3	1-0	1-6	2-0	2-6	3-0	3-6	3-7	NP
	Douglas Fir[e], Hem-fir[e], Spruce-Pine-Fir[e]	2 × 6	8-4	7-6	6-2	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	10-11	9-11	8-3	1-0	1-6	2-0	2-2	NP	NP	NP	NP
		2 × 10	13-11	12-4	10-0	1-0	1-6	2-0	2-6	2-10	NP	NP	NP
		2 × 12	16-6	14-3	11-8	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	2 × 6	7-9	7-0	6-2	1-0	1-4	NP	NP	NP	NP	NP	NP
		2 × 8	10-2	9-3	7-11	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	13-0	11-9	9-7	1-0	1-6	2-0	2-6	2-7	NP	NP	NP
		2 × 12	15-9	13-8	11-2	1-0	1-6	2-0	2-6	3-0	3-2	NP	NP
70 Ground Snow Load	Southern Pine	2 × 6	8-3	7-6	6-5	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	10-10	9-10	8-2	1-0	1-6	2-0	2-2	NP	NP	NP	NP
		2 × 10	13-9	11-11	9-9	1-0	1-6	2-0	2-6	2-9	NP	NP	NP
		2 × 12	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
	Douglas Fir[e], Hem-fir[e], Spruce-Pine-Fir[e]	2 × 6	7-11	7-1	5-9	1-0	1-6	NP	NP	NP	NP	NP	NP
		2 × 8	10-5	9-5	7-8	1-0	1-6	2-0	2-1	NP	NP	NP	NP
		2 × 10	13-3	11-6	9-5	1-0	1-6	2-0	2-6	2-8	NP	NP	NP
		2 × 12	15-5	13-4	10-11	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP
	Redwood[f], Western Cedars[f], Ponderosa Pine[f], Red Pine[f]	2 × 6	7-4	6-8	5-10	1-0	1-4	NP	NP	NP	NP	NP	NP
		2 × 8	9-8	8-10	7-4	1-0	1-6	1-11	NP	NP	NP	NP	NP
		2 × 10	12-4	11-0	9-0	1-0	1-6	2-0	2-6	2-6	NP	NP	NP
		2 × 12	14-9	12-9	10-5	1-0	1-6	2-0	2-6	3-0	3-0	NP	NP

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg. NP = Not Permitted

a. Dead load = 10 psf. Snow load not assumed to be concurrent with live load.
b. No. 2 grade, wet service factor included.
c. L/Δ = 360 at main span.
d. L/Δ = 180 at cantilever with 220-pound point load applied to end.
e. Includes incising factor.
f. Incising factor not included.
g. Interpolation permitted. Extrapolation is not permitted.

(Deleted text not shown for clarity.)

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CHANGE SIGNIFICANCE: Table R507.6, maximum deck joist spans, has created confusion for determining cantilever lengths for given joist spans. The 2018 IRC table listed an allowable cantilever length in terms of joist spacing. Since the assumed main span was the maximum allowable joist span for that spacing, the maximum cantilevers in some cases were not intuitive. Determining whether a joist and its cantilever met the maximum limits was time consuming and unclear. The second cantilever limit of one-quarter of the main span was located within the footnotes where it may have been overlooked. In the 2018 IRC, designers had to check both the table's maximum cantilever length and the limit of not more than one-fourth of the actual joist span.

With the updated 2021 IRC table, cantilevers are based on the actual back span creating a more intuitive maximum cantilever length. The term back span is used to differentiate the actual joist span from the maximum joist span available in the table. Where the table states a cantilever is not permitted, the back span in the table is longer than the maximum permitted joist span. An example of this is a 2 × 6 joist which has a maximum joist span in the 6.5-foot to 9-foot range. The table has entries for back spans of 10 feet to 18 feet but the cantilever length for a 2 × 6 is shown as "Not Permitted" since a joist span of 10 feet is not permitted for a 2 × 6.

New table organization now first lists maximum joist spans based on their on-center spacing. Then the table lists maximum cantilever lengths. Cantilevers, in order to carry their loads, must have the joist extend back along the deck a distance longer than the cantilever's length. Generally, a back span needs to be at least four times as long as the cantilever.

For example, for a Southern Pine 2 × 6 joist, if the joist spans 8 feet from the ledger to a supporting beam, then the joist can continue past the beam and cantilever up to 18 inches beyond the beam. But a Southern Pine 2 × 8 joist can cantilever 2 feet or a full one-quarter of the joist back span (distance between ledger and beam).

Table R507.6 is also updated to account for ground snow loads of 50, 60 and 70 pounds per square foot (psf).

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R507.7
Decking

CHANGE TYPE: Modification

CHANGE SUMMARY: The wood decking table is updated to show maximum on-center joist spacing for single- and multi-span configurations.

2021 CODE TEXT: R507.7 Decking. Maximum allowable spacing for joists supporting wood decking, excluding stairways, shall be in accordance with Table R507.7. Wood decking shall be attached to each supporting member with not less than two 8d threaded nails or two No. 8 wood screws. Maximum allowable spacing for joists supporting plastic composite decking shall be in accordance with Section R507.2. Other approved decking or fastener systems shall be installed in accordance with the manufacturer's installation requirements.

TABLE R507.7 Maximum Joist Spacing for Wood Decking

Decking Material Type and Nominal Size	~~Maximum On-Center Joist Spacing~~[c]			
	Decking perpendicular to joist		Decking diagonal to joist[a]	
	Single Span[c]	Multi-Span[c]	Single Span[c]	Multi-Span[c]
	Maximum On-Center Joist Spacing (inches)			
1¼ inch-thick wood deck boards[b]	12	16 ~~inches~~	8	12 ~~inches~~
2-inch-thick wood	24	24 ~~inches~~	18	24 ~~16~~ inches
~~Plastic composite~~	~~In accordance with Section R507.2~~		~~In accordance with Section R507.2~~	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.
a. Maximum angle of 45 degrees from perpendicular for wood deck boards.
b. Or other maximum span provided by an accredited lumber grading or inspection agency.
c. Individual wood deck boards supported by two joists shall be considered single span and three or more joists shall be considered multi-span.

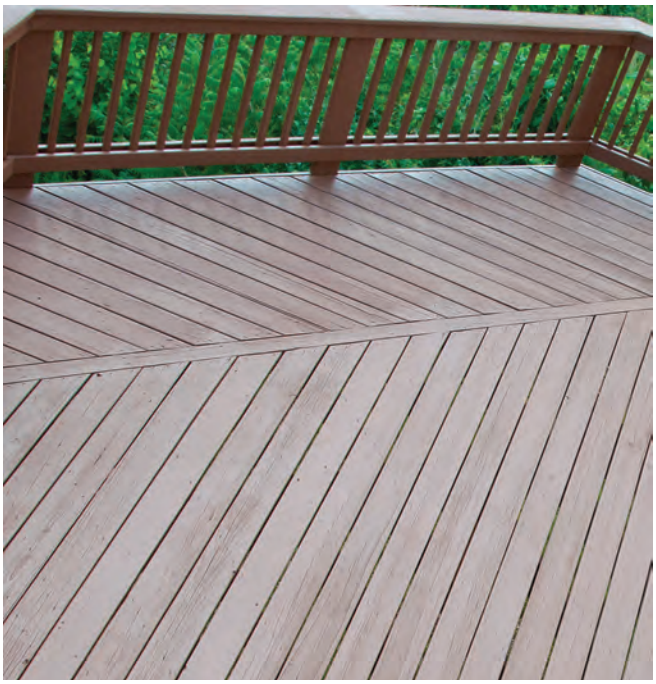


Photo courtesy of Anne Kitzman

Decking may span two or more joists.

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CHANGE SIGNIFICANCE: Table R507.7, Maximum Joist Spacing for Decking, is conservative for 2-inch nominal wood decking material. When evaluated using the American Lumber Standard Committee's (ALSC) decking policy, 2-inch nominal material can span 24 inches rather than 16 inches as shown in the 2018 IRC. Similarly, 5/4-inch decking is rated per ALSC's decking policy. While the minimum rated span is 16 inches, for certain species and grades, the allowable joist spacing may increase. The 2021 IRC Table R507.7 keeps a conservative baseline while increasing flexibility for manufacturers and designers.

The maximum joist spacing is updated to consider whether decking spans across two joists (called a single span) or three or more joists (a multi-span condition). Load resistance changes when decking is laid across multiple joists. This can change the allowable joist spacing. A multispan condition with decking allows an increase in the maximum joist spacing in some cases, particularly when decking is relatively thin and flexible. If a wider spacing of joists is desired for 5/4-inch-thick wood decking, footnote b allows a lumber grading agency or third-party wood inspection agency to provide maximum spans for specific 5/4-inch-thick decking.

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R507.10

Exterior Guards

CHANGE TYPE: Addition

CHANGE SUMMARY: Specific requirements for deck guards are added.

2021 CODE TEXT:

R507.10 Exterior guards. Guards shall be constructed to meet the requirements of Sections R301.5 and R312 and this section.

R507.10.1 Support of guards. Where guards are supported on deck framing, guard loads shall be transferred to the deck framing with a continuous load path to the deck joists.

R507.10.1.1 Guards supported by side of deck framing. Where guards are connected to the interior or exterior side of a deck joist or beam, the joist or beam shall be connected to the adjacent joists to prevent rotation of the joist or beam. Connections relying only on fasteners in end grain withdrawal are not permitted.

R507.10.1.2 Guards supported on top of deck framing. Where guards are mounted on top of the decking, the guards shall be connected to the deck framing or blocking and installed in accordance with manufacturer's instructions to transfer the guard loads to the adjacent joists.

R507.10.2 Wood posts at deck guards. Where 4-inch by 4-inch (102 mm by 102 mm) wood posts support guard loads applied to the top of the guard, such posts shall not be notched at the connection to the supporting structure.



Photo courtesy of Peter Kulczyk

Deck guards are used for fall protection.

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R507.10.3 Plastic composite guards. Plastic composite guards shall comply with the provisions of Section R507.2.2.

R507.10.4 Other guards. Other guards shall be in accordance with manufacturer's instructions or in accordance with accepted engineering principles.

CHANGE SIGNIFICANCE: The 2018 IRC had no requirements for constructing exterior guards on decks in Section R507. Guards provide the first line of defense against significant falls, which can result in serious and sometimes fatal injuries. Exterior guards on decks, particularly the guard system connection to the deck framing, are rarely engineered and even more rarely tested to verify adequacy to meet the 200-pound load requirements of Table R301.5, Minimum Live Loads.

Exterior deck guards must continue to meet Section R312 requirements and the loads listed in Table R301.5. The new provisions also reinforce the need for a load path from the guard and rail into the deck joists, beams or blocking to which a guard is connected. End grain connections in withdrawal are prohibited. In other words, guard fasteners may not be installed into the ends of deck joists or beams if loading will occur parallel to the length of the joist or beam slowly pulling the fasteners out of the lumber. When guards are connected to the side of beams or joists, the beam or joist shall be connected to adjacent joists—for example by blocking or straps—to resist rotation of the beam or joist when load is applied to the guard.

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Table R602.3(1)

Fasteners – Roof and Wall

CHANGE TYPE: Modification

CHANGE SUMMARY: Additional fastener options are added to the fastener table for roof and walls.

2021 CODE TEXT:

EXCERPT OF TABLE R602.3(1) Fastening Schedule

Item	Description of Building Elements	Number and Type of Fastener[a,b,c,e]	Spacing and Location
		Roof	
1	Blocking between ceiling joists, ~~or~~ rafters or trusses to top plate or other framing below	4-8d box (2½" × 0.113") nails 3-8d common (2½" × 0.131") nails 3-10d box (3" × 0.128") nails 3-(3" × 0.131") nails	Toenail
	Blocking between rafters or truss not at the wall top plates, to rafter or truss	2-8d common (2½" × 0.131") nails 2-(3" × 0.131") nails	Each end, toenail
		2-16d common (3½" × 0.162") nails 3-(3" × 0.131") nails	End nail
	Flat blocking to truss and web filler	16d common (3½" × 0.162") nails 3-(3" × 0.131") nails	6"o.c. face nail
		Wall	
12	Adjacent full-height stud to end of header	3-16d common (3½" × 0.162") nails 4-16d box (3 ½" × 0.135") nails 4-10d box (3" × 0.128") nails 4-(3" × 0.131") nails	End nail

CHANGE SIGNIFICANCE: *International Residential Code* (IRC) Table R602.3(1) and *International Building Code* (IBC) Table 2304.10.1 are essentially the same table. Although the fastener tables are closely aligned, there are variations in the prescribed fasteners within the two tables. Some fastener options are offered only in the IRC table and other options are offered in the IBC table and not the IRC table. Changes to the 2021 codes attempt to harmonize fastener options in the two tables. Item 1 of the table shows such changes with addition of nailing options and clarifying text describing blocking attachment to specific roof elements.

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King studs nailed to header.

The required nailing of the first full-height stud adjacent to a header is added to the fastening schedule table in Item 12 for wall connections, where it can be located quickly. Additional full-height studs are fastened to each other in accordance with Item 8 of Table R602.3(1), Stud to stud (not at braced wall panels) or Item 9, Stud to stud and abutting studs at intersecting wall corners (at braced wall panels).

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Table R602.3(1)

Fasteners – Roof Sheathing

CHANGE TYPE: Modification

CHANGE SUMMARY: Additional fastener options are added to the fastener table in the roof sheathing section while maximum field nailing is reduced.

2021 CODE TEXT:

EXCERPT OF TABLE R602.3(1) Fastening Schedule

Item	Description of Building Elements	Number and Type of Fastener[a,b,c]	Spacing of Fasteners: Edges[h] (inches)	Spacing of Fasteners: Intermediate supports[c,e] (inches)
Wood structural panels (WSP), subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing				
~~30~~ 31	3/8" – 1/2"	6d common or deformed (2" × 0.113" × 0.266" head)-~~(subfloor, wall)~~[i]; 2 3/8" × 0.113" × 0.266" head nail (subfloor, wall) [i]	6[f]	~~12~~ 6[f]
		8d common (2½" × 0.131") (roof) RSRS-01 (2 3/8" × 0.113") nail (roof)[ib]	6[f]	~~12~~ 6[f]
~~31~~ 32	19/32"– ~~1"~~ 3/4"	8d common (2 – 2½" × 0.131") (subfloor, wall) Deformed 2 3/8" × 0.113" × 0.266" head (wall or subfloor)	6	12
		8d common (2½" × 0.131") nail (roof) RSRS-01 (2 3/8" × 0.113") nail (roof)~~[i]~~[ib]	6[f]	~~12~~6[f]
~~32~~ 33	~~1 1/8"~~ 7/8" – 1 1/4"	10d common (3" × 0.148") nail ~~8d~~ (2½" × 0.131" × 0.281" head) deformed nail	6	12

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s; 1 ksi = 6.895 MPa.

f. For wood structural panel roof sheathing attached to gable end roof framing and to intermediate supports within 48 inches of roof edges and ridges, nails shall be spaced at ~~6~~ 4 inches on center where the ultimate design wind speed is ~~less than 130 mph and shall be spaced 4 inches on center where the ultimate design wind speed is 130 mph or greater but less than 140 mph~~ greater than 130 mph in Exposure B or greater than 110 mph in Exposure C.

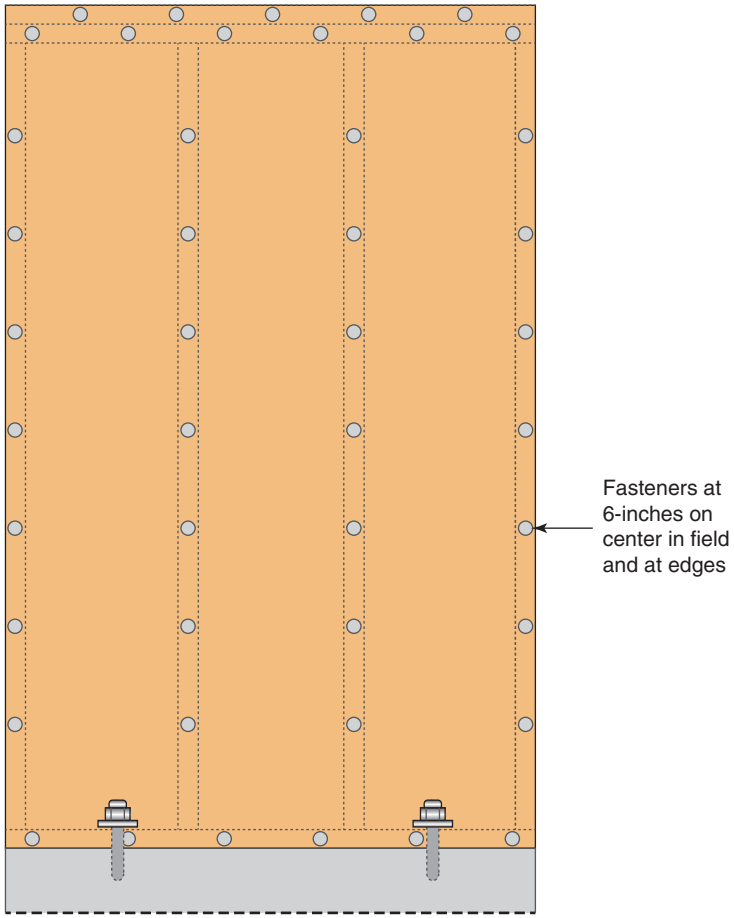
CHANGE SIGNIFICANCE: IRC Table R602.3(1) and IBC Table 2304.10.1 are essentially the same table in terms of structural connections. Although the connections are closely aligned, there are variations in the prescribed fasteners within the two tables. Some fastener options are offered only in the IRC table and not in the IBC table and other options are offered in the IBC table and not the IRC table. These changes harmonize fastener options in the two tables. In addition, where additional information exists in one table and not the other, it is added.

Roof sheathing nailing is updated in Table R602.3(1) based on wind load values from ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. The table changes are also consistent with the roof sheathing nailing requirements in the *2018 Wood Frame Construction Manual* (WFCM). Wind uplift nailing requirements for

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Method WSP fasteners are now required to be a maximum of 6 inches on center.

common species of roof framing with specific gravities of 0.42 or greater, for example SPF and Hem-Fir, are the basis of the new nail spacing requirements in Table R602.3(1) intended to be easy to specify for roof nailing.

The basic roof sheathing nailing schedule is 6 inches on center at panel edges and 6 inches on center at intermediate supports of the panel. As shown in WFCM Table 3.10A for the common case of roof framing spaced at 24 inches on center, nailing at intermediate supports in the interior portions of the roof is 6 inches on center for wind speeds within the scope of IRC. The 6 inches on center spacing is also appropriate for edge zones except where ultimate wind speeds equal or exceed 130 mph in Exposure B and 110 mph in Exposure C where nailing at 4 inches on center for panel edges and intermediate supports is required. This special case is addressed by the modification to footnote f.

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Table R602.3(2)

Alternate Attachments

CHANGE TYPE: Clarification

CHANGE SUMMARY: Table R602.3(2) footnote g is updated for clarity.

2021 CODE TEXT:

TABLE R602.3(2) Alternate Attachments to Table R602.3(1)

Nominal Material Thickness (inches)	Description[a,b] of Fastener and Length (inches)	Spacing[c] of Fasteners	
		Edges (inches)	Intermediate supports (inches)
Wood structural panels subfloor, roof[g] and wall sheathing to framing and particleboard wall sheathing to framing[f]			
.			
.			
.			

Nominal Material Thickness (inches)	Description[a,b] of Fastener and Length (inches)	Spacing[c] of Fasteners	
		Edges (inches)	Body of panel[d] (inches)
.			
.			
.			

b. Staples shall have a minimum crown width of $^{7}/_{16}$-inch ~~on diameter~~ except as noted.

g. ~~Specified alternate attachments for roof sheathing shall be permitted where~~ Alternate fastening is only permitted for roof sheathing where the ultimate design wind speed is less than or equal to 110 mph, and where fasteners are installed 3 inches on center at all supports ~~130 mph. Fasteners attaching wood structural panel roof sheathing to gable end wall framing shall be installed using the spacing listed for panel edges~~.

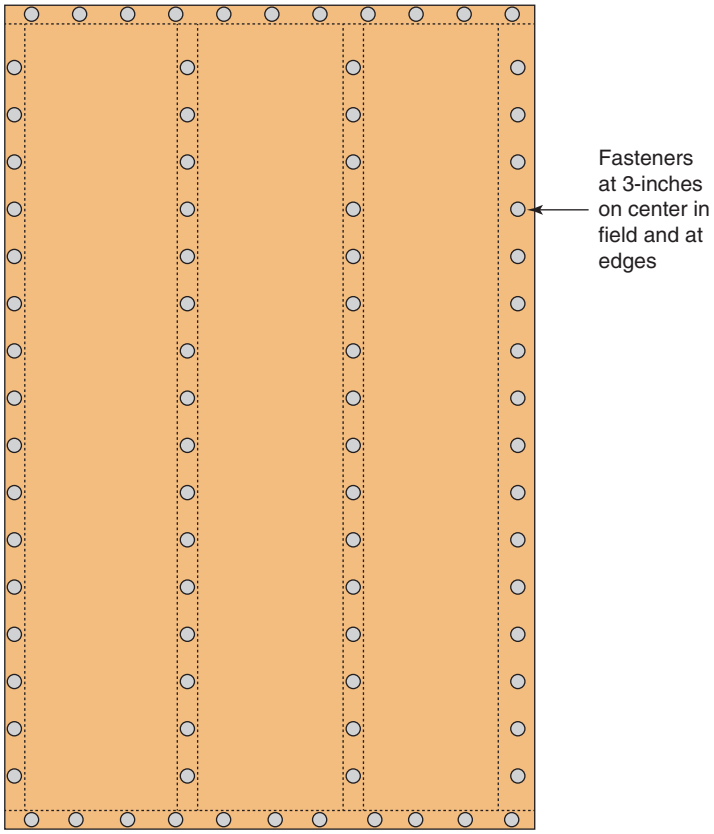
(No changes to table values)

CHANGE SIGNIFICANCE: Footnote g is updated in Table R602.3(2), Alternate attachments, based on uplift load requirements in ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structure* for the alternative fasteners. To keep specification of roof sheathing to relatively simple attachment schedules, reference calculations use a 0.099-inch and 0.113-inch diameter nail at 3-inch on center spacing at all locations. This value is based on the nail shank withdrawal capacity in wood framing with a specific gravity equal to 0.42 (e.g., SPF lumber) and pre-calculated wind uplift loads from Table 3.10 of the *Wood Frame Construction Manual* (WFCM). The use of 3-inch spacing at all supports was extended to staples based on the assumption that the ASCE 7-16 load increase would similarly require reduced spacing. This assumption was applied to staples because a withdrawal value is not available for staples in the *National Design Specification* (NDS) *for Wood Construction*.

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Fasteners are now required to be 3 inches on center on roof sheathing.

Therefore, with this change a narrower nail or a staple used in roof sheathing must be placed using a maximum 3-inch on center spacing. These fasteners are only allowed in regions with a wind speed less than or equal to 110 mph. In areas with higher wind speeds, the alternate attachment table may not be used for roof sheathing.

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R602.9

Cripple Walls

CHANGE TYPE: Clarification

CHANGE SUMMARY: Cripple wall requirements apply only to exterior cripple walls.

2021 CODE TEXT: **R602.9 Cripple walls.** Foundation cripple walls shall be framed of studs not smaller than the studding above. Where exceeding 4 feet (1219 mm) in height, such walls shall be framed of studs having the size required for an additional story. ~~Cripple~~ Exterior cripple walls with a stud height less than 14 inches (356 mm) shall be continuously sheathed on one side with wood structural panels fastened to both the top and bottom plates in accordance with Table R602.3(1), or the cripple walls shall be constructed of solid blocking.

Cripple walls shall be supported on continuous foundations.

CHANGE SIGNIFICANCE: The IRC and IBC require foundation cripple walls, below exterior walls, with studs less than 14 inches tall to be "continuously-sheathed" in all seismic regions. This requirement is not related to wall bracing which is covered in Section R602.10. The requirement for continuous sheathing on cripple wall studs with a height less than 14 inches (or solid-blocking) is intended to ensure the integrity of the studs when nails are end-nailed into top and bottom plates by face-nailing sheathing into the top and bottom plates as well as studs.



Cripple wall along exterior of house – unsheathed.



Cripple wall along exterior of house – sheathed.

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In regions with shallow frost-depth it is common to have shallow crawl spaces. Typically, a concrete stem wall forms the exterior foundation walls and directly supports the floor. The interior walls, typically 2 to 4 feet tall, are cripple walls laid on a strip footing. These walls move with the exterior concrete walls during an earthquake and have few issues. Therefore, continuous blocking or sheathing is not required for these interior walls when the exterior foundation is concrete up to the floor framing and bottom plate. Continuous sheathing on these short walls in a crawl space also creates issues for ventilation, under-floor mechanical systems, plumbing and access.



Interior cripple wall.

In past earthquakes, exterior cripple walls have been very vulnerable to out-of-plane movement with the cripple wall losing its ability to support the walls above causing the cripple wall to rock out of plumb and collapse. As exterior cripple walls need protection and interior cripple walls simply need to be nailed appropriately, the requirement for a cripple wall to be continuously sheathed is updated from a provision for all cripple walls to a requirement for exterior walls only in the 2021 IRC.

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R602.10.1.2

Location of Braced Wall Lines

CHANGE TYPE: Modification

CHANGE SUMMARY: Section R602.10.1.2 limits placement of a braced wall line.

2021 CODE TEXT: **R602.10.1.2 ~~Offsets along a~~ Location of braced wall lines and permitted offsets.** Each braced wall line shall be located such that no more than two-thirds of the required braced wall panel length is located to one side of the braced wall line. Braced wall panels shall be permitted to be offset up to 4 feet (1219 mm) from the designated braced wall line. Braced wall panels parallel to a braced wall line shall be offset not more than 4 feet (1219 mm) from the designated braced wall line location as shown in Figure R602.10.1.1.

Exterior walls parallel to a braced wall line shall be offset not more than 4 feet (1219 mm) from the designated braced wall line location as shown in Figure R602.10.1.1.

Interior walls used as bracing shall be offset not more than 4 feet (1219 mm) from a braced wall line through the interior of the building as shown in Figure R602.10.1.1.

CHANGE SIGNIFICANCE: Over a series of code cycles, changes to IRC Section R602.10 wall bracing provisions have caused some of the important concepts fundamental to the development of the bracing provisions to be lost. In the 2006 IRC and earlier editions, braced wall panels were required on exterior walls with additional interior braced wall lines where needed to meet braced wall line spacing requirements. The concept that exterior walls are to be braced is not specifically stated in the 2009 IRC forward. Rather, a line is drawn on plans with braced wall panels on walls counted as part of a braced wall line when the panels are within 4 feet of the line drawn on the plans.

This sounds reasonable. It allows the designer to break up the exterior walls pushing some out and others inward along the front of a building. But what about when the front of a house is one single continuous wall? Can the designer still draw the braced wall line 4 feet inward of the actual wall?

The IRC did not address this issue leaving each jurisdiction to decide and designers arguing their case with each jurisdiction. In fact, most jurisdictions feel that the braced wall line must be on a physical wall when the wall line forms a single unbroken line.

For the 2021 edition, the IRC requires that at least one-third of all braced wall panels be either on a braced wall line or on the opposite side of the braced wall line from the other braced wall panels. Braced wall panels continue to be required to be within 4 feet of the braced wall line. For the case where a single wall forms the entire braced wall line, all braced wall panels must be on the braced wall line. In other words, the braced wall line must be drawn at the physical wall.

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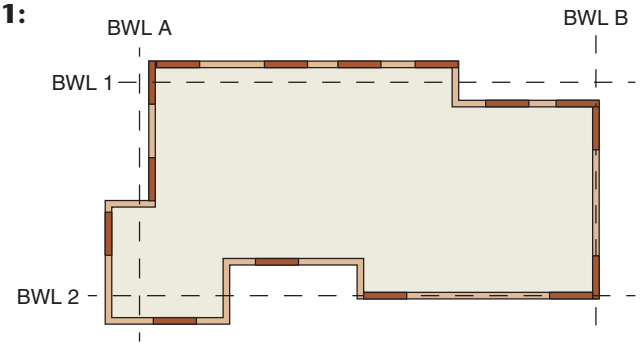
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Braced wall line (BWL) examples:

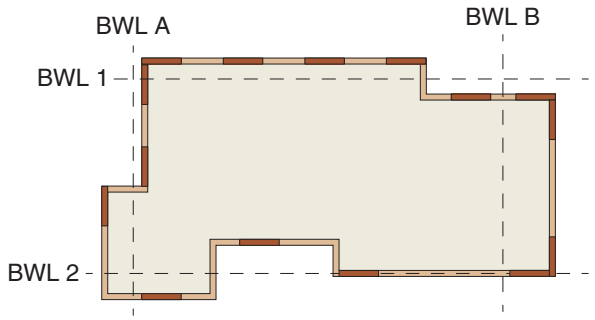
— — — Braced Wall Line
Braced Wall Panel (BWP)

Example 1:



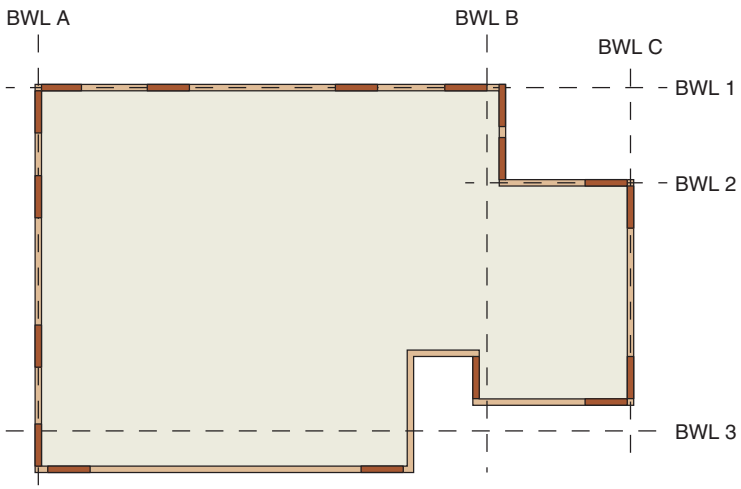
BWL 1: line runs between two walls, 4 of 6 panels on outside side of line, 2 of 6 panels on opposite side of line = OK
BWL 2: line runs between three walls, 1 of 4 panels outside line, 2 of 4 panels on BWL and 1 of 4 panels inside line = OK
BWL A: line runs between two walls, 2 of 3 panels on one side of line, 1 of 3 panels on opposite side of line = OK
BWL B: line runs on one wall = OK

Example 2:



BWL 1: line runs between two walls, 4 of 6 panels on outside side of line, 2 of 6 panels on opposite side of line = OK
BWL 2: line runs between three walls, 1 of 4 panels outside line, 2 of 4 panels on BWL and 1 of 4 panels inside line = OK
BWL A: line runs between two walls, 2 of 3 panels on one side of line, 1 of 3 panels on opposite side of line = OK
BWL B: line runs inside single wall, 2 of 2 panels outside BWL = **No Good**

Example 3:

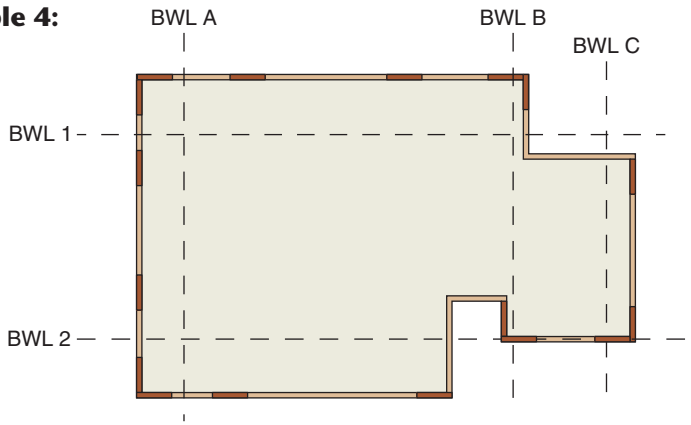


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BWL 1: line runs along a single wall, 4 of 4 panels are on the BWL = OK
BWL 2: line runs along a single wall, 1 of 1 panel is on the BWL = OK
BWL 3: line runs between two walls, 2 of 3 panels on one side of line, 1 of 3 panels on opposite side of line = OK
BWL A: line runs along a single wall, 4 of 4 panels are on the BWL = OK
BWL B: line runs between two walls, 2 of 3 panels on one side of line, 1 of 3 panels on opposite side of line = OK
BWL C: line runs along a single wall, 2 of 2 panels are on the BWL = OK

Example 4:



BWL 1: line runs between two walls, 4 of 5 panels on one side of line, 1 of 5 panels on opposite side of line = **No Good**, as more than 2/3 of panels are on one side of the BWL.
BWL 2: line runs on one wall, 3 of 5 panels on one side of line, 2 of 5 panels on the wall = **No Good**
BWL A: line inside of a single wall, 4 of 4 panels are on one side of the BWL = **No Good**
BWL B: line runs between two walls, 1 of 2 panels on one side of line, 1 of 2 panels on opposite side of line = OK
BWL C: line inside of a single wall, 2 of 2 panels are on the inside of the BWL = **No Good**

From the examples, it is clear that when a single wall contains all the braced wall panels in a braced wall line, the BWL must be drawn on the wall. When there are multiple braced wall panels in a BWL, one-third of the panels need to be on one side of the line. This can mean that a long wall with a short wall will need to have the braced wall line placed on the long wall as seen in Example 4's BWL 1. In some cases, the braced wall line will be broken into two separate wall lines like Example 3's BWL 1 and 2.

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R602.10.2.2

Location of Braced Wall Panels (BWPs)

CHANGE TYPE: Clarification

CHANGE SUMMARY: Section R602.10.2.2 is clarified for the starting point of the first braced wall panel when not placed at the corner of the structure.

2021 CODE TEXT: **R602.10.2.2 Locations of braced wall panels.** A braced wall panel shall begin within 10 feet (3810 mm) from each end of a braced wall line as determined in Section R602.10.1.1. The distance between adjacent edges of braced wall panels along a braced wall line shall be not greater than 20 feet (6096 mm) as shown in Figure R602.10.2.2.

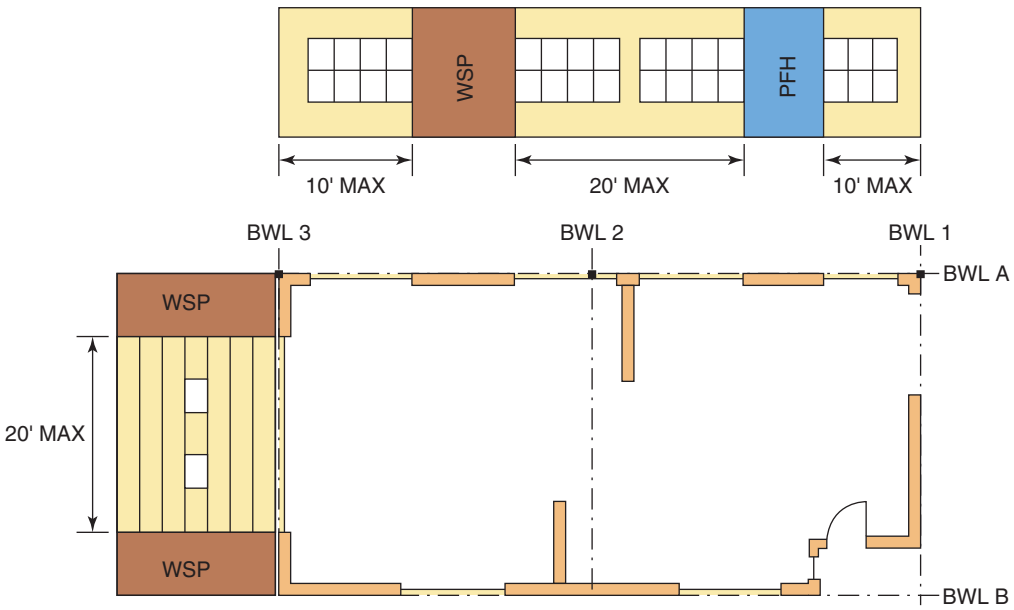
Exceptions:

1. Braced wall panels in Seismic Design Categories D_0, D_1 and D_2 shall comply with Section R602.10.2.2.1.
2. Braced wall panels with continuous sheathing in Seismic Design Categories A, B or C shall comply with Section R602.10.7.

R602.10.2.2.1 Location of braced wall panels in Seismic Design Categories D_0, D_1 and D_2. Braced wall panels shall be located at each end of a braced wall line.

~~Exception~~ Exceptions:

1. Braced wall panels constructed of Method WSP or BV-WSP and continuous sheathing methods as specified in Section R602.10.4 shall be permitted to begin not more than 10 feet (3048 mm) from each end of a braced wall line provided that each end complies with one of the following:



Method PFH panels may start 10 feet from the end of the BWL.

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~~1.~~ 1.1. A minimum 24-inch-wide (610 mm) panel for Methods WSP, CS-WSP, CS-G and CSPF is applied to each side of the building corner as shown in End Condition 4 of Figure R602.10.7.

~~2.~~ 1.2. The end of each braced wall panel closest to the end of the braced wall line shall have an 1,800 lb (8 kN) hold-down device fastened to the stud at the edge of the braced wall panel closest to the corner and to the foundation or framing below as shown in End Condition 5 of Figure R602.10.7.

2. Braced wall panels constructed of Method PFH or ABW, or of Method BV-WSP where a hold-down is provided in accordance with Table R602.10.6.5.4, shall be permitted to begin not more than 10 feet from each end of a braced wall line.

CHANGE SIGNIFICANCE: Section R602.10.2.2 deals with placement of braced wall panels on a braced wall line. The main requirement in this section is that the first braced wall panel must begin within 10 feet from the end of the braced wall line. There are two exceptions to this requirement.

1. In Seismic Design Categories (SDC) D_0, D_1 and D_2 additional bracing is required at the corner. Either a hold-down at the BWP or a 2-foot strip of sheathing using wood structural panel at the corner is required.
2. When continuous sheathing methods are used, additional bracing is also required at a corner per Section R602.10.7. Again, either a 2-foot strip of sheathing on each side of the corner or a hold-down at the BWP is installed.

The purpose of the corner sheathing and hold-down options in this section is to restrain the first braced wall panel from overturning, either by having it located at a corner, or by providing a hold-down. When bracing methods already have a hold-down to restrain the panel from overturning, they can be located away from the corner.

Section R602.10.2.2.1 covers bracing in SDC D_0, D_1 and D_2. Braced wall panels may be located up to 10 feet from the corner when the braced wall panel has an 1800-pound hold-down. There are alternate braced wall panels that already have a hold-down of this capacity or higher. Method ABW requires a hold-down with a minimum capacity of 1800 pounds, and Method PFH requires a hold-down with a minimum capacity of 3500 pounds. Generally, Method BW-WSP requires a hold-down with a capacity in excess of 1800 pounds as well. However, there is one case where Method BV-WSP does not require a hold-down, which is considered by adding the text "where a hold-down is provided in accordance with Table R602.10.6.5.4." All three of these methods may be placed up to 10 feet from the end of the braced wall line as the first panel in the wall line.

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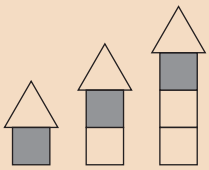
CHANGE TYPE: Modification

R602.10.3(1)
Bracing for Winds

CHANGE SUMMARY: Rows are added to the wind bracing requirements table for 95 mph wind speeds.

2021 CODE TEXT:

TABLE R602.10.3(1) Bracing Requirements Based on Wind Speed

• Exposure Category B • 30-foot Mean Roof Height • 10-foot Wall Height • 2 Braced Wall Lines			Minimum Total Length (feet) of Braced Wall Panels Required Along Each Braced Wall Line[a]			
Ultimate Design Wind Speed (mph)	Story Location	Braced Wall Line[c] (feet)	Method LIB[b]	Method GB	Methods DWB, WSP, SFB, PBS, PCP, HPS, BV-WSP, ABW, PFH, PFG, CS-SFB	Methods CS-WSP, CS-G, CS-PF
< 95 mph		10	2.5	2.5	1.5	1.5
		20	4.5	4.5	2.5	2.5
		30	6.5	6.5	4.0	3.5
		40	8.5	8.5	5.0	4.0
		50	10.5	10.5	6.0	5.0
		60	12.5	12.5	7.0	6.0
		10	5.0	5.0	3.0	2.5
		20	8.5	8.5	5.0	4.5
		30	12.5	12.5	7.0	6.0
		40	16.0	16.0	9.5	8.0
		50	20.0	20.0	11.5	10.0
		60	23.5	23.5	13.5	11.5
		10	NP	7.0	4.0	3.5
		20	NP	13.0	7.5	6.5
		30	NP	18.5	10.5	9.0
		40	NP	24.0	13.5	11.5
		50	NP	29.5	17.0	14.5
		60	NP	35.0	20.0	17.0

(*All changes to text or footnotes are shown.*)

CHANGE SIGNIFICANCE: With update of the wind map in Figure R301.2(2), rows for lower wind speeds are needed in Table R602.10.3(1), Bracing requirements based on wind speed. The *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE 7-16) wind maps include many areas of the country where wind speeds decrease below 110 mph. This limit was the lower wind speed limit for the western United States in the 2018 IRC. To coordinate the IRC with these new less conservative wind speeds in ASCE 7, existing wind provisions are modified to account for the lower speeds. To see additional explanation about the wind map changes, go to the significant change discussion of Section R301.2.

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Wind damage to roof and walls.

For Table R602.10.3(1), bracing requirements based on wind speed, new regions have wind speed as low as 90 mph. The 2018 IRC table began with a wind speed of 110 mph. Continuing to use 110 mph for regions with design wind speeds ranging from 90 to 110 mph is unnecessarily conservative. Because the lowest wind speeds are between 90 and 95 mph, a new category is created. When a design wind speed is less than 95 mph, in other words in western Washington, Oregon or California, the less than 95 mph rows can be used to determine minimum bracing lengths. At this time there are not additional rows for wind speeds less than 100 or 105 mph. Buildings in most areas of Washington, Oregon and California will continue to use 110 mph design wind speed rows in Table R602.10.3(1). Buildings in the mountain states and mid-west will use either 110 or 115 mph design wind speed rows. Areas that are special wind regions will continue to use the wind speeds designated by the state or local jurisdiction.

To identify local wind speeds, the easiest course is to use software currently available from the Applied Technology Council (ATC) or the American Society of Civil Engineers (ASCE). ATC's website is hazards.atcouncil.org and ASCE's website is https://asce7hazardtool.online. Type in an address or GPS coordinates, and it is possible to determine the ground snow load, wind speed, seismic design category and tornado risk in one location. The ATC website remains free to users, while the ASCE website charges a nominal yearly fee and offers wind speeds and tsunami hazard zones for free.

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CHANGE TYPE: Clarification

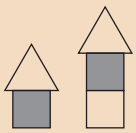
CHANGE SUMMARY: Table R602.10.3(3) labeling and footnotes are updated to clarify use of the table.

Table R602.10.3(3)
Seismic Wall Bracing

2021 CODE TEXT:

TABLE R602.10.3(3) Bracing Requirements Based on Seismic Design Category

- ~~SOIL CLASS D[b]~~
- Wall Height = 10 feet
- 10 PSF Floor Dead Load
- 15 PSF Roof/Ceiling Dead Load
- Braced Wall Line Spacing ≤ 25 feet

Seismic Design Category[b]	Story Location	Braced Wall Line Length (feet)[c]	Minimum Total Length (Feet) of Braced Wall Panels Required along each Braced Wall Line[a,f,g] Method LIB[d]	Method GB	Methods DWB, SFB, PBS, PCP, HPS, CS- SFB[e]	Methods WSP, PFH[f], PFG[e, f] and ABW[f]	Methods CS-WSP, CS-G, CS-PF
D_2[h]		10	NP	4	4	2.5	2.1
		20	NP	8	8	5	4.3
		30	NP	12	12	7.5	6.4
		40	NP	16	16	10	8.5
		50	NP	20	20	12.5	10.6
		10	NP	7.5	7.5	5.5	4.7
		20	NP	15	15	11	9.4
		30	NP	22.5	22.5	16.5	14
		40	NP	30	30	22	18.7
		50	NP	37.5	37.5	27.5	23.4
	Cripple wall below one- or two-story dwelling	10	NP	NP	NP	7.5	6.4
		20	NP	NP	NP	15	12.8
		30	NP	NP	NP	22.5	19.1
		40	NP	NP	NP	30	25.5
		50	NP	NP	NP	37.5	31.9

b. ~~Wall bracing lengths are based on a soil site class "D."~~ Interpolation of bracing length between the S_{DS} values associated with the seismic design categories shall be permitted when a site-specific S_{DS} value is determined in accordance with Section 1613.2 of the International Building Code.

f. Methods PFH, PFG and ABW are only permitted on a single story or a first of two stories.

~~f.~~g. Where more than one bracing method is used, mixing methods shall be in accordance with Section R602.10.4.1.

h. One- and two-family dwellings in Seismic Design Category D_2 exceeding two stories shall be designed in accordance with accepted engineering practice.

(*All changes to text or footnotes are shown.*)

CHANGE SIGNIFICANCE: Changes were made to the fundamental structure of the bracing requirements for seismic forces table. The SDCs are no longer based exclusively on Class D soils. This attribute is deleted from the list in the upper left corner of the table. When the site does not have a geotechnical survey, the site soil class may end up based on either Class C or Class D soils. For additional discussion of the changes to soil class see Section R301.2.2 in the *2018 IRC Commentary* or *Significant Changes to the 2018 IRC*.

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Damage due to ground movement.

The itemized bracing methods in Table R602.10.3(3) are revised to include all permissible bracing methods. Missing methods included intermittent bracing methods ABW, PFH and PFG; these methods are currently listed in Table R602.10.3(1) for wind forces. Table R602.10.3(3) footnote f is added to identify bracing methods permitted only at the ground floor; in other words, only in single story buildings or on the first floor of two-story buildings. Two of these bracing methods require a hold-down cast in a concrete basement or stem wall or turned down slab edge. Bracing methods with hold-downs limited to the bottom of a two-story building are Methods ABW and PFH. Method PFG is also limited to the bottom of two-stories. Each of these methods was tested in a laboratory to prove its equivalence to Method WSP. In testing, loads used were equivalent to a two-story building's weight. The methods haven't been tested with loads equivalent to a three-story building.

Table R602.10.3(3) footnote h is added to emphasize the two-story height limit for buildings in SDC D_2. If a building is three stories in SDC D_2, an engineered design is required for the building's lateral design. In other words shear walls must be used rather than braced wall panels and diaphragm, beam and column connections are checked for their ability to resist earthquake loads.

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CHANGE TYPE: Clarification

CHANGE SUMMARY: Table R602.10.3(4) is updated to clarify the limits of brick veneer use and when additional bracing must be used on the building in SDC D_0, D_1 and D_2.

Table R602.10.3(4)

Adjustment Factors – Seismic

2021 CODE TEXT:

TABLE R602.10.3(4) Seismic Adjustment Factors to the Required Length of Wall Bracing

Item Number	Adjustment Based On	Story[g]	Condition	Adjustment Factor [Multiply length from Table R602.10.3(3) by this factor]	Applicable Methods
7	Walls with stone or masonry veneer, detached one- or two-family dwellings in SDC D_0-D_2	Any Story	See Section R602.10.6.5.4 ~~Table R602.10.6.5~~		BV-WSP
8	Walls with stone or masonry veneer, detached one- or two-family dwellings in SDC D_0-D_2	First and second story of two-story dwelling	Limited Brick Veneer on Second Story. See Section R602.10.6.5.3. ~~Table R602.10.6.5~~	1.2	WSP, CS-WSP
10	Horizontal blocking	Any story	Horizontal blocking omitted	2.0	WSP, PBS, CS-WSP

g. One- and two-family dwellings in Seismic Design Category D_2 exceeding two stories shall be designed in accordance with accepted engineering practice.

(*All changes to text or footnotes are shown.*)

CHANGE SIGNIFICANCE: For wall bracing on dwellings with brick veneer, adjustment factors in Table R602.10.3(4) need to be used. Bracing methods available for use with brick veneer exceeding the first story in high seismic regions include Method BV-WSP, Method WSP and Method CS-WSP.

1. If brick veneer is only on the first story and doesn't extend into gable ends, no additional wall bracing is required—use the minimum bracing length from Table R602.10.3(3).

Example 1:

One-story house with bonus room in Seattle, WA

Brick veneer columns at garage and under front windows only



Veneer on upper story.

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Brick does not extend above the first story, minimum wall bracing length for seismic forces is determined per Table R602.10.3(3) only.

2. If brick veneer extends into the gable-end walls or into an upper story, Method WSP or CS-WSP may be used, if limited brick veneer is placed on the second story. Limited veneer can mean veneer only on the front side of the house at the second story or total veneer area that is less than 25 percent of the second story floor area. With this option, there is a 20 percent increase in the bracing length required by Table R602.10.3(3) using Item 8 of Table R602.10.3(4). Section R602.10.6.5.3 contains the limits for use of these bracing methods.

Example 2:

Two-story house in Portland, OR

Brick veneer across entire front side of building, no veneer on sides or back of building





Veneer above first story on one side of the building.

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Brick exists only on the front of the building. Minimum wall bracing length for seismic forces is determined per Table R602.10.3(3) using Method WSP or Method CS-WSP and increasing the required length by 20 percent per Item 8 of Table R602.10.3(4) or use Method BV-WSP.

3. If brick veneer is used to sheathe the full height of multiple second story walls or more than 25 percent of all four second story walls, then Method BV-WSP is the only option. The minimum required length of Method BV-WSP is found in Section R602.10.6.5.4 and Table R602.10.6.5.4.

Example 3:

Two-story house in Memphis, TN

Brick veneer on entire exterior



Brick exists on all sides of the building, minimum wall bracing length for seismic forces is determined per Table R602.10.6.5.4 using Method BV-WSP.

In Table R602.10.3(4), footnote g is added to the Story column to reinforce the two-story limit for brick veneer. A three-story single- or two-family dwelling will require engineering for the lateral system when the building is in SDC D_2. This footnote mirrors the note in Table R602.10.3(3) for clarity.

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R602.10.6.5

Stone and Masonry Veneer

CHANGE TYPE: Clarification

CHANGE SUMMARY: Veneer applications in high seismic areas are broken into first story and veneer above the first story applications.

2021 CODE TEXT: **R602.10.6.5 Wall bracing for dwellings with stone and masonry veneer in Seismic Design Categories D_0, D_1 and D_2.** Townhouses in Seismic Design Categories D_0, D_1 and D_2 with stone or masonry veneer exceeding the first-story height shall be designed in accordance with accepted engineering practice. One- and two-family dwellings in Seismic Design Category D_2 exceeding two stories and having stone or masonry veneer shall be designed in accordance with accepted engineering practice.

Where stone and masonry veneer are installed in accordance with Section R703.8, wall bracing on exterior braced wall lines and braced wall lines on the interior of the building, backing or perpendicular to and laterally supporting veneered walls shall comply with this section.

R602.10.6.5.1 Veneer on First Story Only. Where dwellings in Seismic Design Categories D_0, D_1 and D_2 have stone or masonry veneer installed in accordance with Section R703.8, and the veneer does not exceed the first-story height, wall bracing shall be in accordance with Section R602.10, exclusive of Section R602.10.6.5.



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Veneer above first story.

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R602.10.6.5.2 Veneer Exceeding First Story Height. Where detached one- or two-family dwellings in Seismic Design Categories D_0, D_1 and D_2 have stone or masonry veneer installed in accordance with Section R703.8, and the veneer exceeds the first-story height, wall bracing at exterior braced wall lines and braced wall lines on the interior of the building shall be constructed using Method BV-WSP in accordance with this section and Figure R602.10.6.5.2. Cripple walls shall not be permitted and required interior braced wall lines shall be supported on continuous foundations.

R602.10.6.5.3 Limited Veneer Exceeding First Story Height. Where detached one- or two-family dwellings in Seismic Design Categories D_0, D_1 and D_2 have exterior veneer installed in accordance with Section R703.8 and brick veneer installed above the first story height meets the following limitations, bracing in accordance with Method WSP or CS-WSP shall be permitted provided that the total length of braced wall panels specified by Table R602.10.3(3) is multiplied by 1.2 for each first- and second-story braced wall line.

1. The dwelling does not extend more than two stories above grade plane.
2. The veneer does not exceed 5 inches (127 mm) in thickness.
3. The height of veneer on gable-end walls does not extend more than 8 feet (2438 mm) above the bearing wall top plate elevation.
4. Where veneer is installed on multiple walls above the first story, the total area of the veneer on the second-story exterior walls shall not exceed 25 percent of the occupied second floor area.
5. Where the veneer is installed on one entire second-story exterior wall, including walls on bay windows and similar appurtenances, brick veneer shall not be installed on any of the other walls on that floor.

R602.10.6.5.4 Length of bracing. The length of bracing along each braced wall line shall be the greater of that required by the ultimate design wind speed and braced wall line spacing in accordance with Table R602.10.3(1) as adjusted by the factors in Table R602.10.3(2) or the seismic design category and braced wall line length in accordance with either Table R602.10.6.5.4 when using Method BV-WSP, or Table R602.10.3(3) as adjusted by the factors in Table R602.10.3(4) when using Method WSP or CS-WSP. Angled walls shall be permitted to be counted in accordance with Section R602.10.1.4, and braced wall panel location shall be in accordance with Section R602.10.2.2. Spacing between braced wall lines shall be in accordance with Table R602.10.1.3. The seismic adjustment factors in Table R602.10.3(4) shall not be applied to the length of bracing determined using Table R602.10.6.5.4, except that the bracing amount increase for braced wall line spacing greater than 25 feet (7620 mm) in accordance with Table R602.10.1.3 shall be required. The minimum total length of bracing in a braced wall line, after all adjustments have been taken, shall be not less than 48 inches (1219 mm) total.

(Deleted text not shown for clarity and brevity)

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CHANGE SIGNIFICANCE: Section R602.10.6.5 now begins with two limitations. Townhouses with brick veneer height exceeding the top of the first story require engineering when in SDC D_0, D_1 and D_2. Three-story buildings with brick veneer for one- and two-families in SDC D_2 also require engineering. Note, all three-story one- and two-family dwellings in SDC D_2 require engineering of the lateral force-resisting system.

Subsections are now organized so veneer on the building is dealt with in terms of the maximum height and extent of the veneer.

IRC Section	Maximum Veneer Height	Extent Allowed	Bracing Methods Allowed
R602.10.6.5.1	Veneer in first story only	Throughout first story	Any
R602.10.6.5.2	Veneer throughout second story	Throughout first and second stories	Method BV-WSP
R602.10.6.5.3	Veneer in gable or into portion of second story	Throughout first story, limited area in second story	Method WSP, Method CS-WSP, Method BV-WSP

In the 2018 IRC, a section was added to permit limited brick veneer on the second story without triggering the use of Method BV-WSP; meanwhile there has been confusion as to how the provision should be applied. Table R602.10.3(4) is modified to refer to Section R602.10.6.5.3 where the limitations for Methods WSP and CS-WSP reside describing how much brick veneer may extend into a second story. To determine minimum bracing lengths for Methods WSP and CS-WSP, Table R602.10.3(3) is used, adjusted by the 1.2 factor in Table R602.10.3(4). For details on determining whether a building requires Method BV-WSP or may use Methods WSP or CS-WSP, see Significant Change R602.10.3(4).

When brick veneer extends to multiple walls of a second story, Table R602.10.6.5.4 gives the minimum wall bracing required for Method BV-WSP. Method BV-WSP continues to require a hold-down at each end of the braced wall panel from the top story down through the building to the foundation. The method may be used when veneer is only on the first story or when it runs up into a gable end wall; but is only required when all other options are not allowed, in other words, when more than 25 percent of the second story is covered in veneer.

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R609.4.1
Garage Doors

CHANGE TYPE: Addition

CHANGE SUMMARY: All garage doors must have a permanent label identifying wind pressure ratings among other information.

2021 CODE TEXT: **R609.4.1 Garage door labeling.** Garage doors shall be labeled with a permanent label provided by the garage door manufacturer. The label shall identify the garage door manufacturer, the garage door model/series number, the positive and negative design wind pressure rating, the installation instruction drawing reference number, and the applicable test standard.

CHANGE SIGNIFICANCE: Since 2005, there has been a push toward considering sustainability in the way our buildings are constructed. If this goal is to be successful, as building owners and occupants increasingly want more information about the sustainability of the buildings they occupy, information to determine how critical components are expected to perform in buildings must be readily available. Some manufacturers already include permanent labels on their products that provide traceability to the manufacturer and the product characteristics.

Garage doors are important components of the building envelope and their performance is critical in preventing wind and water infiltration as well as to maintaining the overall structural integrity of the building. The 2018 IRC did not require garage doors to have a permanent label to provide homeowners, insurers and builders information on a door's wind performance characteristics. For products that do not have permanent labels, it becomes nearly impossible for the owner to determine an installed garage door's structural wind load resistance or energy efficiency. New Section R609.4.1 requires a permanent label on the garage door indicating the manufacturer and model/series number and performance characteristics.

Insurance incentives are now being offered in some states for homes, new and existing, that comply with certain levels of the Fortified program administered by the Insurance Institute for Business and Home Safety (IBHS).



Garage doors must be labeled.

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The Fortified program is a set of engineering and building standards designed to help strengthen new and existing homes through system-specific building upgrades to minimum building code requirements that will reduce damage from natural hazards. Fortified offers three different levels of designation depending on the extent of the recommended upgrades to the building's wind resistance. To qualify for a designation, the home is inspected. Without a permanent label indicating the manufacturer and product model/series number, the performance characteristics of garage doors often cannot be determined, and Fortified designations become more difficult to achieve.

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R702.7
Vapor Retarders

CHANGE TYPE: Modification

CHANGE SUMMARY: The vapor retarder section is reorganized for clarity and ease of use.

2021 CODE TEXT: **R702.7 Vapor retarders.** Vapor retarder materials shall be classified in accordance with Table R702.7(1). A vapor retarder shall be provided on the interior side of frame walls of the class indicated in Table R702.7(2), including compliance with Table R702.7(3) or Table R702.7(4) where applicable. An approved design using accepted engineering practice for hygrothermal analysis shall be permitted as an alternative. The climate zone shall be determined in accordance with Section N1101.7.

Exceptions:

1. Basement walls.
2. Below-grade portion of any wall.
3. Construction where accumulation, condensation, or freezing of moisture will not damage the materials.
4. A vapor retarder shall not be required in Climate Zones 1, 2, and 3.

R702.7(1) Vapor Retarder Materials and Classes

CLASS	ACCEPTABLE MATERIALS
I	Sheet polyethylene, nonperforated aluminum foil, or other approved materials with a perm rating of less than or equal to 0.1.
II	Kraft-faced fiberglass batts, vapor retarder paint, or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating greater than 0.1 and less than or equal to 1.0.
III	Latex paint, enamel paint, or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating of greater than 1.0 and less than or equal to 10.0.

R702.7(2) Vapor Retarder Options

	VAPOR RETARDER CLASS		
CLIMATE ZONE	CLASS I[a]	CLASS II[a]	CLASS III
1,2	Not Permitted	Not Permitted	Permitted
3,4 (except Marine 4)	Not Permitted	Permitted[c]	Permitted
5,6,7,8, Marine 4	Permitted[b]	Permitted[c]	See Table R702.7(3)

a. Class I and II vapor retarders with vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B) shall be allowed on the interior side of any frame wall in all climate zones.
b. Use of a Class I interior vapor retarder in frame walls with a Class I vapor retarder on the exterior side shall require an approved design.
c. Where a Class II vapor retarder is used in combination with foam plastic insulating sheathing installed as continuous insulation on the exterior side of frame walls, the continuous insulation shall comply with Table R702.7(4) and the Class II vapor retarder shall have a vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B).

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TABLE ~~R702.7.1~~ R702.7(3) Class III Vapor Retarders

Climate Zone	Class III Vapor Retarders Permitted For:[a,b]
7 ~~and 8~~	Continuous insulation with R-value ≥ 10 over 2 × 4 wall. Continuous insulation with R-value ≥ 15 over 2 × 6 wall.
8	Continuous insulation with R-value ≥ 12.5 over 2 × 4 wall. Continuous insulation with R-value ≥ 20 over 2 × 6 wall.

(no changes for Climate Zones Marine 4, 5 and 6)

a. Vented cladding shall include vinyl, polypropylene, horizontal aluminum siding, or brick veneer with a clear airspace as specified in Table R703.8.4(1), and other approved vented claddings.

b. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class III vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

R702.7(4) Continuous Insulation with Class II Vapor Retarder

Climate Zone	Class II Vapor Retarders Permitted for:[a]
3	Continuous insulation with R-value ≥ 2.
4, 5 and 6	Continuous insulation with R-value ≥ 3 over 2 × 4 wall. Continuous insulation with R-value ≥ 5 over 2 × 6 wall.
7	Continuous insulation with R-value ≥ 5 over 2 × 4 wall. Continuous insulation with R-value ≥ 7.5 over 2 × 6 wall.
8	Continuous insulation with R-value ≥ 7.5 over 2 × 4 wall. Continuous insulation with R-value ≥ 10 over 2 × 6 wall.

a. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class II vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

R702.7.1 Spray foam plastic insulation for moisture control with Class II and III vapor retarders. For purposes of compliance with Tables R702.7(3) and R702.7(4), spray foam with a maximum permeance of 1.5 perms at the installed thickness applied to the interior side of wood structural panels, fiberboard, insulating sheathing or gypsum shall be deemed to meet the continuous insulation moisture control requirement in accordance with one of the following conditions:

1. The spray foam R-value is equal to or greater than the specified continuous insulation R-value.
2. The combined R-value of the spray foam and continuous insulation is equal to or greater than the specified continuous insulation R-value.

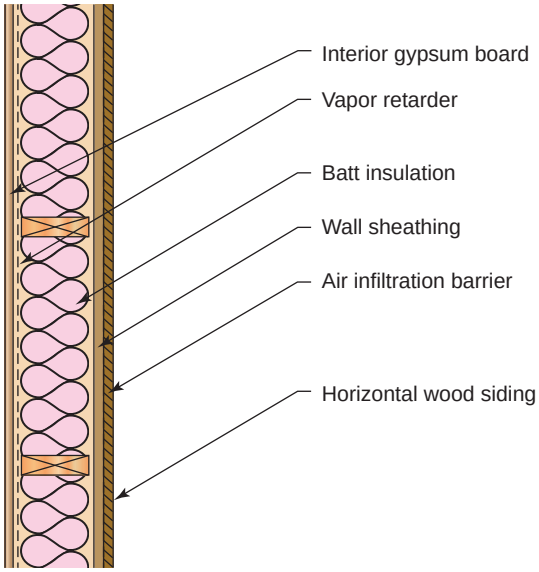
(Deleted text in Section not shown for brevity and clarity.)

CHANGE SIGNIFICANCE: A wall must be designed to prevent accumulation of water within the wall assembly. This is accomplished by providing a water-resistant barrier behind exterior cladding with a means of draining to the exterior any water that enters the assembly. A vapor retarder is provided on the interior side of framed walls to resist passage of condensation into a wall assembly from the building interior. Water vapor tends to move from the warm side of an assembly to the cool side.

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Vapor retarder on exterior wall.

The codes have historically required vapor retarders on the "warm in winter" side of exterior walls. Over time, research has shown that this is not needed in warmer climates. Therefore, the *International Residential Code* (IRC) requires a vapor retarder to be installed on the interior side of a building's thermal envelope in specific climate zones.

Three classifications of vapor retarders are referenced in the IRC: Class I, Class II and Class III.

- Class I vapor retarders are typically sheet polyethylene and nonperforated aluminum foil with a perm rating of more than 0.1.
- Class II retarders can include kraft-faced fiberglass batt insulation or paint that has a perm rating greater than 0.1 and no more than 1.0.
- Latex or enamel paint is considered a Class III vapor retarder with a perm rating between 1 and 10.

The IRC generally requires a Class I or Class II vapor retarder on the interior side of frame walls in Zones 5, 6, 7, 8 and Marine 4; although a Class III vapor retarder can be used when continuous insulation is used on the exterior side of the wall.

The 2021 IRC vapor retarder provisions are reorganized to clarify their use. New tables and text are intended to assist a designer in selecting appropriate vapor retarders for various climatic conditions and desired vapor retarder classes. Some vapor retarders do not fit neatly into categories defined by vapor permeability measurements alone. The prohibition of certain vapor retarder classes in warmer climate zones is based on the need to design assemblies with the ability to dry to the interior and not trap moisture within the wall that has come from outside the building.

However, if a vapor retarder has vapor permeability that increases with relative humidity (RH) to a Class III level, it will allow moisture movement through the exterior wall without accumulation and should not be prohibited. While there is adequate experience in colder climates

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in the United States and Canada to justify use of Class I interior vapor retarders, for example a 4-mil polyethylene, with foam plastic insulating sheathing on the exterior side of an assembly, a design for double vapor barrier assemblies must be submitted for approval. Due to concerns with low drying potential, walls using a double vapor barrier, in other words a Class I vapor retarder on both sides, must be accompanied by air sealing details and a drainage plane to minimize the potential for water leakage and moisture accumulation.

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R703.2, R703.7.3

Water-Resistive Barriers

CHANGE TYPE: Modification

CHANGE SUMMARY: Language for water-resistive barriers is clarified with wet or dry climates specifically considered.

2021 CODE TEXT: **R703.2 Water-resistive barrier.** Not fewer than one layer of water-resistive barrier shall be applied over studs or sheathing of all exterior walls with flashing as indicated in Section R703.4, in such a manner as to provide a continuous water-resistive barrier behind the exterior wall veneer. The water-resistive barrier material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1.

Water-resistive barrier materials shall comply with one of the following:

1. No. 15 felt complying with ASTM D226, Type 1
2. ASTM E2556, Type I or II
3. ASTM E331 in accordance with Section R703.1.1
4. Other approved materials installed in accordance with the manufacturer's installation instructions.

No.15 asphalt felt and water-resistive barriers complying with ASTM E2556 shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm), and where joints occur, shall be lapped not less than 6 inches (152 mm).

R703.7.3 Water-resistive barriers. Water-resistive barriers shall be installed as required in Section R703.2 and, where applied over wood-based sheathing, shall comply with Section R703.7.3.1 or Section R703.7.3.2.



Photo courtesy of Peter Kulczyk

House wrap installed as a continuous water barrier.

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R703.7.3.1 Dry Climates. In dry (B) climate zones indicated in Figure N1101.7, water-resistive barriers shall comply with one of the following:

1. The water-resistive barrier shall be two layers of 10-minute Grade D paper or have a water resistance equal to or greater than two layers of a water-resistive barrier complying with ASTM E2556, Type I. The individual layers shall be installed independently such that each layer provides a separate continuous plane. Flashing installed in accordance with Section R703.4 and intended to drain to the water-resistive barrier, shall be directed between the layers.
2. The water-resistive barrier shall be 60-minute Grade D paper or have a water resistance equal to or greater than one layer of a water-resistive barrier complying with ASTM E2556, Type II. The water-resistive barrier shall be separated from the stucco by a layer of foam plastic insulating sheathing or other non-water-absorbing layer or a designed drainage space.

R703.7.3.2 Moist or marine climates. In the moist (A) or marine (C) climate zones indicated in Figure N1101.7, water-resistive barriers shall comply with one of the following:

1. In addition to complying with Section R703.7.3.1, a space or drainage material not less than 3/16 inch (5 mm) in depth shall be added to the exterior side of the water-resistive barrier.
2. In addition to complying with Section R703.7.3.1 Item 2, drainage on the exterior side of the water-resistive barrier shall have a drainage efficiency of not less than 90 percent, as measured in accordance with ASTM E2273 or Annex A2 of ASTM E2925.

(Deleted text not shown for brevity and clarity.)

CHANGE SIGNIFICANCE: Walls must be designed to prevent accumulation of water within wall assemblies. This is accomplished by providing a water-resistant barrier behind exterior cladding with a means of draining to the exterior any water that enters the assembly. A vapor retarder is provided on the interior side of exterior framed walls to resist passage of condensation into wall assemblies from the building interior.

The most common way to provide a drainage plane is to install weather-resistant materials in shingle fashion beneath a wall covering. A water-resistive barrier must provide a path for water flow if it migrates through a wall covering. Siding and veneers are typically not impervious to wind-driven rain. Water-resistive barriers in combination with flashing complete a weather protective system to move moisture out of a wall assembly. A water-resistive barrier must be continuous from the base of a building to the top of its walls.

There is a broad range of water-resistive barriers available in addition to traditional No. 15 asphalt felt. Sheet-type water-resistive barriers complying with ASTM D226, ASTM E331 or ASTM E2556 may be used. Nonsheet-style materials that provide equivalent protection may also be used. Section R703.2 now lists materials which may be used and testing standards that alternative materials must meet to be used as water-resistive barriers.

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Section R703.7.3, water-resistive barriers for stucco, is reorganized into subsections that focus on different methods of complying with requirements based on wet or dry climatic conditions. It is critical to determine the local climate and tendency of moisture to infiltrate walls. These considerations were not accounted for in earlier code editions when stucco was assumed to be typically applied in dry, warm climates. Today, stucco is used throughout the United States and climate consideration is needed to avoid increased risk of moisture problems in climates that are moist or frequently rainy. This revision helps resolve performance issues due to moisture when stucco is placed over wood-based sheathing and does not affect construction methods in dry climates such as the southwestern region of the United States where stucco has performed well.

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Table R703.8.4(1)

Veneer Attachment

CHANGE TYPE: Modification

CHANGE SUMMARY: Larger air gaps are allowed behind veneer to accommodate thicker continuous insulation.

2021 CODE TEXT:

TABLE R703.8.4(1) Tie Attachment and Airspace Requirements

Backing and Tie	Minimum Tie	Minimum Tie Fastener[a]	Airspace[b]	
Wood stud backing with corrugated sheet metal	22 U.S. gage (0.0299 in.) × 7/8 in. wide	8d common nail[b,c] (2½ in. × 0.131in.)	Nominal 1 in. between sheathing and veneer	
Wood stud backing with adjustable metal strand wire	W1.7 (No. 9 U.S. gage; 0.148 in. dia.) with hook embedded in mortar joint[d]	8d common nail[b,c] (2½ in. × 0.131in.)	Minimum nominal 1in. between sheathing and veneer	Maximum ~~4½~~ 4⅝ in. between backing and veneer
Wood stud backing with adjustable metal strand wire	W2.8 (0.187 in. dia.) with hook embedded in mortar joint[e,f]	8d common nail[c] (2½ in. × 0.131in.)	Greater than 4⅝ in. between backing and veneer	Maximum 6⅝ in. between backing and veneer
Cold-formed steel stud backing with adjustable metal strand wire	W1.7 (No. 9 U.S. gage; 0.148 in. dia.) with hook embedded in mortar joint[d]	No. 10 screw extending through the steel framing a minimum of three exposed threads	Minimum nominal 1 in. between sheathing and veneer	Maximum ~~4½~~ 4⅝ in. between backing and veneer
Cold-formed steel stud backing with adjustable metal strand wire	W2.8 (0.187 in. dia.) with hook embedded in mortar joint[e,f]	No. 10 screw extending through the steel framing a minimum of three exposed threads	Greater than 4⅝ in. between backing and veneer	Maximum 6⅝ in.between backing and veneer

~~b.~~a. All fasteners shall have rust-inhibitive coating suitable for the installation in which they are being used or be manufactured from material not susceptible to corrosion.

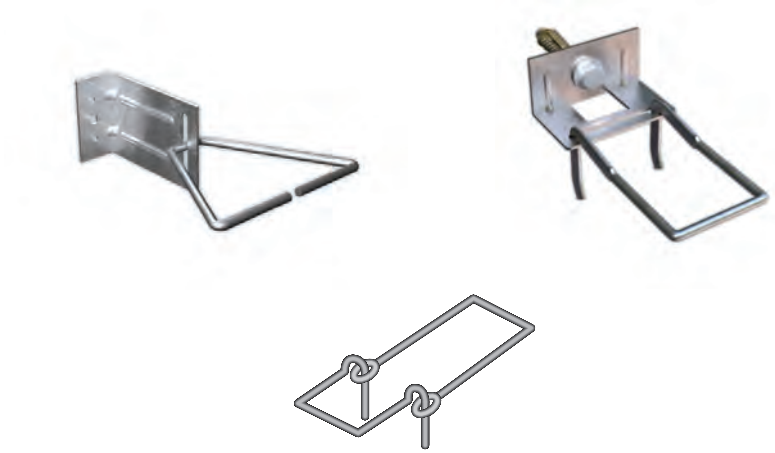
~~c.~~b. An airspace that provides drainage shall be permitted to contain mortar from construction.

~~a.~~c. In Seismic Design Category D_0, D_1 or D_2, the minimum tie fastener shall be an 8d ring-shank nail (2½ in. × 0.131 in.) ~~or a No. 10 screw extending through the steel framing a minimum of three exposed threads~~.

d. Adjustable tie pintles shall include not fewer than 1 pintle leg of wire size W2.8 (MW18) with a maximum offset of 1-1/4 in.

e. Adjustable tie pintles shall include not fewer than 2 pintle legs with a maximum offset of 1¼ in. Distance between inside face of brick and end of pintle shall be a maximum of 2 in.

f. Adjustable tie backing attachment components shall consist of one of the following: eyes with minimum wire W2.8 (MW18), barrel with minimum ¼ in. outside dia., or plate with minimum thickness of 0.074 in. and minimum width of 1¼ in.



Veneer anchor examples.

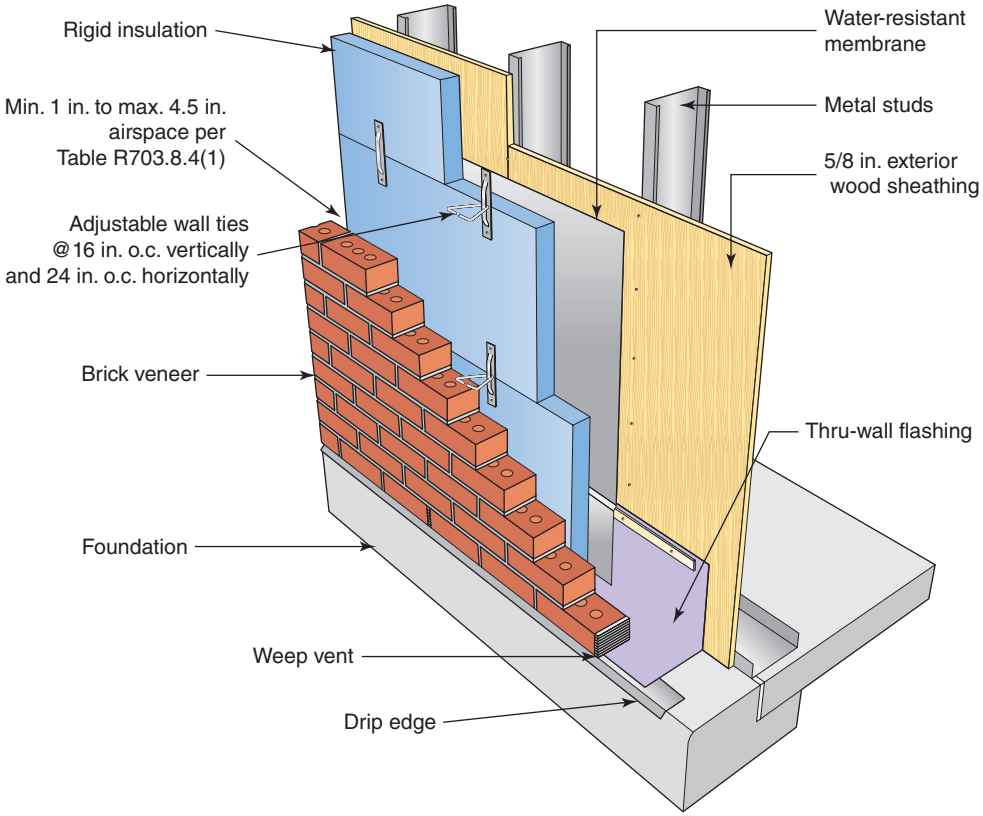
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CHANGE SIGNIFICANCE: IRC tie and airspace provisions now match *International Building Code* (IBC) requirements through reference to the anchored masonry veneer provisions of TMS 402, *Building Code Requirements for Masonry Structures*.

Energy conservation techniques using exterior foam sheathing require larger airspaces constructed between anchored masonry veneer and its backing in order to accommodate thicker continuous insulation used in colder climate zones. Masonry veneer with airspaces up to a maximum of $4^{5}/_{8}$ inches may be constructed using traditional tie configurations. Airspaces up to $6^{5}/_{8}$ inches must be constructed using stiffer tie configurations. These ties use thicker pintles with double legs or an eye, barrel or plate arrangement for greater strength.



Veneer attachment to wood-frame construction.

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R703.11.2

Vinyl Siding Installation Over Foam Plastic Sheathing

CHANGE TYPE: Modification

CHANGE SUMMARY: Wind pressure ratings for vinyl siding are decreased.

2021 CODE TEXT: **R703.11.2 Installation over foam plastic sheathing.** Where vinyl siding or insulated vinyl siding is installed over foam plastic sheathing, the vinyl siding shall comply with Section R703.11 and shall have a wind load design ~~wind~~ pressure ~~resistance~~ rating in accordance with Table R703.11.2.

Exceptions:

1. Where the foam plastic sheathing is applied directly over wood structural panels, fiberboard, gypsum sheathing or other approved backing capable of independently resisting the design wind pressure, the vinyl siding shall be installed in accordance with Sections R703.3.3 and R703.11.1.
2. Where the vinyl siding manufacturer's product specifications provide an approved wind load design ~~wind~~ pressure rating for installation over foam plastic sheathing, use of this wind load design ~~wind~~ pressure rating shall be permitted and the siding shall be installed in accordance with the manufacturer's installation instructions.
3. Where the foam plastic sheathing and its attachment have a design wind pressure resistance complying with Sections R316.8 and R301.2.1, the vinyl siding shall be installed in accordance with Sections R703.3.3 and R703.11.1.



Vinyl siding over foam plastic sheathing.

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TABLE R703.11.2 ~~Adjusted~~ Required Minimum Wind Load Design ~~Wind~~ Pressure ~~Requirement~~ Rating for Vinyl Siding Installed over Foam Plastic Sheathing Alone

Ultimate Design Wind Speed (mph)	Adjusted Minimum Design Wind Pressure (ASD) (psf)[a,b]					
	Case 1: With interior gypsum wallboard[c]			Case 2: Without interior gypsum wallboard[c]		
	Exposure			Exposure		
	B	C	D	B	C	D
≤95	-30.0	-33.2	-39.4	-33.9	-47.4	-56.2
100	-30.0	-36.8	-43.6	-37.2	-52.5	-62.2
105	-30.0	-40.5	-48.1	-41.4	-57.9	-68.6
110	~~-44.0~~ -31.8	~~-61.6~~ -44.5	~~-73.1~~ -52.8	~~-62.9~~ -45.4	~~-88.1~~ -63.5	~~-104.4~~ -75.3
115	~~-49.2~~ 35.5	~~-68.9~~ -49.7	~~-81.7~~ -59.0	~~-70.3~~ -50.7	~~-98.4~~ -71.0	~~-116.7~~ -84.2
120	~~-51.8~~ -37.4	~~-72.5~~ -52.4	~~-86.0~~ -62.1	~~-74.0~~ -53.4	~~-103.6~~ -74.8	~~-122.8~~ -88.6
130	~~-62.2~~ -44.9	~~-87.0~~ -62.8	~~-103.2~~ -74.5	~~-88.8~~ -64.1	~~124.3~~ -89.7	~~-147.4~~ -106
> 130	See Footnote d ~~Not Allowed~~[d]					

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, 1 mile per hour = 0.447 m/s, 1 pound per square foot = 0.0479 kPa.

a. Linear interpolation is permitted.

b. The table values are based on a maximum 30-foot mean roof height, and effective wind area of 10 square feet Wall Zone 5 (corner), and the ASD design component and cladding wind pressure from Table R301.2.1(1), adjusted for exposure in accordance with Table R301.2.1(2), multiplied by the following adjustment factors: ~~2.6~~ 1.87 (Case 1) and ~~3.7~~ 2.67 (Case 2) ~~for wind speeds less than 130 mph and 3.7 (Case 2) for wind speeds greater than 130 mph~~.

c. Gypsum wallboard, gypsum panel product or equivalent.

d. For the indicated wind speed condition, and where foam sheathing is the only sheathing on the exterior of frame walls with vinyl siding, ~~is not allowed unless the vinyl siding complies with an adjusted minimum design wind pressure requirement as determined in accordance with Note b and~~ the wall assembly ~~is~~ shall be capable of resisting an impact without puncture at least equivalent to that of a wood frame wall with minimum $^{7}/_{16}$-inch OSB sheathing as tested in accordance with ASTM E1886. The vinyl siding shall comply with an adjusted design wind pressure requirement in accordance with Note b, using an adjustment factor of 2.67.

CHANGE SIGNIFICANCE: Table R703.11.2 is updated so adjusted vinyl siding design wind pressure ratings are consistent with requirements in ASTM D3679, *Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding*. The ASTM D3679 pressure equalization factor for determining design wind pressure ratings of vinyl siding was recently revised. Because the pressure equalization factor in ASTM D3679 is now more conservative (changed from 0.36 to 0.5), adjustments for vinyl siding applications over foam sheathing are adjusted downward by multiplying existing tabulated values by 0.36/0.5 = 0.72. Consistency with ASTM D3679 is also provided by using the term wind load design pressure rating.

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R704

Soffits

CHANGE TYPE: Addition

CHANGE SUMMARY: Requirements for soffit material and installation are expanded.

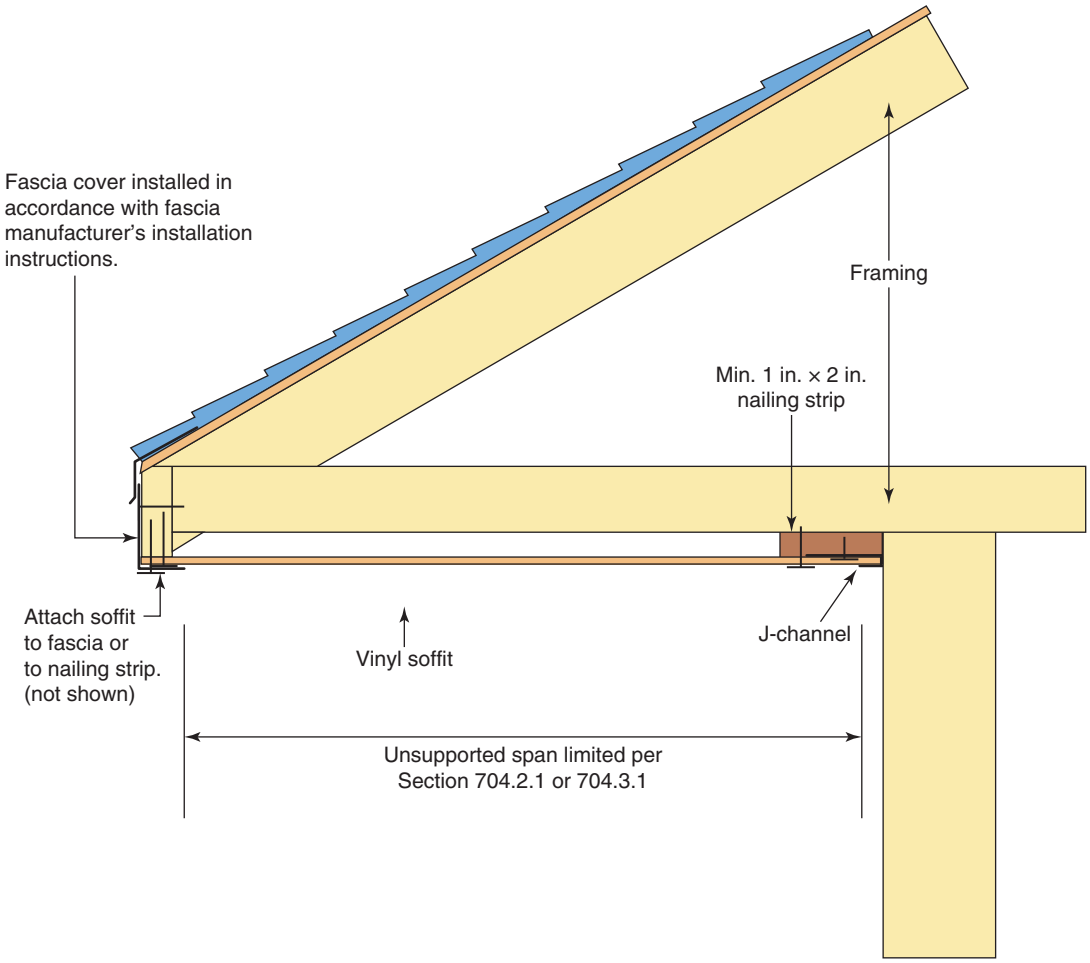


Fiber-cement soffit.

2021 CODE TEXT: **R703.3.1 Soffit installation.** Soffits shall comply with Section R704.~~R703.3.1.1, Section R703.3.1.2 or the manufacturer's installation instructions~~.

SECTION R704 SOFFITS

R704.1 General wind limitations. Where the design wind pressure is 30 pounds per square foot (1.44 kPa) or less, soffits shall comply with Section R704.2. Where the design wind pressure exceeds 30 pounds per square foot (1.44 kPa), soffits shall comply with Section R704.3. The design wind pressure on soffits shall be determined using the component and cladding loads specified in Table R301.2.1(1) for walls using an effective wind area of 10 square feet and adjusted for height and exposure in accordance with Table R301.2.1(2).



Soffit support: Single span.

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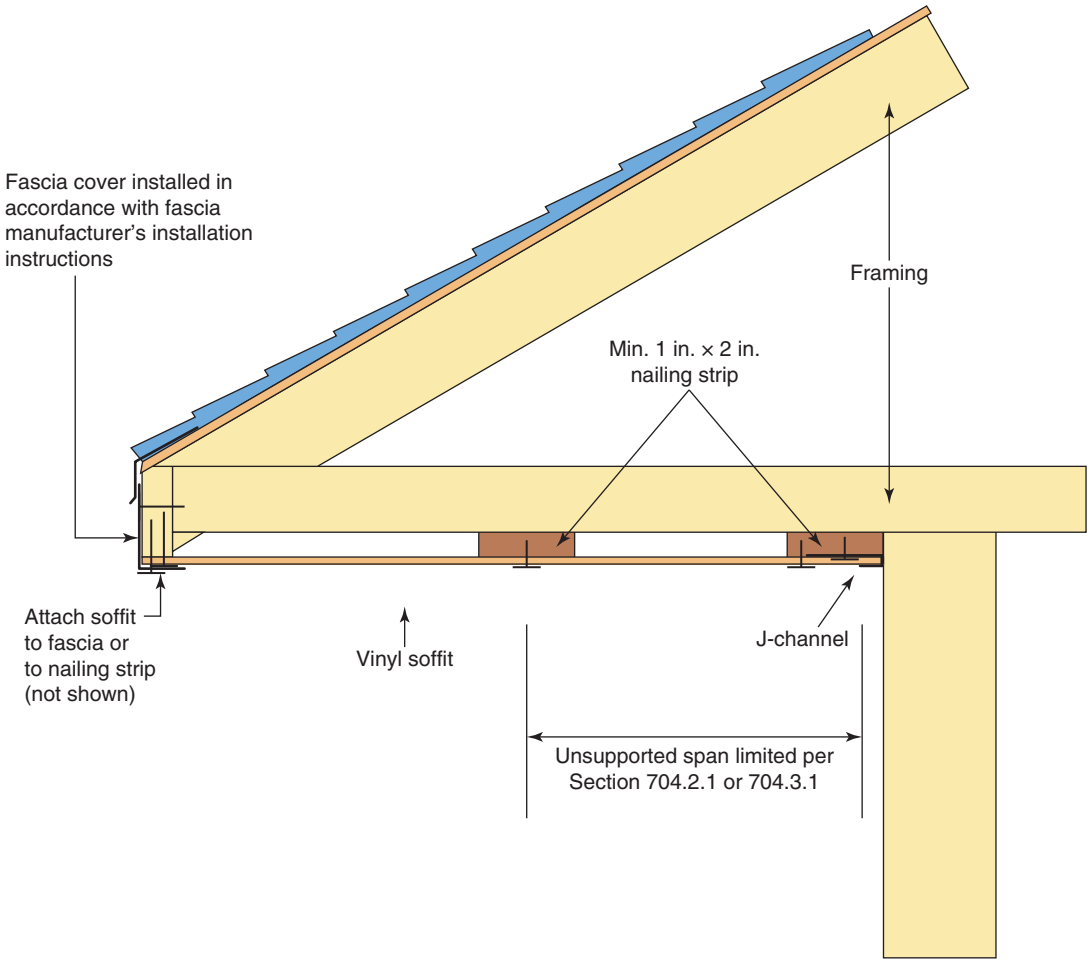
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R704.2 Soffit installation where the design wind pressure is 30 psf or less. Where the design wind pressure is 30 pounds per square foot (1.44 kPa) or less, soffit installation shall comply with Section R704.2.1, Section R704.2.2, Section R704.2.3, or Section R704.2.4. Soffit materials not addressed in Sections R704.2.1 through R704.2.4 shall be in accordance with the manufacturer's installation instructions.

R704.2.1 Vinyl soffit panels. Vinyl soffit panels shall be installed using fasteners specified by the manufacturer and shall be fastened at both ends to a supporting component such as a nailing strip, fascia or subfascial component in accordance with Figure R704.2.1(1). Where the unsupported span of soffit panels is greater than 16 inches, intermediate nailing strips shall be provided in accordance with Figure R704.2.1(2). Vinyl soffit panels shall be installed in accordance with the manufacturer's installation instructions. Fascia covers shall be installed in accordance with the manufacturer's installation instructions.

R704.2.2 Fiber-cement soffit panels Fiber-cement soffit panels shall be a minimum of ¼-inch in thickness and shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over framing or over wood structural panel sheathing. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's installation instructions.



Soffit support: Double span.

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R704.2.3 Hardboard soffit panels. Hardboard soffit panels shall be not less than $^{7}/_{16}$-inch in thickness and shall be fastened to framing or nailing strips with 2½" × 0.113" (64 mm × 2.9 mm) siding nails spaced not more than 6 inches (152 mm) on center at panel edges and 12 inches (305 mm) on center at intermediate supports.

~~R703.3.1.1~~ R704.2.4 Wood structural panel soffit. The minimum nominal thickness for wood structural panel soffits shall be $^{3}/_{8}$-inch (9.5 mm) and shall be fastened to framing or nailing strips with 2-inch by 0.099-inch (51 mm × 2.5 mm) nails. Fasteners shall be spaced not less than 6 inches (152 mm) on center at panel edges and 12 inches (305 mm) on center at intermediate supports.

R704.3 Soffit installation where the design wind pressure exceeds 30 psf. Where the design wind pressure is greater than 30 psf, soffit installation shall comply with Section R704.3.1, Section R704.3.2, Section R704.3.3, or Section R704.3.4. Soffit materials not addressed in Sections R704.3.1 through R704.3.4 shall be in accordance with the manufacturer's installation instructions.

R704.3.1 Vinyl soffit panels. Vinyl soffit panels and their attachments shall be capable of resisting wind loads specified in Table R301.2.1(1) for walls using an effective wind area of 10 square feet (0.929 m^2) and adjusted for height and exposure in accordance with Table R301.2.1(2). Vinyl soffit panels shall be installed using fasteners specified by the manufacturer and shall be fastened at both ends to a supporting component such as a nailing strip, fascia or subfascia component in accordance with Figure R704.2.1(1). Where the unsupported span of soffit panels is greater than 12 inches (305 mm), intermediate nailing strips shall be provided in accordance with Figure R704.2.1(2). Vinyl soffit panels shall be installed in accordance with the manufacturer's installation instructions. Fascia covers shall be installed in accordance with the manufacturer's installation instructions.

R704.3.2 Fiber-cement soffit panels. Fiber-cement soffit panels shall comply with Section R704.2.2 and shall be capable of resisting wind loads specified in Table R301.2.1(1) for walls using an effective wind area of 10 square feet (0.929 m^2) and adjusted for height and exposure in accordance with Table R301.2.1(2).

R704.3.3 Hardboard soffit panels. Hardboard soffit panels shall comply with the manufacturer's installation instructions and shall be capable of resisting wind loads specified in Table R301.2.1(1) for walls using an effective wind area of 10 square feet (0.929 m^2) and adjusted for height and exposure in accordance with Table R301.2.1(2).

R704.3.4 Wood structural panel soffit. Wood structural panel soffits shall be capable of resisting wind loads specified in Table R301.2.1(1) for walls using an effective wind area of 10 square feet (0.929 m^2) and adjusted for height and exposure in accordance with Table R301.2.1(2). Alternatively, wood structural panel soffits shall be installed in accordance with Table R704.3.4.

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TABLE R704.3.4 Prescriptive Alternative for Wood Structural Panel Soffit[b,c,d,e]

Maximum Design Pressure (+ or - psf)	Minimum Panel Span Rating	Minimum Panel Performance Category	Nail Type and Size	Fastenera Spacing Along Edges and Intermediate Supports	
				Galvanized Steel	Stainless Steel
30	24/0	3/8	6d box (2 × 0.099 × 0.266 head diameter)	6[f]	4
40	24/0	3/8	6d box (2 × 0.099 × 0.266 head diameter)	6	4
50	24/0	3/8	6d box (2 × 0.099 × 0.266 head diameter)	4	4
			8d common (2½ × 0.131 × 0.281 head diameter)	6	6
60	24/0	3/8	6d box (2 × 0.099 × 0.266 head diameter)	4	3
			8d common (2½ × 0.131 × 0.281 head diameter)	6	4
70	24/16	7/16	8d common (2½ × 0.131 × 0.281 head diameter)	4	4
			10d box (3 × 0.128 × 0.312 head diameter)	6	4
80	24/16	7/16	8d common (2½ × 0.131 × 0.281 head diameter)	4	4
			10d box (3 × 0.128 × 0.312 head diameter)	6	4
90	32/16	15/32	8d common (2½ × 0.131 × 0.281 head diameter)	4	3
			10d box (3 × 0.128 × 0.312 head diameter)	6	4

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

a. Fasteners shall comply with Sections R703.3.2 and R703.3.3.

b. Maximum spacing of soffit framing members shall not exceed 24 inches.

c. Wood structural panels shall be of an exterior exposure grade.

d. Wood structural panels shall be installed with strength axis perpendicular to supports with not fewer than two continuous spans.

e. Wood structural panels shall be attached to soffit framing members with specific gravity of at least 0.42. Framing members shall be minimum 2×3 nominal with the larger dimension in the cross section aligning with the length of fasteners to provide sufficient embedment depths.

f. Spacing at intermediate supports shall be not greater than 12 inches on center.

CHANGE SIGNIFICANCE: Specific material requirements are added for soffits to clarify their wind performance when using IRC installation provisions for common manufactured soffit types. New Section R704 also provides a prescriptive alternative for wood structural panel soffits that complies with design wind pressures specified in the IRC and ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. This section refines and further clarifies provisions adopted into the 2018 IRC and adds new provisions to address soffit installation in high wind regions. Provisions move to new Section R704 to better distinguish soffit requirements from exterior wall covering provisions in Section R703.

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Observations during damage assessments of Hurricane Harvey in Texas and Hurricane Irma in Florida revealed frequent soffit damage in both new and existing construction. In Florida, vinyl and metal soffits were damaged, but vinyl soffit panels were the most common product observed, particularly in the Florida Keys where vinyl soffit damage was widespread. In Texas, many soffits lacked adequate wind resistance due to use of improper materials, a lack of fasteners, or inadequate framing leading to water intrusion inside the building envelope. Based on estimated wind speeds at the sites visited, failure occurred to soffit components at wind speeds well below design wind speeds for the area. Loss of soffit vents can allow hurricane winds to drive large amounts of water through resulting openings and soak insulation, which can lead to mold growth and, in some cases, ceiling collapse.

In many cases, inadequate support and attachment at soffit panel ends led to failure. There were cases where soffits appeared to have been fastened by a single nailing strip across the midpoint of the framing above. New Section R704.2.1 clarifies that vinyl soffit panels are required to be fastened at each end and an unsupported span cannot exceed 16 inches unless permitted by the manufacturer's product approval.

Provisions in this section are applied based on component and cladding design wind pressures from Table R301.2.1(1) and Table R301.2.1(2) with an assumed 30 psf design wind pressure. For most of the country, design wind pressures will be 30 psf or less, even in Exposure Category D areas, requiring connections similar to those in the 2018 IRC. For higher wind regions, enhanced soffit construction will be required where the design wind pressure exceeds 30 psf.

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R802
Wood Roof Framing

CHANGE TYPE: Modification

CHANGE SUMMARY: Revised provisions clarify ridge beam and ceiling joist requirements.

2021 CODE TEXT: **R802.3 Ridge.** A ridge board used to connect opposing rafters shall be not less than 1 inch (25 mm) nominal thickness and not less in depth than the cut end of the rafter. Where ceiling joist or rafter ties do not provide continuous ties across the structure as required by Section R802.5.2, the ~~a~~ ridge shall be supported by a wall or ridge beam designed in accordance with accepted engineering practice ~~shall be provided~~ and supported on each end by a wall or column ~~girder~~.

R802.5 Ceiling joists. Ceiling joists shall be continuous across the structure or securely joined where they meet over interior partitions in accordance with ~~Table R802.5.2~~ Section R802.5.2.1. Ceiling joists shall be fastened to the top plate in accordance with Table R602.3(1).

R802.5.2 Ceiling joist and rafter connections. Where ceiling joists run parallel to rafters, and are located ~~they shall be connected to rafters at the top wall plate in accordance with Table R802.5.2. Where ceiling joists are not connected to the rafters at the top wall plate, they shall be installed~~ in the bottom third of the rafter height, they shall be installed in accordance with Figure R802.4.5 and fastened to rafters in accordance with Table R802.5.2(1). Where the ceiling joists are installed above the bottom third of the rafter height, the ridge shall be designed as a beam in accordance with R802.3. Where ceiling joists do not run parallel to rafters, ~~the ceiling joists shall be connected to top plates in accordance with Table R602.3(1). Each~~ rafters shall be tied across the structure with a rafter tie in accordance with R802.5.2.2, or the ridge shall be designed



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Wood-framed roof line.

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as a beam in accordance with R802.3. ~~or a 2-inch by 4-inch (51 mm × 102 mm) kicker connected to the ceiling diaphragm with nails equivalent in capacity to Table R802.5.2.~~

R802.5.2.1 Ceiling joists lapped. Ends of ceiling joists shall be lapped not less than 3 inches (76 mm) or butted over bearing partitions or beams and toenailed to the bearing member. Where ceiling joists are used to provide the continuous tie across the building ~~resistance to rafter thrust~~, lapped joists shall be nailed together in accordance with Table R802.5.2(1) and butted joists shall be tied together with a connection of equivalent capacity ~~in a manner to resist such thrust~~. Laps in joists ~~Joists~~ that do not ~~resist thrust~~ provide the continuous tie across the building shall be permitted to be nailed in accordance with Table R602.3(1). ~~Wood structural panel roof sheathing, in accordance with Table R503.2.1.1(1), shall not cantilever more than 9 inches (229 mm) beyond the gable endwall unless supported by gable overhang framing.~~

R802.5.2.2 Rafter ties. Wood rafter ties shall be not less than 2 inches by 4 inches (51 mm × 102 mm) installed in accordance with Table R802.5.2(1) ~~at each rafter~~ a maximum of 24 inches (610 mm) on center. Other approved rafter tie methods shall be permitted.

R802.5.2.3 Blocking. Blocking shall be not less than utility grade lumber.

CHANGE SIGNIFICANCE: Requirements for connection of rafters and ceiling joists are clarified. Section R802.5 establishes the concept of a continuous tie across lower portions of rafters, using either ceiling joists or rafter ties, so rafters under roof loads do not push out exterior bearing walls—an action referred to as rafter thrust. Rafters and ceiling joists form a triangle, which is a stable shape as long as member ends are connected together. When the lower ends of rafters are not connected to rafter ties or ceiling joists to resist thrust, the only way to prevent thrust is to support them at the peak by a ridge beam.

Ceiling joists are installed in the lower portion of an attic and fastened in a specific manner to create a rafter tie. However, ceiling joists may be installed higher in an attic or perpendicular to rafters. Occasionally, there may not be any ceiling joists, such as in a cathedral ceiling. When ceiling joists are not located at the top of a bearing wall, ties are required to meet the provisions of Section R802.5.2 to ensure that rafters do not push (thrust) walls outward. In these cases, either a tie can be provided, or a ridge beam should be designed in accordance with accepted engineering practice.

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CHANGE TYPE: Modification

CHANGE SUMMARY: The heel joint connection table is updated for roof spans of 24 and 36 feet and a 19.2-inch rafter spacing.

Table R802.5.2(1)
Heel Joint Connections

2021 CODE TEXT:

TABLE R802.5.2(1) Rafter/Ceiling Joist Heel Joint Connections[g]

RAFTER SLOPE	RAFTER SPACING (inches)	GROUND SNOW LOAD (psf)											
		20[e]			30			50			70		
		Roof span (feet)											
		12	24	36	12	24	36	12	24	36	12	24	36
		Required number of 16d common nails per heel joint splice[a,b,c,d,f]											
3:12	12	3	5	8	3	6	9	5	9	13	6	12	17
	16	4	7	10	4	8	12	6	12	17	8	15	23
	19.2	4	8	12	5	10	14	7	14	21	9	18	27
	24	5	10	15	6	12	18	9	17	26	12	23	34
4:12	12	3	4	6	3	5	7	4	7	10	5	9	13
	16	3	5	8	3	6	9	5	9	13	6	12	17
	19.2	3	6	9	4	7	11	6	11	16	7	14	21
	24	4	8	11	5	9	13	7	13	19	9	17	26
5:12	12	3	3	5	3	4	6	3	6	8	4	7	11
	16	3	4	6	3	5	7	4	7	11	5	9	14
	19.2	3	5	7	3	6	9	5	9	13	6	11	17
	24	3	6	9	4	7	11	6	11	16	7	14	21
7:12	12	3	3	4	3	3	4	3	4	6	3	5	8
	16	3	3	5	3	4	5	3	5	8	4	7	10
	19.2	3	4	5	3	4	6	3	6	9	4	8	12
	24	3	5	7	3	5	8	4	8	11	5	10	15
9:12	12	3	3	3	3	3	3	3	3	5	3	4	6
	16	3	3	4	3	3	4	3	4	6	3	5	8
	19.2	3	3	4	3	4	5	3	5	7	3	6	9
	24	3	4	5	3	4	6	3	6	9	4	8	12
12:12	12	3	3	3	3	3	3	3	3	4	3	3	5
	16	3	3	3	3	3	3	3	3	5	3	4	6
	19.2	3	3	3	3	3	4	3	4	6	3	5	7
	24	3	3	4	3	3	5	3	5	7	3	6	9

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.

a. 10d common (3" × 0.148") nails shall be permitted to be substituted for 16d common (3-1/2" × 0.162") nails where the required number of nails is taken as 1.2 times the required number of 16d common nails, rounded up to the next full nail. ~~40d box nails shall be permitted to be substituted for 16d common nails.~~

~~b. Nailing requirements shall be permitted to be reduced 25 percent if nails are clinched.~~

b.~~c.~~ Heel joint connections are not required where the ridge is supported by a load-bearing wall, header or ridge beam.

c.~~d.~~ Where intermediate support of the rafter is provided by vertical struts or purlins to a load-bearing wall, the tabulated heel joint connection requirements shall be permitted to be reduced proportionally to the reduction in span.

d.~~e.~~ Equivalent nailing patterns are required for ceiling joist to ceiling joist lap splices.

e.~~f.~~ Applies to roof live load of 20 psf or less.

f.~~g.~~ Tabulated heel joint connection requirements assume that ceiling joists or rafter ties are located at the bottom of the attic space. Where ceiling joists or rafter ties are located higher in the attic, heel joint connection requirements shall be increased by the adjustment factors in Table R802.5.2(2).

g. Tabulated requirements are based on 10 psf roof dead load in combination with the specified roof snow load and roof live load.

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TABLE R802.5.2(2) Heel Joint Connection Adjustment Factors

H_C/H_R [a,b]	Heel Joint Connection Adjustment Factor
1/3	1.5
1/4	1.33
1/5	1.25
1/6	1.2
1/10 or less	1.11

a. H_C = Height of ceiling joists or rafter ties measured vertically ~~above~~ from the top of the rafter support walls to the bottom of the ceiling joists or rafter ties; H_R = Height of roof ridge measured vertically ~~above~~ from the top of the rafter support walls to the bottom of the roof ridge.
b. Where H_C/H_R exceeds 1/3, connections shall be designed in accordance with accepted engineering practice.

(Deleted text in table not shown for brevity and clarity.)



Photo courtesy of Arthur Tilley/Stockbyte/Getty Images

Heel joint connection.

CHANGE SIGNIFICANCE: Table R802.5.2(1) is updated to be consistent with the calculation basis of the American Wood Council's (AWC) *2018 Wood Frame Construction Manual* (WFCM) heel joint nailing requirements which are based on the AWC *2018 National Design Specification for Wood Construction* (NDS) provisions for nailed connections. A reduction in the required number of 16d common nails required in rafter tie connections by approximately 15 percent is due to changes based on a penetration factor and load duration. Previously, a 0.77 penetration factor (based on the 1991 and 1997 NDS) was used for 16d common nails with less than 12d penetration in the main member and a load duration factor of 1.25.

Revised nailing requirements are based on a 1.15 load duration factor for snow load cases, 1.25 load duration factor for roof live load cases, and an effective penetration factor equal to 1.0 per the current NDS where lateral design value calculations for nails are based on the actual

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penetration in the wood member. The ratio of nail design values for snow cases originally used to develop nailing requirements to the current nail design values for snow cases is $(Z \times 0.77 \times 1.25) / (Z \times 1.0 \times 1.15) = 0.84$ and explains the reduced number of nails now required in the table. Due to revised NDS nail design provisions, clinched nails are no longer recognized for this application. A 10d common nail option is added based on NDS lateral design value calculations.

Lastly, a sentence is added to footnote f, now Table R802.5.2(2), to clarify that rafter tie connections higher than the bottom third of the attic space ($H_C/H_R > 1/3$) must be engineered while the definitions of H_C and H_R are clarified to show how the variables should be measured.

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R802.6

Rafter and Ceiling Joist Bearing

CHANGE TYPE: Modification

CHANGE SUMMARY: Text is added to clarify when a ridge board connection is sufficient for bearing.

2021 CODE TEXT: **R802.6 Bearing.** The ends of each rafter or ceiling joist shall have not less than $1^1/_2$ inches (38 mm) of bearing on wood or metal and not less than 3 inches (76 mm) on masonry or concrete. The bearing on masonry or concrete shall be direct, or a sill plate of 2-inch (51 mm) minimum nominal thickness shall be provided under the rafter or ceiling joist. The sill plate shall provide a minimum nominal bearing area of 48 square inches (30 865 mm^2). Where the roof pitch is greater than or equal to 3 units vertical in 12 units horizontal (25-percent slope), and ceiling joists or rafter ties are connected to rafters to provide a continuous tension tie in accordance with Section R802.5.2, vertical bearing of the top of the rafter against the ridge board shall satisfy this bearing requirement.

CHANGE SIGNIFICANCE: Changes to Section R802.6 clarify acceptable bearing area, or contact, for rafters, specifically at the top ends of rafters. Section R802.6 requires that the ends of each rafter or ceiling joist have at least 1½ inches of bearing on wood or metal. Bearing typically occurs when one component of an assembly rests on a horizontal surface, such as a top plate, beam or hanger of another element in an assembly to resist vertical loads. However, for a rafter system that has collar ties (or straps) at the top and a continuous tension tie at the bottom of the roof assembly provided by ceiling joists or rafter ties, the downward (gravity) force is transferred to the lower ends of the rafters, and a horizontal bearing force occurs at the top of the rafter toward the ridge board.



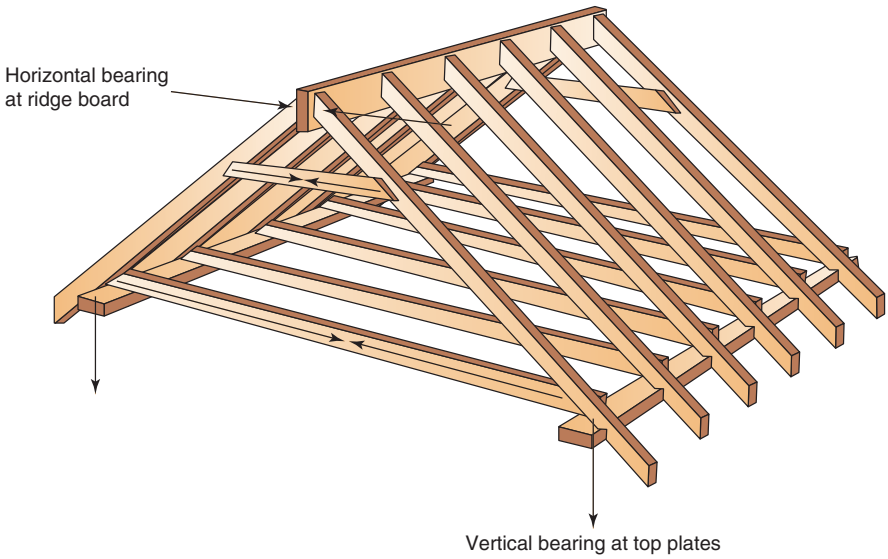
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Rafters bearing on exterior side wall.

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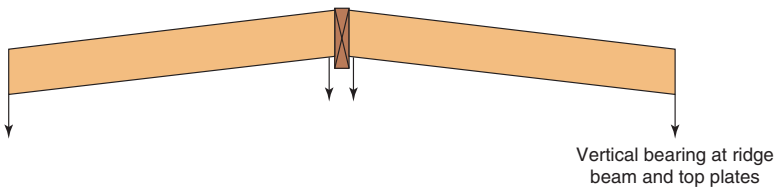
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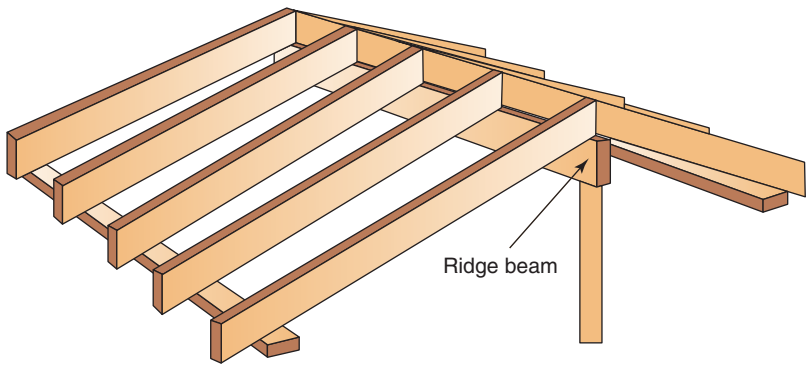
Forces in a stick-built roof.

When a roof slope is shallow, a structural ridge beam is required to manage horizontal and vertical forces per Section R802.4.4. In this case, the ridge beam provides vertical support for the top end of the rafters, and a connection with vertical capacity is required. An example is a joist hanger that provides a horizontal bearing surface for the end of the rafter.



Forces in a low-slope roof.

Cathedral ceilings, while typically having a higher slope, normally do not have ceiling joists or collar ties. Since a horizontal tie is not provided at the bottom of the rafters, a load-bearing ridge beam is required per Section R802.5.2. A ridge beam provides vertical support (bearing) for the top end of the rafter.



Cathedral ceilings require a ridge beam to resist vertical forces.

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Table R804.3

CFS Roof Framing Fasteners

CHANGE TYPE: Modification

CHANGE SUMMARY: Connections for cold-formed steel (CFS) roof framing members are updated and clarified.

2021 CODE TEXT:

TABLE R804.3 Roof Framing Fastening Schedule[a,b]

Description of Building Elements	Number and Size of Fasteners[a]	Spacing of Fasteners
Roof sheathing (oriented strand board or plywood) to rafter	No. 8 screws	6" o.c. on edges and 12" o.c. at interior supports. 6" o.c. at gable end truss
Gypsum board to ceiling joists	No. 6 screws	12" o.c.
Gable end truss to endwall top track	No. 10 screws	12" o.c.
Rafter to ceiling joist and to ridge member	Minimum No. 10 screws, in accordance with Table R804.3.1.1(3)	Evenly spaced, not less than 1/2" from all edges.

Description of Building Elements	Ceiling Joist or Truss Spacing (in.)	Roof Span (ft)	Ultimate Design Wind Speed (mph) and Exposure Category				Spacing of Fasteners
			130B 115C	<139B 120C	130C	<139C	
Ceiling joist or roof truss to top track of bearing wall[b]	16	24	3	3	4	5	Each ceiling joist or roof truss
		28	3	3	4	5	
		32	3	4	5	6	
		36	4	4	5	6	
		40	4	4	6	7	
	24	24	4	5	6	7	
		28	4	5	6	8	
		32	4	6	7	8	
		36	4	6	8	9	
		40	6	6	8	10	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 mil = 0.0254 mm.

a. Screws are a minimum No. 10 unless noted otherwise.

b. Indicated number of screws shall be applied through the flanges of the truss or ceiling joist or through each leg of a 54-mil clip angle. See Section R804.3.8 for additional requirements to resist uplift forces.

(Deleted text not shown for clarity.)

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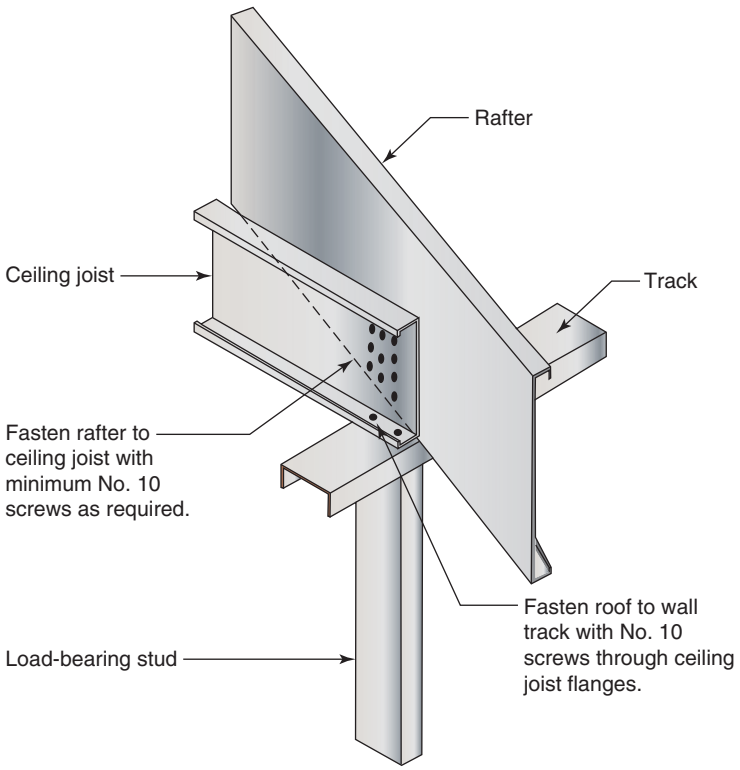
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TABLE R804.3.2.1(2) Ultimate Design Wind Speed to Equivalent Snow Load Conversion

Ultimate Wind Speed and Exposure		Equivalent Ground Snow Load (psf)									
		Roof slope									
Exposure	Wind speed (mph)	3:12	4:12	5:12	6:12	7:12	8:12	9:12	10:12	11:12	12:12
B	115	20	20	20	20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~50~~ 20
	120	20	20	20	20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~50~~ 20
	130	20	20	20	20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~50~~ 20	~~50~~ 20	~~50~~ 20
	<140	20	20	20	20	~~30~~ 20	~~50~~ 20	~~50~~ 20	~~50~~ 30	~~50~~ 30	~~50~~ 30
C	115	20	20	20	20	~~30~~ 20	~~30~~ 20	~~30~~ 20	~~50~~ 20	~~50~~ 30	~~50~~ 30
	120	20	20	20	20	~~30~~ 20	~~30~~ 20	~~50~~ 20	~~50~~ 30	~~50~~ 30	50
	130	20	20	~~20~~ 30	30	30	~~50~~ 30	~~50~~ 30	~~50~~ 30	50	~~70~~ 50
	<140	30	30	~~30~~ 50	50	~~50~~ 30	~~50~~ 30	~~70~~ 50	~~70~~ 50	~~70~~ 50	═ 50

For SI: 1 mile per hour = 0.447 m/s, 1 pound per square foot = 0.0479 kPa.

R804.3.2.1.2 Rake overhangs. Rake overhangs shall not exceed ~~12 inches (305 mm) measured horizontally.~~ the limitations provided for Option 1 or Option 2 in Figure R804.3.2.1.2. Outlookers at gable endwalls shall be installed in accordance with Figure R804.3.2.1.2. The required strength for uplift connectors required for Option 1 shall be determined in accordance with AISI S230 Table F3-4.



Minimum 3 to 10 screws in each CFS ceiling joist to wall track connection.

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CHANGE SIGNIFICANCE: The cold-formed steel framing provisions of the *International Residential Code* (IRC) are updated to parallel requirements in the latest edition of AISI S230 - *Standard for Cold-Formed Steel Framing - Prescriptive Method for One- and Two-Family Dwellings* (AISI S230-18). The 2018 edition of AISI S230 has updated prescriptive provisions conforming to loading criteria of ASCE 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. The cold-formed steel provisions affected by the latest edition of ASCE 7 are located in IRC Section 804 – Roof Framing. Wind pressure coefficients on roof surfaces have increased (see the significant change article for Table R301.2.1(1) for more detail). AISI S230-18 also reduced required bottom flange bracing spacing from 8 feet to 4 feet to minimize changes in the allowable roof span tables due to increased wind loading.

Table R804.3 adds fastening requirements for gypsum board to ceiling joist connections and rafter to ridge connections. Fastening requirements for wind resistance of the ceiling joist or truss to wall track are expanded with fastening increase with higher wind speeds or exposure category.

Table R804.3.2.1(2) updates the wind to ground snow load table for steeper pitched roofs. For example, the equivalent ground snow load is decreased from 30 psf to 20 psf for a roof pitch of 7:12 in a 115-mph region. Lastly, the rake overhang section is clarified by referencing limits in Figure R804.3.2.1.2 and minimum uplift connector capacity in AISI S230 Table F3-4.

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CHANGE TYPE: Addition

CHANGE SUMMARY: Requirements for metal shingle wind resistance are added to Section R905.4.

R905.4.4.1
Metal Roof Shingle Wind Resistance

2021 CODE TEXT: **R905.4.4.1 Wind Resistance of metal roof shingles.** Metal roof shingles applied to a solid or closely fitted deck shall be tested in accordance with ASTM D3161, FM 4474, UL 580, or UL 1897. Metal roof shingles tested in accordance with ASTM D3161 shall meet the classification requirements of Table R905.4.4.1 for the appropriate maximum basic wind speed and the metal shingle packaging shall bear a label to indicate compliance with ASTM D3161 and the required classification in Table R905.2.4.1.

TABLE R905.4.4.1 Classification of Steep Slope Metal Roof Shingles Tested In Accordance With ASTM D3161

Maximum Ultimate Design Wind Speed, V_{ULT} From Figure R301.2(2) (mph)	Maximum Basic Wind Speed, V_{ASD} From Table R301.2.1.3 (mph)	ASTM D3161 Shingle Classification
110	85	A, D or F
116	90	A, D or F
129	100	A, D or F
142	110	F
155	120	F
168	130	F
181	140	F
194	150	F

For SI: 1 mile per hour = 1.609 kph.

CHANGE SIGNIFICANCE: Under wind loads, metal roof shingles do not behave in the same manner as asphalt roof shingles defined in Section R905.2.4.1. Nonetheless, a classification similar to the asphalt shingle classification Table R905.2.4.1 is appropriate and was adapted for Section R905.4.4.1.

For metal roof components, wind uplift testing is currently addressed by multiple standards that determine compliance through uplift ratings. Metal roof shingle performance is not correctly represented by these current tests due to the air permeability inherent in the design of shingle units. A fan-induced test method was developed through ASTM as an alternative to metal roof panel uplift resistance testing.

ASTM D3161, *Standard Test Method for Wind Resistance of Steep Slope Roofing Products* (*Fan-Induced Method*), was originally created for asphalt shingles. The standard was expanded in 2013 to evaluate wind resistance of discontinuous, air-permeable, steep-slope roofing products with or without contribution from adhesives or mechanical interlocking to hold down the leading tab edge. ASTM D3161 is not limited to asphalt shingles and removes difficulties for metal shingle manufacturers previously required to test their products in accordance with UL 1897 or UL 580 via a nonair-permeable method not representative of the product. UL has provided metal shingle wind classifications

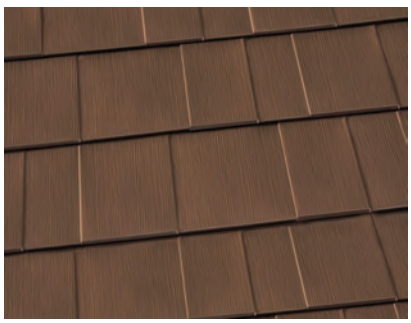


Photo courtesy of Metal Roof Alliance

Metal roof shingles.

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for many years and currently has ASTM D3161-related listings in its Online Classification Directory. The ASTM test method is applicable to many other steep-slope roofing products and is used to evaluate the wind resistance of those products by testing and certification laboratories.

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PART 4

Energy Conservation

Chapter 11



■ **Chapter 11** Energy Efficiency

The IRC energy provisions are extracted from the residential provisions of the *International Energy Conservation Code* (IECC) and editorially revised to conform to the scope and application of the IRC. The section numbers appearing in parentheses after each IRC section number are the section numbers of the corresponding text in the IECC. The IECC Residential Provisions and Chapter 11 of the IRC provide for the effective use and conservation of energy in new residential buildings by regulating the building thermal envelope, mechanical systems, electrical systems, and service water heating systems. IRC Section N1101 establishes climate zones for geographical locations as the basis for determining thermal envelope requirements for conserving energy. The various elements of the building thermal envelope are covered in Section N1102 and include specific insulation, fenestration, and air-leakage requirements for improving energy efficiency. Section N1103 primarily is concerned with mechanical system controls, insulation and sealing of ductwork, equipment sizing, and mandatory mechanical ventilation systems. The insulation of mechanical and service hot water piping systems is also covered in the mechanical systems provisions of Section N1103. Energy-efficient lighting is covered in Section N1104. Alternative compliance paths using the total building performance and Energy Rating Index methods appear in Sections N1105 and N1106. The compliance path for tropical climate has moved to Section N1107. New provisions for additional energy efficiency package options are located in Section N1108. Sections N1109 through N1113 address the application of the energy provisions for work performed on existing buildings. ■

N1101.6
Definition of High-Efficacy Light Sources

N1101.7
Climate Zones

N1101.13
Compliance Options

N1101.13.5
Additional Energy Efficiency Requirements

N1101.14
Permanent Energy Certificate

N1102.1
Building Thermal Envelope

TABLES N1102.1.2 AND N1102.1.3
Insulation and Fenestration Requirements

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N1102.2

Ceiling Insulation

N1102.2.4

Access Hatches and Doors

N1102.2.7

R-Value Reduction for Walls with Partial Structural Sheathing

N1102.2.7

Floor Insulation

N1102.2.8

Unconditioned Basement

N1102.4 AND TABLE N1102.4.1.1

Building Air Leakage and Testing

N1102.4.6

Air-Sealed Electrical Boxes

N1103.3

Duct Installation

N1103.3.5

Duct Testing

N1103.6

Mechanical Ventilation

N1104

Lighting Equipment

N1105 AND TABLE N1105.2

Total Building Performance Analysis

N1106 AND TABLE N1106.2

Energy Rating Index Analysis

N1108

Additional Efficiency Package Options

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N1101.6

Definition of High-Efficacy Light Sources

CHANGE TYPE: Modification

CHANGE SUMMARY: The definition related to high-efficacy lighting now includes both lamps and luminaires and better reflects current technology and federal standards.

2021 CODE: **HIGH-EFFICACY ~~LAMPS~~ LIGHT SOURCES.** Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, ~~or~~ other lamps with an efficacy of not less than ~~the following:~~ 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.

~~1. 60 lumens per watt for lamps over 40 watts.~~

~~2. 50 lumens per watt for lamps over 15 watts to 40 watts.~~

~~3. 40 lumens per watt for lamps 15 watts or less.~~

CHANGE SIGNIFICANCE: The definition of high-efficacy lamps first appeared in the 2009 edition of the code when the LED market was in its infancy. The definition has not changed to keep up with subsequent technology and market developments. As a result, the definition no longer represents the "high efficacy" share of the marketplace. New federal lighting standards in effect in 2020 will eliminate all bulbs on the market with efficiencies lower than 45 lumens per watt. Therefore, when the 2021 code is published, some of the bulbs currently defined by the IECC and Chapter 11 of the IRC as "high efficacy" will not be approved to sell. Given these market and federal standard changes, the definition has been updated to remain relevant and the term "lamp" has been changed to "light source" to be all inclusive. For example, luminaires are added to the definition. A luminaire, as defined by the electrical provisions and the NEC, is a complete lighting unit consisting of a light source, such as lamps (bulbs), that connects to power and distributes light. The requirements for the amount of high efficacy lighting appear in Section N1104.



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High-efficacy LED lamps.

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N1101.7

Climate Zones

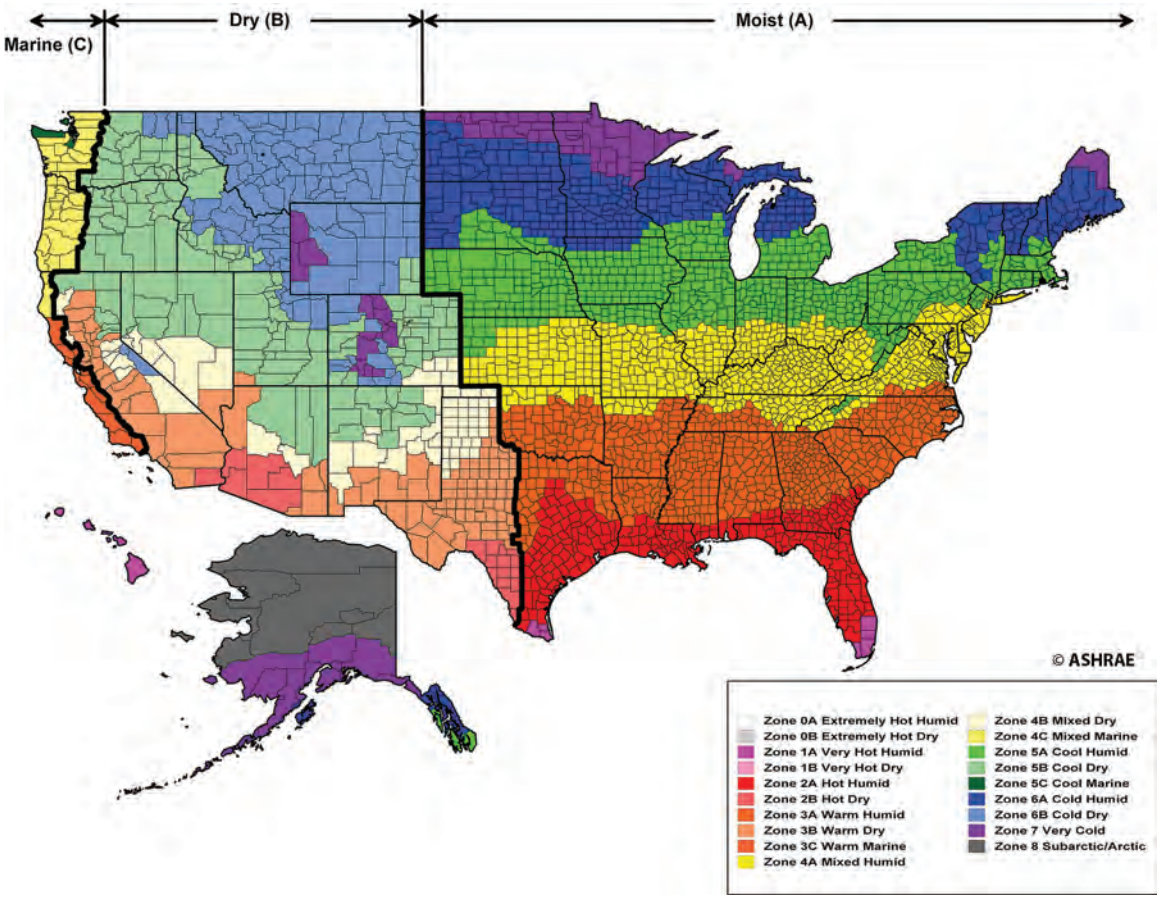
CHANGE TYPE: Modification

CHANGE SUMMARY: The climate zone provisions have been comprehensively updated, including a new Climate Zone 0. Approximately 10 percent of U.S. counties have been assigned a new climate zone.

2021 CODE: **N1101.7 (R301.1) Climate zones.** Climate zones from Figure N1101.7 or Table N1101.7 shall be used for determining the applicable requirements in Sections N1101 through ~~N1111~~ N1113. Locations not indicated in Table N1101.7 shall be assigned a climate zone in accordance with Section N1101.7.2.

Note: Only portions of Section N1101.7 and Table N1101.7 are shown. For the complete text and table, refer to the 2021 IRC.

CHANGE SIGNIFICANCE: The climate zone provisions in Section N1107, including the climate zone tables and map have undergone a significant update. This update of the climate zones corresponds with ASHRAE Standard 169-2013, which is referenced in the 2018 *International Green Construction Code* (IgCC), ASHRAE 90.1, and ASHRAE 90.2. ICC has a licensing agreement with ASHRAE to include the climate zone map, definitions and tables for consistency with ASHRAE Standard 169-2013.



Climate Zones.

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TABLE N1101.7 (R301.1) Climate Zones, Moisture Regimes, and Warm-Humid Designations by State, County and Territory[a]

US STATES

ALABAMA
~~3A~~ 2A Coffee*
~~3A~~ 2A Covington*
~~3A~~ 2A Dale*
~~3A~~ 2A Escambia*
~~3A~~ 2A Geneva*
~~3A~~ 2A Henry*
~~3A~~ 2A Houston*

ALASKA
~~8~~ 7 Bethel
7 Bristol Bay
~~7~~ 8 Denali
~~8~~ 7 Dillingham
~~7~~ 6A Haines
~~7~~ 6A Juneau
7 Kenai Peninsula
~~7~~ 5C Ketchikan Gateway
~~7~~ 6A Kodiak Island
~~7~~ 5C Prince of Wales-Outer Ketchikan
~~7~~ 5C Sitka
~~7~~ 6A Skagway-Hoonah-Angoon
~~7~~ 6A Wrangell-Petersburg

COLORADO
~~5B~~ 4B Bent
5B Broomfield
~~6B~~ 5B Custer
~~5B~~ 4B Prowers

FLORIDA
~~2A~~ 1A Palm Beach*

GEORGIA
~~4A~~ 3A Banks
~~3A~~ 2A Calhoun*
~~4A~~ 3A Catoosa
~~4A~~ 3A Chattooga
~~3A~~ 2A Coffee*
~~4A~~ 3A Dade
~~4A~~ 3A Dawson
~~3A~~ 2A Dougherty*
~~3A~~ 2A Early*
~~4A~~ 3A Fannin
~~4A~~ 3A Floyd
~~4A~~ 3A Franklin
~~4A~~ 3A Gilmer
~~4A~~ 3A Gordon
~~4A~~ 3A Habersham
~~4A~~ 3A Hall
~~4A~~ 3A Lumpkin
~~4A~~ 3A Murray
~~4A~~ 3A Pickens
~~4A~~ 3A Rabun
~~4A~~ 3A Stephens
~~3A~~ 2A Tift*
~~4A~~ 3A Towns
~~4A~~ 3A Union
~~4A~~ 3A Walker
~~4A~~ 3A White
~~4A~~ 3A Whitfield
~~3A~~ 2A Worth*

ILLINOIS
~~5A~~ 4A Calhoun
~~5A~~ 4A Clark
~~5A~~ 4A Coles
~~5A~~ 4A Cumberland
~~5A~~ 4A Greene
~~5A~~ 4A Jersey

INDIANA
~~5A~~ 4A Bartholomew
~~5A~~ 4A Clay
~~5A~~ 4A Decatur
~~5A~~ 4A Fayette
~~5A~~ 4A Franklin
~~5A~~ 4A Hendricks
~~5A~~ 4A Johnson
~~5A~~ 4A Marion
~~5A~~ 4A Morgan
~~5A~~ 4A Owen
~~5A~~ 4A Putnam
~~5A~~ 4A Rush
~~5A~~ 4A Shelby
~~5A~~ 4A Union
~~5A~~ 4A Vigo

IOWA
~~6A~~ 5A Allamakee
~~6A~~ 5A Bremer
~~6A~~ 5A Buchanan
~~6A~~ 5A Buena Vista
~~6A~~ 5A Butler
~~6A~~ 5A Calhoun
~~6A~~ 5A Cherokee
~~6A~~ 5A Chickasaw
~~6A~~ 5A Clayton
~~6A~~ 5A Delaware
~~6A~~ 5A Fayette
~~6A~~ 5A Floyd
~~6A~~ 5A Franklin
~~6A~~ 5A Grundy
~~6A~~ 5A Hamilton
~~6A~~ 5A Hardin
~~6A~~ 5A Howard
~~6A~~ 5A Humboldt
~~6A~~ 5A Ida
~~6A~~ 5A Plymouth
~~6A~~ 5A Pocahontas
~~6A~~ 5A Sac
~~6A~~ 5A Webster
~~6A~~ 5A Winneshiek
~~6A~~ 5A Wright

a. Key: A – Moist, B – Dry, C – Marine. Absence of moisture designation indicates moisture regime is irrelevant. Asterisk (*) indicates a warm-humid location.

Two updates that are relevant to most code users include:

- Updating the climate zone designations in Table N1107 for approximately 10 percent of the counties in the United States. In general, the counties with changes were assigned a warmer climate zone.
- Updating Figure N1107, the climate zone map, to reflect the changes in the county's climate zone designations.

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Notably, the number of climate zones has increased to include Climate Zone 0, representing the hottest of climates. Climate Zone 0 is a subset of the previous Climate Zone 1. Whereas the previous Climate Zone 1 was all locations with more than 9,000 Cooling Degree Days, Climate Zone 1 now "tops out" at 10,800 Cooling Degree Days, and Climate Zone 0 is for those locations with more than 10,800 Cooling Degree Days. Cities in Climate Zone 0 include extremely hot locations such as Mumbai (Bombay), Jakarta and Abu Dhabi. There are no cities in the United States in Climate Zone 0; Miami and the islands of Hawaii are in Climate Zone 1. Several code changes introduced specific provisions for Climate Zone 0. Because Climate Zone 0 is a subset of the former Climate Zone 1, references throughout the IECC (Chapter 11 of the IRC) to Climate Zone 1 have been edited to Climate Zone 0-1.

Code users needing to calculate the moisture zone (marine, dry or humid) will find Section N1107.3 entirely revised. Calculations are in three categories, (a) when monthly average temperature and precipitation data is available, (b) when annual average temperature, degree days and precipitation is available, and (c) when only degree day information is available.

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N1101.13
Compliance Options

CHANGE TYPE: Modification

CHANGE SUMMARY: The compliance path options have been clarified and the Prescriptive and Mandatory labels in the section titles have been removed.

2021 CODE: **N1101.13 (R401.2) ~~Compliance~~ Application.** ~~Projects~~ Residential buildings shall comply with Section N1101.13.5 and Section N1101.13.1, N1101.13.2, N1101.13.3, or N1101.13.4. ~~one of the following:~~

~~1. Sections N1101.14 through N1104.~~

~~2. Section N1105 and the provisions of Sections N1101.14 through N1104 indicated as "Mandatory."~~

~~3. The energy rating index (ERI) approach in Section N1106.~~

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Sections N1109 through N1113 as applicable.

N1101.13.1 (R401.2.1) Prescriptive Compliance Option. The Prescriptive Compliance Option requires compliance with Sections N1101.14 through N1104.

N1101.13.2 (R401.2.2) Total Building Performance Option. The Total Building Performance Option requires compliance with Section N1105.

N1101.13.3 (R401.2.3) Energy Rating Index Option. The Energy Rating Index (ERI) Option requires compliance with Section N1106.

N1101.13.4 (R401.2.4) Tropical Climate Region Option. The Tropical Climate Region Option requires compliance with Section N1107.



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The prescriptive path sets the maximum *U*-factor for windows.

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Note: The Mandatory and Prescriptive labels have been removed from the following section titles:

N1101.14 (R401.3) Certificate ~~(Mandatory)~~.

N1102.1 (R402.1) General ~~(Prescriptive)~~.

N1102.2 (R402.2) Specific insulation requirements ~~(Prescriptive)~~.

N1102.3 (R402.3) Fenestration ~~(Prescriptive)~~.

N1102.4 (R402.4) Air leakage ~~(Mandatory)~~.

N1102.5 (R402.5) Maximum fenestration U-factor and SHGC ~~(Mandatory)~~.

N1103.1 (R403.1) Controls ~~(Mandatory)~~.

N1103.1.2 (R403.1.2) Heat pump supplementary heat ~~(Mandatory)~~.

N1103.3.1 (R403.3.1) ~~Insulation~~ Ducts located outside conditioned space. ~~(Prescriptive)~~.

~~N1103.3.2~~ N1103.3.4 (~~R403.3.2~~ R403.3.5) Sealing ~~(Mandatory)~~.

~~N1103.3.3~~ N1103.3.5 (~~R403.3.3~~ R403.3.5) Duct testing ~~(Mandatory)~~.

~~N1103.3.4~~ N1103.3.6 (~~R403.3.4~~ R403.3.6) Duct leakage ~~(Prescriptive)~~.

~~N1103.3.5~~ N1103.3.7 (~~R403.3.5~~ R403.3.7) Building cavities ~~(Mandatory)~~.

N1103.4 (R403.4) Mechanical system piping insulation ~~(Mandatory)~~.

N1103.5.1 (R403.5.1) Heated water circulation and temperature maintenance systems ~~(Mandatory)~~.

~~N1103.5.3~~ N1103.5.2 (~~R403.5.3~~ R403.5.2) Hot water pipe insulation ~~(Prescriptive)~~.

N1103.6 (R403.6) Mechanical ventilation ~~(Mandatory)~~.

N1103.7 (R403.7) Equipment sizing and efficiency rating ~~(Mandatory)~~.

N1103.8 (R403.8) Systems serving multiple dwelling units ~~(Mandatory)~~.

N1103.9 (R403.9) Snow melt and ice system controls ~~(Mandatory)~~.

Note: Due to space limitations, not all changes are shown. Please refer to the 2021 IRC for the complete text.

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CHANGE SIGNIFICANCE: Beginning in the 2006 code, Section N1101.13 has identified two options for compliance. The options were not formally named within the code but have commonly been referred to as the "prescriptive" and "performance" compliance paths. In addition, a third compliance path was added in 2015, along with a simplified compliance path applicable to certain dwelling units located in the Tropical Zone. The latter compliance option was not listed with the compliance paths.

Section N1101.13 is now titled "Application" for consistency and has been revised to clarify and name the four compliance paths. Naming the compliance options (Prescriptive, Total Building Performance, Energy Rating Index and Tropical Zone) formalizes the way in which the paths are typically identified and adds clarity for training, education and new code users. Using the word "option" reinforces that it is the designer's choice as to which path is followed. The language now clearly leads the code user to the four compliance options.

The terms "Prescriptive" and "Mandatory" in the section titles throughout Sections N1101 through N1104 are eliminated to reduce confusion about the application of the terms. This corresponds to the creation of project requirement tables in Sections N1105 and N1106, and all requirements associated with the respective compliance paths are contained within the associated sections. Additionally, the requirements for Tropical Zone compliance were relocated to the new Section N1107.

The new reference to Section N1101.13.5 directs the user to additional new requirements that apply to all compliance paths and are discussed separately under Sections N1101.13.5 and N1108 in this publication.

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N1101.13.5

Additional Energy Efficiency Requirements

CHANGE TYPE: Addition

CHANGE SUMMARY: Additional energy efficiency measures are required regardless of the compliance path used.

2021 CODE: **N1101.13.5 (R401.2.5) Additional energy efficiency.** This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying with Section N1101.13.1, one of the additional efficiency package options shall be installed according to Section N1108.2.
2. For buildings complying with Section N1101.13.2 the building shall meet one of the following:
   - **2.1.** One of the additional efficiency package options in Section N1108.2 shall be installed without including such measures in the proposed design under Section N1105.
   - **2.2.** The proposed design of the building under Section N1105.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.



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Enhanced envelope performance is one option for satisfying the additional efficiency requirements for the prescriptive or performance path.

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3. For buildings complying with Section N1101.13.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table N1106.5.

The option selected for compliance shall be identified on the certificate required by Section N1101.14.

CHANGE SIGNIFICANCE: Arguably the most significant change to Chapter 11 of the IRC and the residential provisions of the 2021 IECC, new Sections N1101.13.5 and N1108 set additional requirements to conserve energy. Whichever compliance path is chosen, one of the additional options must also be used.

Section N1101.13.5 establishes the application of the additional requirements:

- Prescriptive compliance projects must include one package from Section N1108.
- Total building performance compliance projects must either include one package from Section N1108, without including the additional measures in the proposed design, or the proposed design must have an annual energy cost less than or equal to 95 percent of the standard reference design.
- Projects complying via the Energy Rating Index must have a score at least 5 percent less than the maximum value shown in Table N1106.5.

The additional energy efficiency package options are covered under Section N1108 in this publication.

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N1101.14

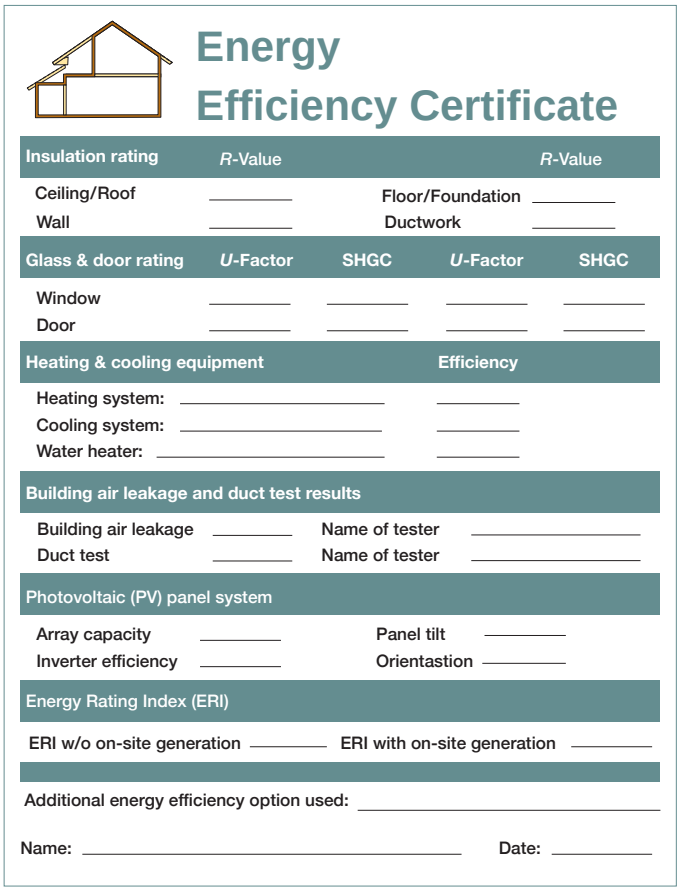
Permanent Energy Certificate

CHANGE TYPE: Modification

CHANGE SUMMARY: Additional information related to the building thermal envelope, solar energy, Energy Rating Index and the code edition is required on the energy certificate.

2021 CODE: **N1101.14 (R401.3) Certificate ~~(Mandatory)~~.** A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall indicate the following:

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors, and ducts outside conditioned spaces.
2. The *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration., ~~and~~ Where there is more than one value for ~~each~~ any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.



Energy Efficiency Certificate

Insulation rating	*R*-Value		*R*-Value
Ceiling/Roof	_____	Floor/Foundation	_____
Wall	_____	Ductwork	_____

Glass & door rating	*U*-Factor	SHGC	*U*-Factor	SHGC
Window	_____	_____	_____	_____
Door	_____	_____	_____	_____

Heating & cooling equipment	Efficiency
Heating system: _____	_____
Cooling system: _____	_____
Water heater: _____	_____

Building air leakage and duct test results			
Building air leakage	_____	Name of tester	_____
Duct test	_____	Name of tester	_____

Photovoltaic (PV) panel system			
Array capacity	_____	Panel tilt	_____
Inverter efficiency	_____	Orientastion	_____

Energy Rating Index (ERI)			
ERI w/o on-site generation	_____	ERI with on-site generation	_____

Additional energy efficiency option used: _____

Name: _____ Date: _____

Sample energy certificate.

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3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The ~~certificate shall indicate the~~ types, sizes and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency is not required to ~~shall not~~ be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where onsite photovoltaic panel systems have been installed, the array capacity size, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section N1106, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted and the compliance path used.

CHANGE SIGNIFICANCE: The IRC energy provisions require the builder or other approved party to complete a permanent energy efficiency certificate and post it near the furnace or other approved location. The certificate lists the primary energy conserving features of the building, the results of air leakage testing and the efficiency ratings of installed heating, cooling and water heating equipment. Providing this information in a permanent location benefits current and future homeowners and certifies that the building complies with the energy efficiency requirements in effect at the time of construction. It is important to record this information during construction as the data can be difficult or impossible to recreate later when needed for maintenance or real estate transaction purposes.

The requirement for posting a permanent certificate first appeared in the energy efficiency provisions of the 2006 IRC and have been modified in each edition of the code since then to reflect trends in energy conservation efforts. For example, results of the blower door test for building air leakage and the duct system air test were added to the certificate in the 2009 IRC. In the 2015 edition, the posting location changed to assure the information was visible to future homeowners. The 2021 IRC requires additional details on the building thermal envelope efficiency (where available) and HVAC equipment size. Reflecting the national trend toward more solar energy systems, specifications for any onsite photovoltaic (PV) panel systems must also appear on the certificate. If the optional compliance path of an energy rating index is used, the resulting score must be listed on the certificate. Finally, the code edition used for compliance with the energy efficiency provisions must be identified on the permanent certificate.

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N1102.1

Building Thermal Envelope

CHANGE TYPE: Modification

CHANGE SUMMARY: The assembly *U*-Factor is established as the primary insulation metric. The *R*-Value approach is now an alternative method.

2021 CODE: **N1102.1 (R402.1) General ~~(Prescriptive)~~.** The building thermal envelope shall comply with the requirements of Sections N1102.1.1 through N1102.1.5.

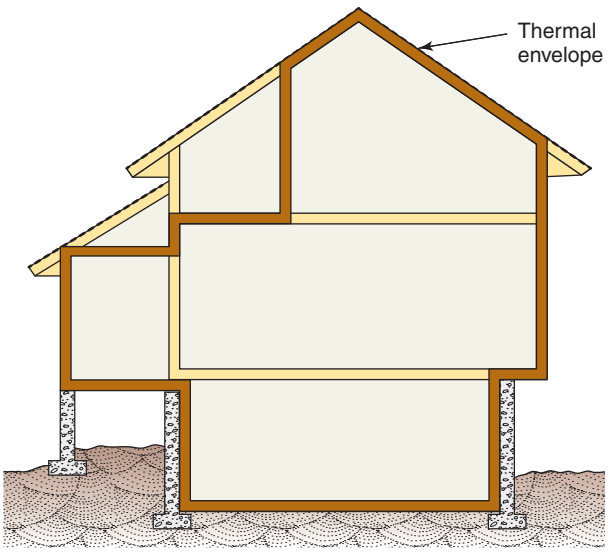
Exceptions: [No changes]

N1102.1.1 (R402.1.1) Vapor retarder. Wall assemblies in the building thermal envelope shall comply with the vapor retarder requirements of Section R702.7.

N1102.1.2 (R402.1.2) Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Table N1102.1.2 based on the climate zone specified in Section N1101.7. Assemblies shall have a *U*-factor equal to or less than that specified in Table N1102.1.2. Fenestration shall have a *U*-factor and glazed fenestration SHGC equal to or less than specified in Table N1102.1.2.

N1102.1.3 (R402.1.3) *R*-value alternative. Assemblies with *R*-value of insulation materials equal to or greater than that specified in Table N1102.1.3 shall be an alternative to the *U*-factor in Table N1102.1.2.

~~N1102.1.3 (R402.1.3)~~ N1102.1.4 (R402.1.4) *R*-value computation. ~~Insulation material used in layers, such as framing cavity insulation or continuous insulation,~~ Cavity insulation alone shall be used to determine compliance with the cavity insulation *R*-value requirements in



The building thermal envelope is an assembly of elements that provide a boundary between conditioned space and unconditioned space.

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Table N1102.1.3. Where cavity insulation is installed in multiple layers, the *R* -values of the cavity insulation layers shall be summed to ~~compute the corresponding component *R*-value~~ determine compliance with the cavity insulation *R* -value requirements. The manufacturer's settled *R*-value shall be used for blown-in insulation. Continuous insulation (ci) alone shall be used to determine compliance with the continuous insulation *R* -value requirements in Table N1102.1.3. Where continuous insulation is installed in multiple layers, the *R*-values of the continuous insulation layers shall be summed to determine compliance with the continuous insulation *R* -value requirements. Cavity insulation *R* -values shall not be used to determine compliance with the continuous insulation *R*-value requirements in Table N1102.1.3. Computed *R*-values shall not include an *R*-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table ~~N1102.1.2~~ N1102.1.3, the manufacturer's labeled *R*-value for insulated siding shall be reduced by *R*-0.6.

CHANGE SIGNIFICANCE: Section N1102 provides prescriptive building thermal envelope provisions, including limitations on air infiltration (leakage). The building envelope is important to building energy efficiency. When it is cold outside, heat loss and air leakages through the building envelope add to the heating load. On hot days, solar gains through windows, heat gain through opaque assemblies and infiltration of hot or humid air contribute to the cooling load. The building envelope requirements of Section N1102 are intended to reduce heat gains and losses through the building envelope.

The building envelope provisions have seen few significant changes since the 2012 edition of the code. Significant changes to the building envelope in the 2021 IRC include:

- Increased insulation requirements
- Reduced fenestration *U*-factors and solar heat gain coefficients (SHGC)
- Increased resistance to air leakage, including sealing of electrical boxes

Since the 2006 editions of the IECC and IRC, *R*-values have been the primary method for measuring envelope efficiencies, with assembly *U*-factors an alternative compliance metric. The change to Section N1102.1 flips the focus of envelope efficiency to *U*-factors and organizes the envelope thermal requirements such that the basis of performance (and any other means of compliance) is founded on *U*-factors which completely define an assembly's performance. The *R*-value approach is retained, providing predetermined solutions based on the *U*-factor requirements. This reorientation ensures that the *R*-values used are a derivative of the intended performance levels that are nonmaterial specific and represented by the assembly *U*-factors. The SHGC values (and footnotes) are consistent with those in the revised *R*-value table.

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Tables N1102.1.2 and N1102.1.3

Insulation and Fenestration Requirements

CHANGE TYPE: Modification

CHANGE SUMMARY: Increased energy efficiency is achieved with lowered assembly *U*-factor requirements in Table N1102.1.2 and increased *R*-value requirements in Table N1102.1.3.

2021 CODE:

TABLE ~~N1102.1.4 (R402.1.4)~~ N1102.1.2 (R402.1.2) ~~Equivalent~~ Maximum Assembly *U*-Factors[a] and Fenestration Requirements

Climate Zone	Fenestration *U*-Factor[f]	Skylight *U*-Factor	Glazed Fenestration SHGC[d,e]	Ceiling *U*-Factor	Frame Wall *U*-Factor	Mass Wall *U*-Factor[b]	Floor *U*-Factor	Basement Wall *U*-Factor	Crawl Space Wall *U*-Factor
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	~~0.030~~ 0.026	0.084	0.165	0.064	0.360	0.477
3	~~0.32~~ .30	0.55	0.25	~~0.030~~ 0.026	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	~~0.32~~ .30	0.55	0.40	~~0.026~~ 0.024	~~0.060~~ 0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	NR	~~0.026~~ 0.024	~~0.060~~ 0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	~~0.026~~ 0.024	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	~~0.026~~ 0.024	0.045	0.057	0.028	0.050	0.055

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
b. Mass walls shall be in accordance with Section N1102.2.5. Where more than half the insulation is on the interior, the mass wall U-factors shall not exceed 0.17 in Climate Zone 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
c. In Warm-Humid locations as defined by Figure N1101.7 and Table N1101.7, the basement wall *U*-factor shall not exceed 0.360.
d. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30

e. There are no SHGC requirements in the Marine Zone.
f. A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located in accordance with one of the following:
   1. Above 4000 feet in elevation above sea level.
   2. In windborne debris regions where protection of openings is required by Section R301.2.1.2.

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~~TABLE N1102.1.2 (R402.1.2)~~ TABLE N1102.1.3 (R402.1.3) Insulation Minimum *R*-Values and Fenestration Requirements by Component[a]

Climate Zone	Fenestration *U*-Factor[b,i]	Skylight[b] *U*-Factor	Glazed Fenestration SHGC[b,e]	Ceiling *R*-Value	Wood Frame Wall *R*-value[hg]	Mass Wall *R*-value[ih]	Floor *R*-Value	Basement[c,d] Wall *R*-Value	Slab[e] *R*-value & Depth	Crawl Space[c,d] Wall *R*-value
0	NR	0.75	0.25	30	13 or 0 + 10ci	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 + 10ci	3/4	13	0	0	0
2	0.40	0.65	0.25	~~38~~ 49	13 or 0 + 10ci	4/6	13	0	0	0
3	~~0.32~~ 0.30	0.55	0.25	~~38~~ 49	20 or 13 + 5ci or 0 + 15ci	8/13	19	5ci ~~/~~or 13[g]	~~0~~ 10ci, 2 ft	5ci ~~/~~or 13
4 except Marine	~~0.32~~ 0.30	0.55	0.40	~~49~~ 60	20 or 13 + 5ci or 0 + 15ci	8/13	19	10ci ~~/~~or 13	10ci, ~~2~~ 4 ft	10 ci ~~/~~or 13
5 and Marine 4	0.30	0.55	NR	~~49~~ 60	20 or 13 + 5ci or 0 + 15ci	13/17	30[g]	15ci ~~/~~or 19 or 13+5ci	10ci, ~~2~~ 4 ft	15ci ~~/~~ or 19 or 13+5ci
6	0.30	0.55	NR	~~49~~ 60	30 or 20 + 5ci or 13 + 10ci or 0+20ci	15/20	30[g]	15ci ~~/~~or 19 or 13+5ci	10ci, 4 ft	15ci ~~/~~ or 19 or 13+5ci
7 and 8	0.30	0.55	NR	~~49~~ 60	30 or 20 + 5ci or 13 + 10ci or 0+20ci	19/21	30[g]	15ci ~~/~~or 19 or 13+5ci	10ci, 4 ft	15ci ~~/~~ or 19 or 13+5ci

For SI:1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones ~~1~~ 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci ~~/~~or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the ~~home~~ wall or R-13 cavity insulation ~~at~~ on the interior side of the ~~basement~~ wall. "15ci ~~/~~or 19" means R-15 continuous insulation on the interior or exterior surface of the ~~home~~ wall or R-19 cavity insulation on the interior side of the ~~basement~~ wall. ~~Alternatively, compliance with "15/19" shall be~~ "13+5ci" means R-13 cavity insulation on the interior side of the ~~basement~~ wall ~~plus~~ in addition to R-5 continuous insulation on the interior or exterior surface of the ~~home~~ wall.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge *R*-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation shall not be required in warm-humid locations as defined by Figure ~~N1101.10~~ N1101.7 and Table ~~N1101.10~~ N1101.7.

~~g. Alternatively, insulation sufficient to fill the framing cavity providing not less than an *R*-value of R-19.~~

~~h.~~ g. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5ci" means R-13 cavity insulation plus R-5 continuous insulation.

~~i.~~ h. Mass walls shall be in accordance with Section N1102.2.5. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

i. A maximum *U*-Factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4000 feet (1220 m) in elevation, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2.

CHANGE SIGNIFICANCE: The order of the two tables controlling the prescriptive approach for energy efficiency of the building thermal envelope has been reversed to recognize that the assembly *U*-factors are the primary method for determining compliance (as discussed in the previous change to Section N1102.1). Some assembly *U*-factors in Table N1102.1.2 have been lowered and corresponding *R*-value requirements in Table N1102.1.4 have increased.

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In particular, efficiencies are increased in ceiling assemblies, wood frame walls and fenestration, depending on climate zone. Ceiling requirements have increased in all climate zones except Climate Zone 1. For example, the minimum *R*-value for ceilings in Climate Zones 4 through 8 have increased from R49 to R60 (assembly *U*-Factors decreased from 0.026 to 0.024). Wood frame wall efficiencies are more stringent in Climate Zones 4 and 5. Fenestration *U*-factors in Climate Zones 3 and 4 are decreased to improve efficiency. An SHGC value has been introduced in climate zone 5 where it was previously not required.

Slab-on-grade insulation has been increased in efficiency for Climate Zones 3 through 5. This is considered an overdue update because the slab *R*-value requirements have not improved in any climate zone since at least 2006.

Other changes relate to footnotes, additional options for using continuous insulation (ci), and clarification to the tables. Basement and crawlspace walls are amended for clarity and move the alternative compliance option (13+5ci) from a footnote to the table. The clarification is made by adding a "ci" designator for the continuous insulation components in the table. This is also carried through in the footnote "c". Footnote "c" is further clarified by consistently referring to "wall" rather than in some cases "basement" and in other cases "home" with no mention of "crawl space." The footnote applies to basement and crawl space walls as noted in the heading of the table columns. Also, the word "surface" is added to clarify that where continuous insulation is used it should be applied to the surface of the foundation wall (with any additional cavity insulation applied to the interior side of the continuous insulation).

The elimination of footnote g related to floor insulation in Climate Zones 4 through 8 improves the efficiency of dwellings in the coldest climate zones by removing an exception that allowed lower floor insulation *R*-values with no corresponding improvements elsewhere in the building.



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Energy efficiency for ceilings has increased in most climate zones.

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A footnote is also established, providing an exception to prescriptive *U*-factors for fenestration installed at high altitudes (above 4000 feet in elevation) and in regions that require fenestration to be resistant to windborne debris in Climate Zones 3 through 8.

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N1102.2

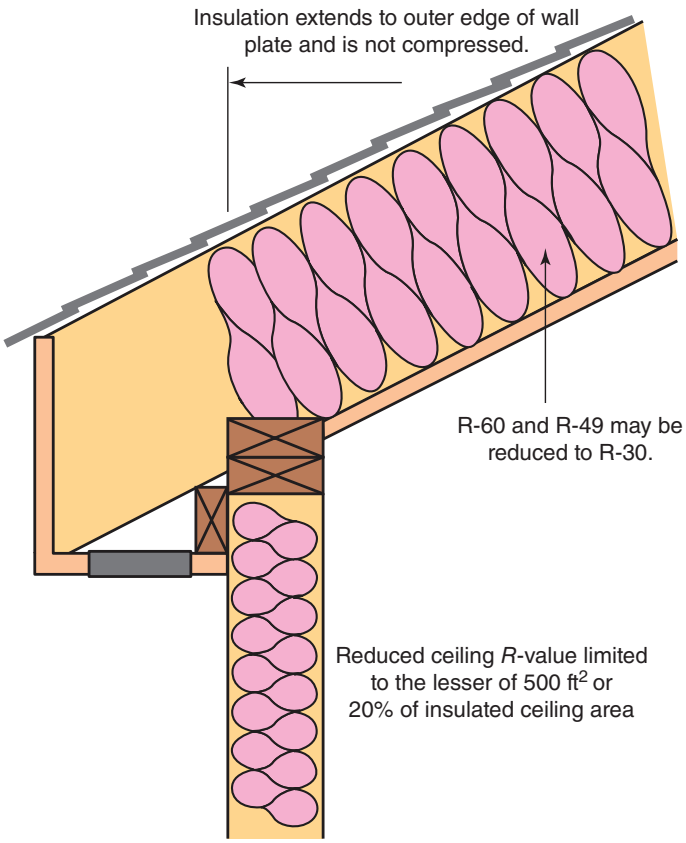
Ceiling Insulation

CHANGE TYPE: Modification

CHANGE SUMMARY: The options for a reduction in *R*-values for both ceilings with attics and those without have been adjusted to recognize the increase in the prescriptive ceiling *R*-values in Table N1102.1.3.

2021 CODE: N1102.2 (R402.2) Specific insulation requirements ~~(Prescriptive)~~. In addition to the requirements of Section N1102.1, insulation shall meet the specific requirements of Sections N1102.2.1 through N1102.2.12.

N1102.2.1 (R402.2.1) Ceilings with attics ~~spaces~~. Where Section ~~R1102.1.2~~ R1102.1.3 requires ~~R-38~~ R-49 insulation in the ceiling or attic, installing ~~R-30~~ R-38 insulation over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for ~~R-38~~ R-49 insulation wherever the full height of uncompressed ~~R-30~~ R-38 insulation extends over the wall top plate at the eaves. Where Section ~~N1102.1.2~~ N1102.1.3 requires ~~R-49~~ R-60 insulation in the ceiling or attic, installing ~~R-38~~ R-49 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for ~~R-49~~ R-60 insulation wherever the full height of uncompressed ~~R-38~~ R-49 insulation extends over the top plate at the eaves. This reduction shall not apply to the insulation and fenestration criteria in ~~U-factor alternative approach in~~ Section ~~N1102.1.4~~ N1102.1.3 and the Total UA alternative in Section N1102.1.5.



Reduced *R*-value for vaulted ceiling.

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N1102.2.2 (R402.2.2) Ceilings without attics spaces. Where Section ~~N1102.1.2~~ N1102.1.3 requires insulation *R*-values greater than R-30 in the ~~ceiling~~ interstitial space above a ceiling and below the structural roof deck and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation *R*-value for such roof/ceiling assemblies shall be R-30. Insulation shall extend over the top of the wall plate to the outer edge of such plate and shall not be compressed. This reduction of insulation from the requirements of Section ~~N1102.1.2~~ N1102.1.3 shall be limited to 500 square feet (46 m^2) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the ~~*U*-factor alternative approach in Section N1102.1.4 and the~~ Total UA alternative in Section N1102.1.5.

N1102.2.3 (R402.2.3) Eave baffle. For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain ~~an~~ a net free area opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material. The baffle shall be installed to the outer edge of the exterior wall top plate so as to provide maximum space for attic insulation coverage over the top plate. Where soffit venting is not continuous, baffles shall be installed continuously to prevent ventilation air in the eave soffit from bypassing the baffle.

CHANGE SIGNIFICANCE: In the revised prescriptive tables, the minimum *R*-value for ceilings in Climate Zones 4 through 8 have increased from R-49 to R-60 (assembly *U*-factors decreased from 0.026 to 0.024). In Climate Zones 2 and 3, the ceiling *R*-value increased from R-38 to R-49 (assembly *U*-factors decreased from 0.030 to 0.026). The update to Sections N1102.2.1 and N1102.2.2 recognizes those changes and factors in the increase to the prescriptive values in the referenced tables.

The IRC has long offered two exceptions to the prescriptive ceiling insulation requirements. The first in Section N1102.2.1, Ceilings with Attic Spaces, recognizes the effectiveness of energy (raised heel) trusses. The increased height at the exterior wall plate allows for the full thickness of ceiling insulation throughout and the code accordingly allows a reduction in the required *R*-value. The second exception in Section N1102.2.2, Ceilings without Attic Spaces, recognizes the difficulty of achieving the full required thickness of insulation in vaulted or cathedral ceilings framed with solid-sawn dimension lumber, or perhaps I-joists, rather than trusses. In this case, the code allows a reduction in *R*-value but limits the total area for the reduction.

The reductions have been revised to reflect the changes to the prescriptive tables and are based on the prescriptive value for the particular climate zone. For houses with attics, a prescriptive *R*-value of R-60 may be reduced to R-49 for the entire area provided energy (raised heel) trusses are used to allow the full height of insulation above the wall top plate. Compression of the insulation at any point reduces the *R*-value and is less effective at conserving energy.

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For ceilings without attics, the reduction in *R*-value is limited to 500 square feet or 20 percent of the total insulated ceiling area, whichever is less. Again, the full depth of the insulation must continue to the outside of the wall top plate. Where the prescriptive ceiling value is greater than R-30, the vaulted ceiling value can be reduced to R-30.

In a clarification to Section N1102.2.3, the requirements have been strengthened to ensure optimal performance of the eave baffles in providing proper circulation of ventilation air.

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N1102.2.4

Access Hatches and Doors

CHANGE TYPE: Modification

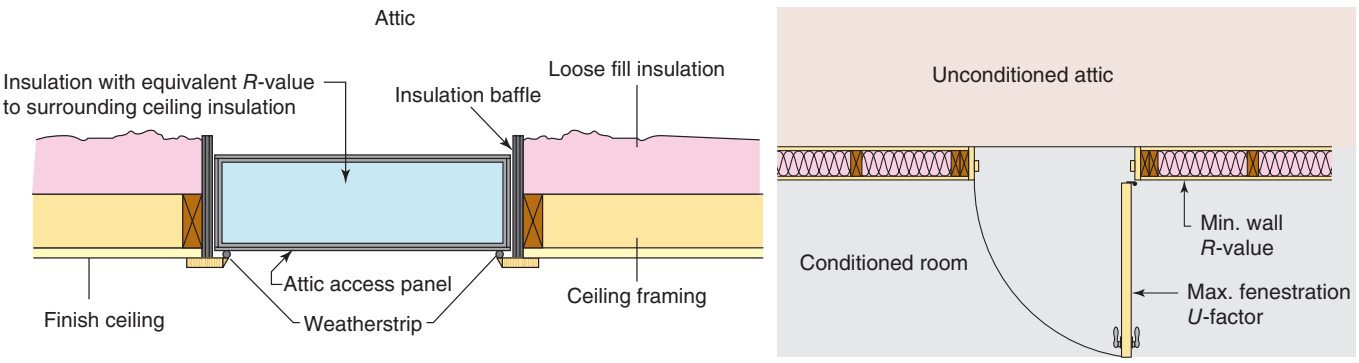
CHANGE SUMMARY: Prescriptive provisions for insulation levels and mandatory provisions for installation (weather-stripping and baffles) have been placed in separate sections. Provisions addressing pull-down stairs have been added.

2021 CODE: **N1102.2.4 (R402.2.4) Access hatches and doors.** Access hatches and doors from conditioned to unconditioned spaces such as attics and crawlspaces shall be insulated to the same level required for the wall or ceiling *R*-value in Table N1102.1.3 in which they are installed.

Exceptions:

1. Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table N1102.1.3 based on the applicable climate zone specified in Section N1101.7.
2. Horizontal pull-down, stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces in Climate Zones 0 through 4 shall not be required to comply with the insulation level of the surrounding surfaces provided that the hatch meets all of the following:
   - 2.1. The average *U*-factor of the hatch shall be less than or equal to U-0.10 or have an average insulation *R*-value of *R*-10 or greater.
   - 2.2. Not less then 75 percent of the panel area shall have an insulation *R*-value of R-13 or greater.
   - 2.3. The net area of the framed opening shall be less than or equal to 13.5 square feet (1.25 m^2).
   - 2.4. The perimeter of the hatch edge shall be weatherstripped.

The reduction shall not apply to the total UA alternative in Section N1102.1.5.



Approved vertical and horizontal access to unconditioned attics.

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~~N1102.2.4 (R402.2.4)~~ N1102.2.4.1 (R402.2.4.1) Access ~~hatches~~ hatch and ~~doors~~ door insulation installation and retention. ~~Access~~ Vertical or horizontal access hatches and doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped ~~and insulated to a level equivalent to the insulation on the surrounding surfaces~~. Access that prevents damaging or compressing the insulation shall be provided to all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle, ~~or~~ retainer or dam shall be installed to prevent ~~the~~ loose-fill insulation from spilling into ~~the~~ living spaces ~~when the attic access is opened~~, from higher to lower sections of the attic, and from attics covering conditioned spaces to unconditioned spaces.. The baffle or retainer shall provide a permanent means of maintaining the installed *R*-value of the loose-fill insulation.

> **~~Exception:~~** ~~Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table N1102.1.2 based on the applicable climate zone specified in Section N1101.7.~~

CHANGE SIGNIFICANCE: Section N1102.2.4 regulates the installation of access panels and doors entering unconditioned spaces such as attics. The provisions are mandatory for the prescriptive, total building performance and ERI compliance paths. To conserve energy, this section sets minimum levels of insulation for the panel as part of the building thermal envelope based on climate zone. Installation requirements include weather-stripping to reduce air leakage and baffles to prevent displacement of insulation.

The approach for horizontal attic hatches has been to insulate the hatch to meet the required *R*-value of the surrounding area of the attic. In the 2015 edition of the code, it was recognized that insulating vertical doors to the same *R*-value as the wall was not practical and not consistent with how fenestration, including doors, in the building thermal envelope were treated in other situations. Subsequently, vertical access panels or doors were treated as fenestration and only needed to meet the associated prescriptive *U*-factor requirements. Similarly, in the 2021 edition, an exception is added to allow pull-down stair-type access hatches in ceiling assemblies for transitioning from conditioned to unconditioned space. This exception is limited to Climate Zones 0 through 4 and allows a reduced *R*-value (or increased *U*-factor). The area of the pull-down stair is limited to 13.5 square feet. The reason behind the change was that horizontal access panels were subjected to a higher level of performance than what is required for skylights in an insulated ceiling assembly and that affordable, premanufactured pull-down stair access systems are not readily available to meet the R-30 to R-49 requirement. The *U*-factor specified at U-0.10 is less stringent than the *U*-factors specified for the insulated ceilings but is far more stringent than those permitted for skylights in all climate zones. Also, the size limit is more stringent than that permitted for skylights. Consensus was that the practical implications outweigh the minimal loss of insulation *R*-value in this application and that having this option in the code might discourage construction of "field-crafted detachable apparatuses" that were often discarded.

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N1102.2.7

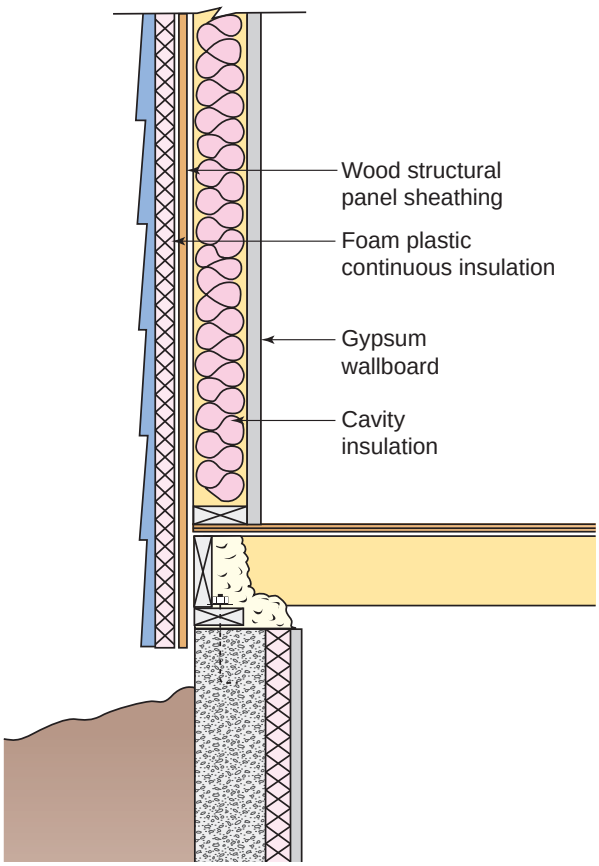
R-Value Reduction for Walls with Partial Structural Sheathing

CHANGE TYPE: Deletion

CHANGE SUMMARY: The provision for reducing the *R*-value of the required continuous wall insulation at areas of structural wall sheathing has been deleted.

2021 CODE: ~~**N1102.2.7 (R402.2.7) Walls with partial structural sheathing.** Where Section N1102.1.2 requires continuous insulation on exterior walls and structural sheathing covers 40 percent or less of the gross area of all exterior walls, the required continuous insulation *R*-value shall be permitted to be reduced by an amount necessary, but not more than R-3, to result in a consistent total sheathing thickness on areas of the walls covered by structural sheathing. This reduction shall not apply to the *U*-factor alternative in Section N1102.1.4 and the Total UA alternative in Section N1102.1.5.~~

CHANGE SIGNIFICANCE: Previously, the code had allowed a compromise to balance structural requirements with energy efficiency requirements as it relates to the use of wood structural panels for wall bracing. In colder climates, it is often necessary to use continuous exterior wall insulation in conjunction with cavity insulation. The code allowed a reduced *R*-value for the continuous insulation for an area up to 40 percent



Reduction of continuous wall insulation at areas of structural wall bracing is no longer permitted.

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of the total exterior wall area. This was a way to achieve uniform total thickness of wall sheathing throughout – the full thickness of insulation over 60 percent of the walls would be equal to the reduced thickness of insulation plus the thickness of the wall bracing over 40 percent of the area. In the interest of improving energy efficiency in homes, this option has been deleted as being unnecessary. Unlike other trade-offs in the code, this prescriptive exception did not require any additional energy savings elsewhere to offset the loss in efficiency. Consensus for this change was based on the concept that the prescriptive thermal envelope requirements were reasonable and that there were a broad range of other energy-neutral trade-offs that could be implemented in the design of the building.

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N1102.2.7
Floor Insulation

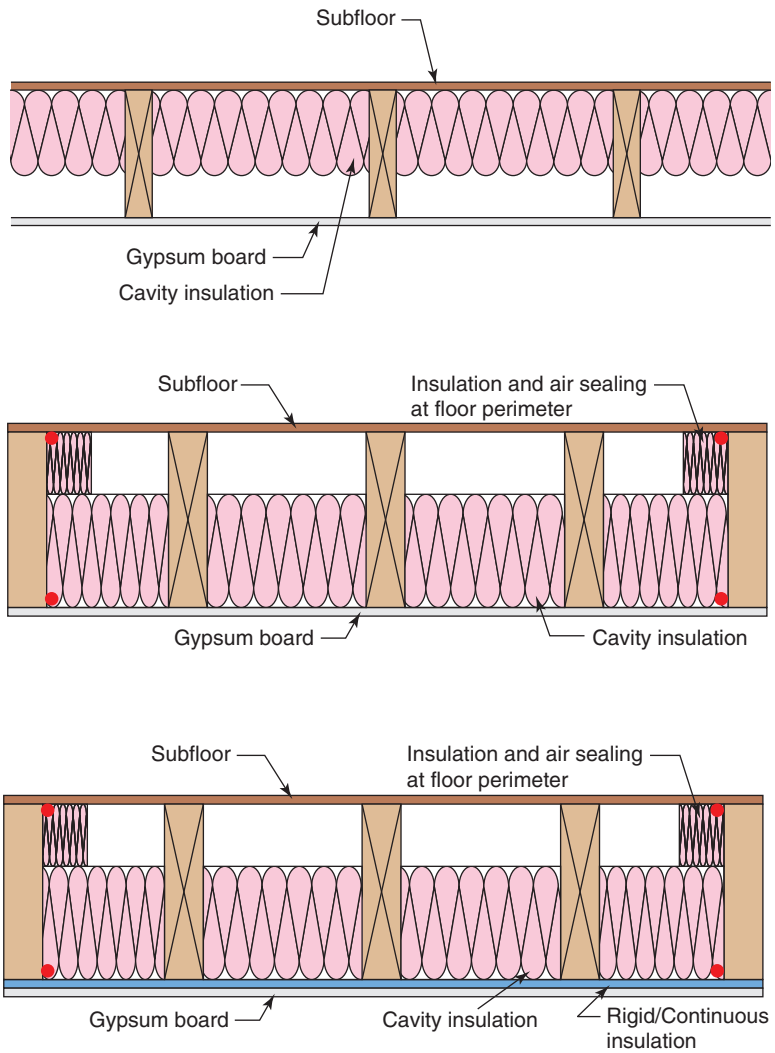
CHANGE TYPE: Clarification

CHANGE SUMMARY: The floor insulation provisions have been placed into three separate methods of compliance for clarification.

2021 CODE: ~~**N1102.2.8 (R402.2.8)**~~ **N1102.2.7 (R402.2.7) Floors.** Floor ~~framing~~-cavity insulation shall comply with one of the following:

1. Insulation shall be installed to maintain permanent contact with the underside of the subfloor decking in accordance with manufacturer instructions to maintain required *R*-value or readily fill the available cavity space.

2. Floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing separating the cavity and the unconditioned space below. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.



Three options for floor cavity insulation.

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3. A combination of cavity and continuous insulation shall be installed so that the cavity insulation is **Exception:** ~~As an alternative, the floor framing cavity insulation shall be~~ in contact with the top side of ~~sheathing or~~ the continuous insulation that is installed on the ~~bottom side~~ underside of the floor framing ~~where combined with insulation that meets or exceeds the minimum wood frame wall *R*-value in Table N1102.1.2 and that extends~~ separating the cavity and the unconditioned space below. The combined *R*-value of the cavity and continuous insulation shall equal the required *R*-value for floors. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

CHANGE SIGNIFICANCE: Prior to the 2015 code, cavity insulation in floor assemblies above unconditioned spaces had to be in contact with the underside of the floor sheathing. In the 2015 edition, another option permitted an air space between the floor sheathing and the top of the cavity insulation. In this case, the cavity insulation is in direct contact with the topside of the sheathing or continuous insulation installed on the underside of the floor framing and is combined with perimeter insulation that meets or exceeds the *R*-value requirements for walls. This second option was seen as having fewer cold spots and did not increase heat loss. It also facilitates ductwork and piping to be enclosed within the thermal envelope.

This second option was written as an exception and the language had been unclear to some code users. For example, the exception mentioned insulation being in contact with the ceiling membrane below or in contact with continuous insulation, raising the question as to whether continuous insulation was required to use this exception. The revised language does not intend to change the requirement, only to clarify and simplify the language. The text is now broken into a list of three separate options to comply with the code.

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N1102.2.8
Unconditioned Basement

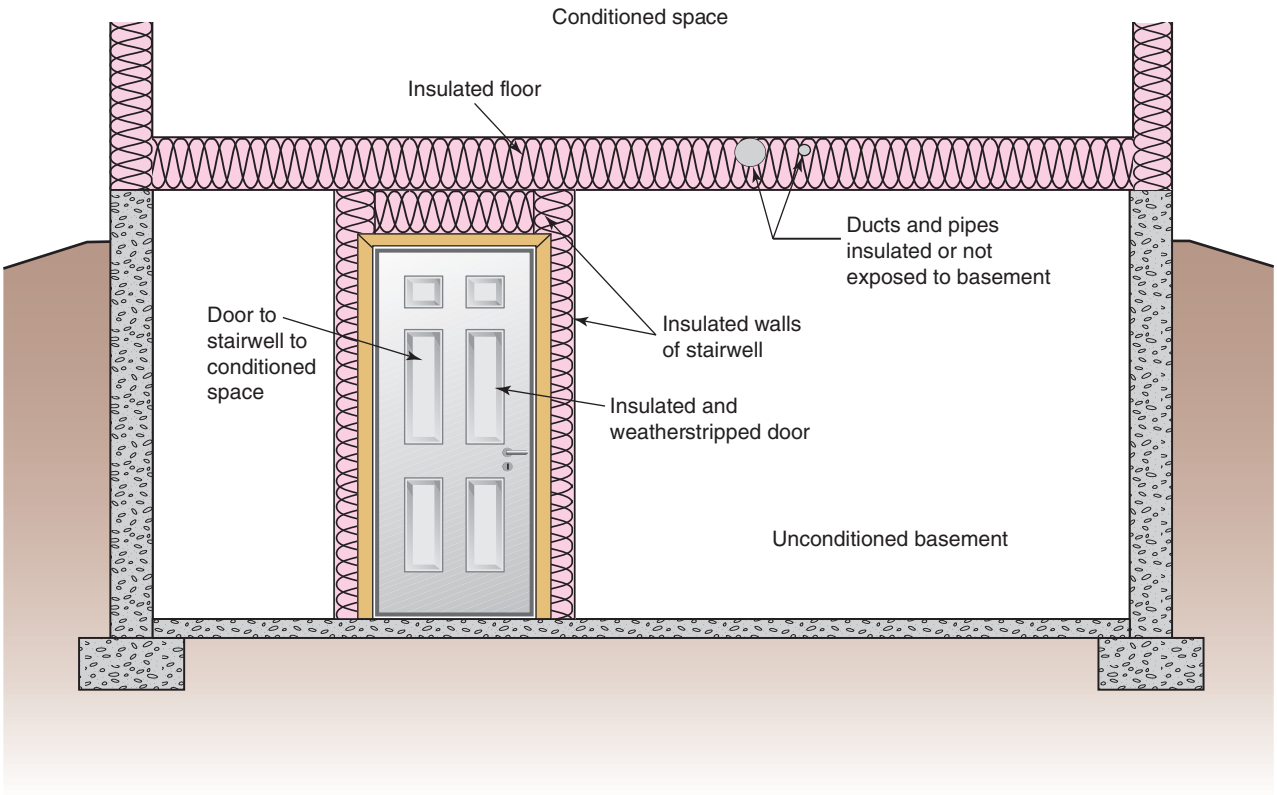
CHANGE TYPE: Modification

CHANGE SUMMARY: A number of specific criteria must be met for a space to qualify as an unconditioned basement.

2021 CODE: **N1102.2.8 (R402.2.8) Basement Walls.** Basement walls shall be insulated in accordance with Table N1102.1.3.

Exception: Basement walls associated with unconditioned basements where all of the following requirements are met:

1. The floor overhead, including the underside stairway stringer leading to the basement, is insulated in accordance with Section N1102.1.3 and applicable provisions of Sections N1102.2 and N1102.2.7.
2. There are no uninsulated duct, domestic hot water, or hydronic heating surfaces exposed to the basement.
3. There are no HVAC supply or return diffusers serving the basement.
4. The walls surrounding the stairway and adjacent to conditioned space are insulated in accordance with Section N1102.1.3 and applicable provisions of Section N1102.2.



Unconditioned basement requirements.

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5. The door(s) leading to the basement from conditioned spaces are insulated in accordance with Section N1102.1.3 and applicable provisions of Section N1102.2, and weather-stripped in accordance with Section N1102.4.
6. The building thermal envelope separating the basement from adjacent conditioned spaces complies with Section N1102.4.

~~N1102.2.9 (R402.2.9)~~ N1102.2.8.1 (R402.2.8.1) Basement walls insulation installation. ~~Walls associated with conditioned basements~~ Where basement walls are insulated, the insulation shall be ~~insulated~~ installed from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. ~~Walls associated with unconditioned basements shall comply with this requirement except where the floor overhead is insulated in accordance with Sections N1102.1.2 and N1102.2.8.~~

CHANGE SIGNIFICANCE: The changes to this section comprehensively clarify what qualifies as an unconditioned basement. Significantly more than insulating the floor over the basement is required to consider the basement unconditioned and not just an extension of conditioned space. Under previous energy codes, heat transfer through ducts, stairways, doors and other elements of the basement were not taken into consideration.

The new language identifies the characteristics that must be present in order for the basement to qualify as an unconditioned space. For compliance with the prescriptive option, basements without these characteristics require wall insulation in accordance with Table N1102.1.3.

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N1102.4 and Table N1102.4.1.1

Building Air Leakage and Testing

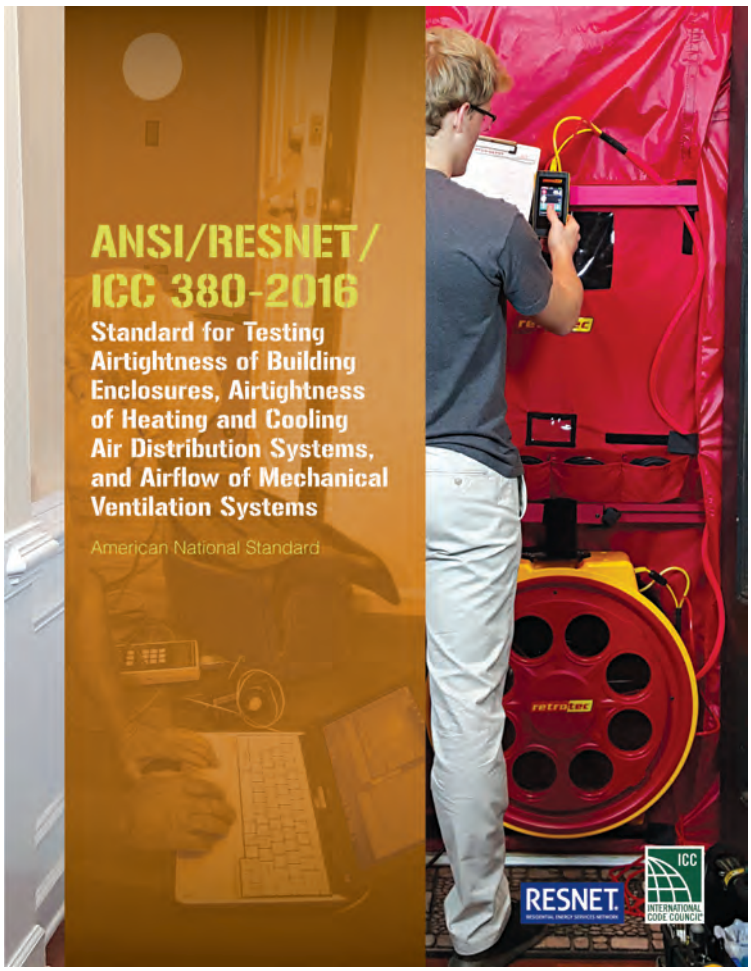
CHANGE TYPE: Modification

CHANGE SUMMARY: The building air leakage and testing requirements are revised in Section N1102.4.

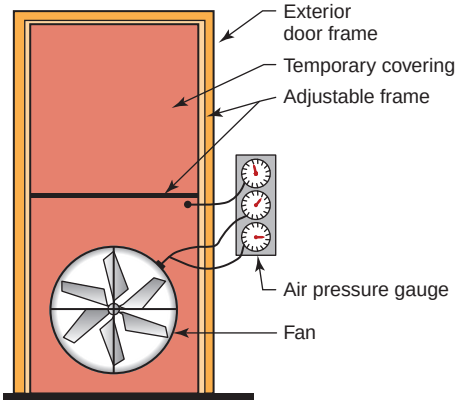
2021 CODE: **N1101.6 (R202) Dwelling unit enclosure area.** The sum of the area of ceiling, floors, and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.

N1102.4 (R402.4) Air leakage ~~(Mandatory)~~. The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections N1102.4.1 through N1102.4.5.

N1102.4.1.2 (R402.4.1.2) Testing. The building or dwelling unit shall be tested ~~and verified as having an air leakage rate of not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8~~ for air leakage. The maximum air leakage rate for any building or dwelling unit under any compliance path shall



RESNET/ICC 380 establishes test procedures for determining air tightness of buildings.



The air leakage rate of the building thermal envelope is measured with a blower door test.

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not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the building official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the building official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope have been sealed.

Exception: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table N1102.4.1.1, applicable to the method of construction, are field verified. Where required by the building official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other conditioned spaces in accordance with Sections N1102.2.12 and N1102.3.5, as applicable.

During testing:

Items 1 through 6 *(No changes)*

Exception: When testing individual dwelling units, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area tested in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals), shall be permitted in all climate zones for:

1. Attached single- and multiple-family building dwelling units.
2. Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of this code or Section 403.3.2 of the *International Mechanical Code*, as applicable, or with other approved means of ventilation.

N1102.4.1.3 (R402.4.1.3) Leakage Rate. Where complying with Section N1101.13.1, the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section N1102.4.1.2.

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TABLE N1102.4.1.1 (R402.4.1.1) Air Barrier and Insulation Installation[a]

Component	Air Barrier Criteria	Insulation Installation Criteria
General requirements	A continuous air barrier shall be installed in the building envelope. ~~The exterior thermal envelope contains a continuous air barrier.~~ Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include ~~the~~ an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board toand the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.[b]
Floors including cantilevered floors and floors above garages.	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing or continuous insulation installed on the underside of floor framing; and extending from the bottom to the top of all perimeter floor framing members.
Basement, ~~Crawl~~ crawl space ~~walls~~, and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier ~~with overlapping joints taped~~ in accordance with Section N1102.2.10. Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 Vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7.	Crawl space insulation, where provided instead of floor insulation, shall ~~be permanently attached to the walls~~ be installed in accordance with Section N1102.2.10. Conditioned basement foundation wall insulation shall be installed in accordance with Section N1102.2.8.1. Slab on grade floor insulation shall be installed in accordance with Section N1102.2.10.
Shafts, penetrations	Duct and flue shafts, ~~utility penetrations~~, ~~and flue shafts~~ and other similar penetrations ~~opening~~ to the exterior or unconditioned space shall be sealed to allow for expansion, contraction, and mechanical vibration. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required *R*-value.
Narrow cavities	Narrow cavities of an inch or less that are not able to be insulated, shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.

(*continues*)

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TABLE N1102.4.1.1 (R402.4.1.1) (*Continued*)

Component	Air Barrier Criteria	Insulation Installation Criteria
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and N1102.2.7
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed ~~to the finished surface~~ in accordance with Section N1102.4.5.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, ~~and~~ wiring or other obstructions	Holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	~~In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing or insulation that on installation, readily conforms to available space, shall extend behind piping and wiring.~~ Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required *R*-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers, and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.
b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Note: Not all changes are shown. Please refer to the 2021 IRC for the complete text.

CHANGE SIGNIFICANCE: Several significant changes have been made to the building air leakage and testing provisions. For testing, the maximum air leakage rate has been set at five air changes per hour (ACH) for any compliance path. However, when following the prescriptive compliance path, the maximum leakage rate remains at 3 ACH for dwellings in Climate Zones 3 through 8. An exception was added for heated attached and detached garages that are field verified for air barrier and insulation installation criteria in the revised Table N1102.4.1.1. The ACH requirements for buildings and dwelling units following the prescriptive compliance path are relocated to new Section N1102.4.1.3.

An exception to using ACH to quantify air leakage in attached and small volume dwelling units was added because ACH is biased against small volume and attached dwellings. Although it is not difficult to get a single-family median size home to pass 3 or 5 ACH as required by the

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code, it is significantly more difficult to get a small volume home or an attached dwelling unit to pass. The alternative more accurately reflects leakage through the exterior enclosure area which removes built in volumetric bias while continuing to ensure a tight structure.

Changes also occur throughout Table N1102.4.1.1 Air Barrier and Insulation Installation. In many cases, the changes are editorial: redundant text has been removed and other provisions have been clarified. The component section of the table has been amended to include other obstructions besides wiring and plumbing piping. There are a number of obstructions in insulated building cavities that insulation must be split around so that it fully encloses the obstruction. For example, gas piping or HVAC duct work now can be included as obstructions. New references in the table point to specific sections of the code to clarify the details of installations. For example, recessed lighting fixture air leakage requirements are described in Section N1102.4.5.

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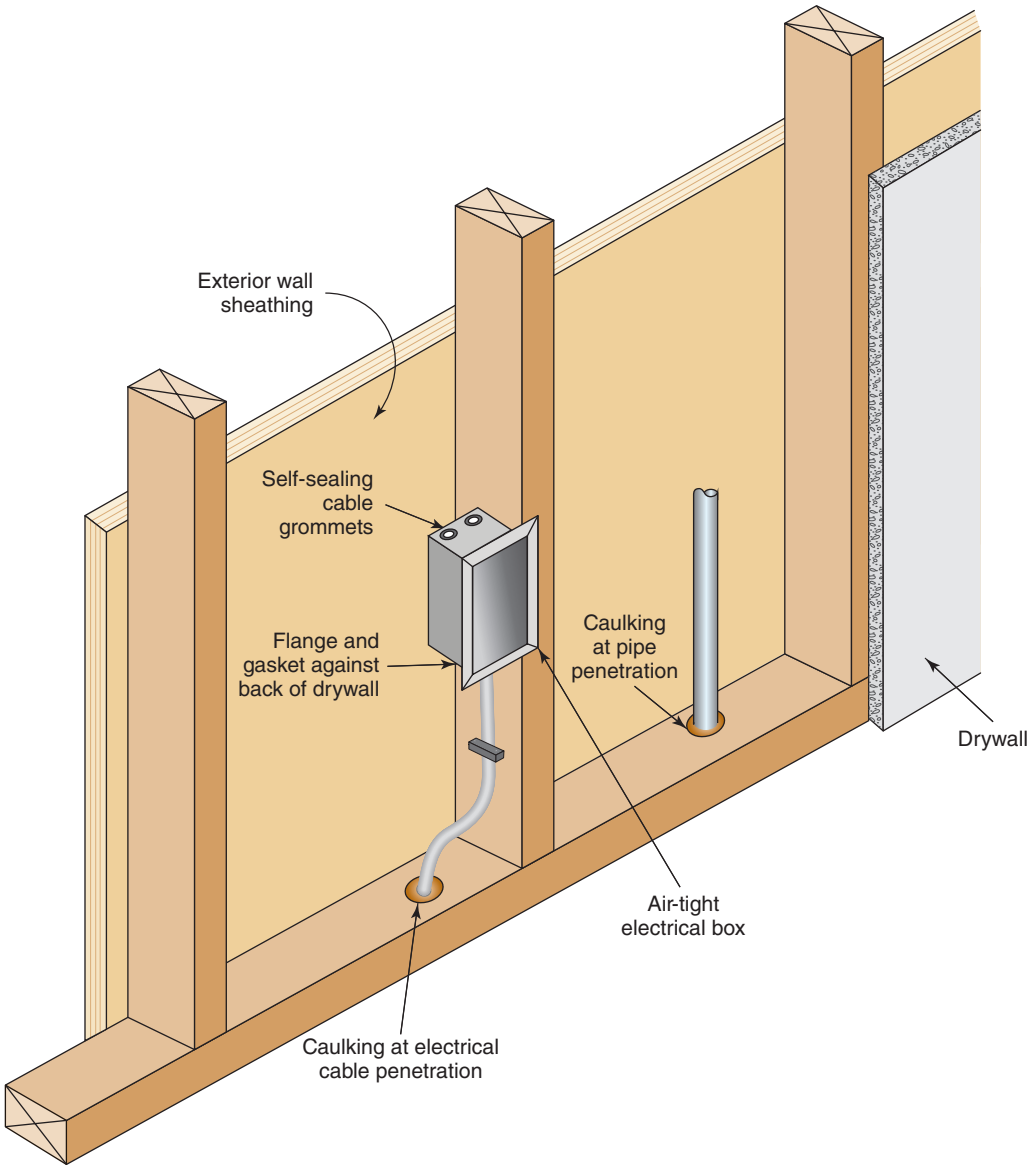
N1102.4.6

Air-Sealed Electrical Boxes

CHANGE TYPE: Addition

CHANGE SUMMARY: Electrical and communication outlet boxes installed in the building thermal envelope must be sealed, tested and marked for compliance with the referenced standards.

2021 CODE: **N1102.4.6 (R402.4.6) Electrical and communication outlet boxes (air-sealed boxes).** Electrical and communication outlet boxes installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. Electrical and communication outlet boxes shall be tested in accordance with NEMA OS 4, *Requirements for Air-Sealed Boxes for Electrical and Communication Applications*, and shall have an air leakage rate of not greater than



Electrical and communication outlet boxes in the thermal envelope must be sealed to limit air leakage.

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2.0 cubic feet per minute (0.944 L/s) at a pressure differential of 1.57 psf (75 Pa). Electrical and communication outlet boxes shall be marked "NEMA OS 4" or "OS 4" in accordance with NEMA OS 4. Electrical and communication outlet boxes shall be installed per the manufacturer's instructions and with any supplied components required to achieve compliance with NEMA OS 4.

CHANGE SIGNIFICANCE: Similar to the requirements for recessed lighting, the new section sets specific air leakage requirements for electrical and communications outlet boxes to improve the efficiency of the building thermal envelope. The existing language in Table N1102.4.1.1 describes that the air barrier must be installed behind electrical and communication boxes, or alternatively, air-sealed boxes must be installed. The new Section N1102.4.6 defines air-sealed boxes as those meeting the prescribed standard and tested under the prescribed criteria. The new requirement will supersede other provisions in the code permitting onsite sealing of the air barrier, based on the concept that sealing air-barrier penetrations is not always as simple as applying more insulation, caulk, or expanding foam. Electrical and communication outlet boxes in the thermal envelope now must be tested and marked in compliance with the air-sealing standards and installed in accordance with the manufacturer's instructions.

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N1103.3

Duct Installation

CHANGE TYPE: Modification

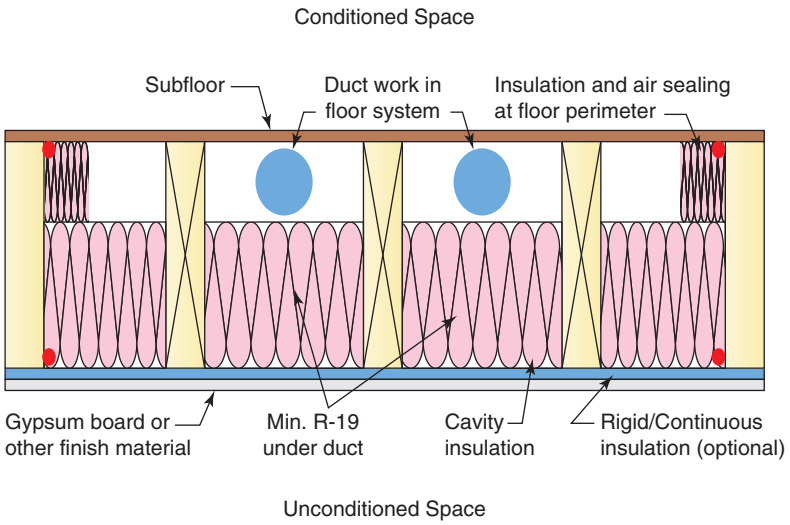
CHANGE SUMMARY: Duct insulation requirements have been clarified in Sections N1103.3.1 through N1103.3.3.1

2021 CODE: **N1101.6 (R202). Thermal Distribution Efficiency (TDE).** The resistance to changes in air heat as air is conveyed through a distance of air duct. TDE is a heat loss calculation evaluating the difference in the heat of the air between the air duct inlet and outlet caused by differences in temperatures between the air in the duct and the duct material. TDE is expressed as a percent difference between the inlet and outlet heat in the duct.

N1103.3 (R403.3) Ducts. Ducts and air handlers shall be installed in accordance with Sections N1103.3.1 through N1103.3.7.

N1103.3.1 (R403.3.1) Ducts ~~Insulation~~ located outside conditioned space ~~(Prescriptive)~~. Supply and return ducts ~~in attics~~ located outside conditioned space shall be insulated to an *R*-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. ~~Supply and return ducts in other portions of the building shall be insulated to not less than R-6 for ducts 3 inches (76 mm) in diameter and to not less than R-4.2 for ducts smaller than 3 inches (76.2 mm) in diameter.~~ Ducts buried beneath a building shall be insulated as required by this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the *R*-value equivalency.

> **Exception:** ~~Ducts or portions thereof located completely inside the building thermal envelope.~~



Ductwork considered to be in conditioned space.

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~~N1103.3.7 (R403.3.7)~~ N1103.2 (R403.3.2) Ducts located in conditioned space. For ~~ducts~~ ductwork to be considered ~~as~~ inside ~~a~~ conditioned space, ~~such ducts~~ it shall comply with ~~either~~ one of the following:

1. The duct system is located completely within the continuous air barrier and within the building thermal envelope.
2. ~~The ducts are~~ Ductwork in ventilated attic spaces is buried within ceiling insulation in accordance with Section ~~N1103.3.6~~ N1103.3.3 and all of the following conditions exist:
   2.1. The air handler is located completely within the continuous air barrier and within the building thermal envelope.
   2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section ~~N1103.3.4~~ N1103.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of conditioned floor area served by the duct system.
   2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.
3. Duct work in floor cavities located over unconditioned space shall have the following:
   3.1. A continuous air barrier installed between unconditioned space and the duct
   3.2 Insulation installed in accordance with Section N1102.2.7
   3.3. A minimum *R*-19 insulation installed in the cavity width separating the duct from unconditioned space.
4. Duct work located within exterior walls of the building thermal envelope shall have the following:
   4.1. A continuous air barrier installed between unconditioned space and the duct
   4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing
   4.3 The remainder of the cavity insulation fully insulated to the drywall side.

~~N1103.3.6 (R403.3.6)~~ N1103.3.3 (R403.3.3) Ducts buried within ceiling insulation.

~~N1103.3.6.1 (R403.3.6.1)~~ N1103.3.3.1 (R403.3.3.1) Effective *R*-value of deeply buried ducts.

~~N1103.3.2 (R403.3.2)~~ N1103.3.4 (R403.3.4) Sealing (~~Mandatory~~).

~~N1103.3.2.1 (R403.3.2.1)~~ N1103.3.4.1 (R403.3.4.1) Sealed air handler.

~~N1103.3.3 (R403.3.3)~~ N1103.3.5 (R403.3.5) Duct testing (~~Mandatory~~).

~~N1103.3.4 (R403.3.4)~~ N1103.3.6 (R403.3.6) Duct leakage (~~Prescriptive~~).

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~~N1103.3.5~~ (~~R403.3.5~~) N1103.3.7 (R403.3.7) Building cavities (~~Mandatory~~).

Note: Not all changes are shown. Please refer the 2021 IRC for the complete text.

CHANGE SIGNIFICANCE: In the 2018 code, the addition of provisions for ducts buried within ceiling insulation addressed the installation issue for ducts located outside of the continuous air barrier assemblies. The new language completes this transition by addressing ducts that are located within the continuous air barrier and the building thermal envelope assemblies in concealed locations. Section N1103.3 now clearly defines the four scenarios where ductwork can be installed and qualify as being in conditioned space:

- Duct system completely within the continuous air barrier and building thermal envelope
- Duct work in ventilated attic and buried within ceiling insulation
- Duct work in floor cavities over unconditioned space
- Duct work within exterior walls

The new language addresses minimum requirements to separate the ductwork from unconditioned spaces with prescribed insulation and air barrier, including installations in floor assemblies and walls. Keeping the ducts inside conditioned space increases the energy performance of homes.

The entire Section N1103.3 was reorganized for clarity and application:

- N1103.3.1 Ducts located outside conditioned space
- N1103.3.2 Ducts located in conditioned space
- N1103.3.3 Ducts buried within ceiling insulation
- N1103.3.4 Duct Sealing
- N1103.3.5 Duct Testing
- N1103.3.6 Duct Leakage
- N1103.3.7 Building Cavities

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N1103.3.5
Duct Testing

CHANGE TYPE: Modification

CHANGE SUMMARY: The exception for duct testing of ducts located entirely in conditioned spaces has been removed.

2021 CODE: ~~**N1103.3.3 (R403.3.3)**~~ **N1103.3.5 (R403.3.5) Duct testing ~~(Mandatory)~~.** Ducts shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

~~1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.~~

~~2.~~ A duct air-leakage test shall not be required for ducts serving ~~heat or energy recovery ventilators~~ ventilation systems that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the building official.



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Ductwork entirely within the building thermal envelope requires testing.

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~~N1103.3.4 (R403.3.4)~~ N1103.3.6 (R403.3.6) Duct leakage ~~(Prescriptive)~~. The total leakage of the ducts, where measured in accordance with Section N1103.3.5, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
2. Postconstruction test: Total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.
3. Tests for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the building thermal envelope, total air leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m^2) of conditioned floor area.

CHANGE SIGNIFICANCE: The code previously exempted homes from duct testing requirements where the air handler and all ducts were located inside conditioned space. Although moving all ducts inside conditioned space may have a positive impact on energy efficiency overall, this practice alone cannot guarantee that the ducts will be tight enough to deliver conditioned air to all occupied areas of the home. Uncomfortable occupants commonly adjust thermostat settings to counteract the effect of poor delivery of conditioned air, leading to losses in energy efficiency.

This code change requires a duct leakage test for all new dwellings, including those with all ducts inside conditioned space. Note that the allowable leakage rate will be set at twice the prescriptive rate when all ducts are located inside conditioned space.

Duct leakage rates can be extremely high when ducts are not tested. Without an objective test as a means of quality assurance, even careful builders may not be aware of missed connections or poor sealing. In a recent Department of Energy (DOE) field study of residential homes in Kentucky, homes received duct leakage tests even where all supply and return ducts were located inside conditioned space. Of the 24 homes tested with ducts inside conditioned spaces, the leakage rate averaged 18.5 cfm/sqft, with individual homes ranging from 6.26 cfm/sqft to as high as 40.36 cfm/sqft, higher leakage rates than the 2018 IECC requirement. Forty other homes in the same study with at least some ducts located outside conditioned space achieved leakage rates of 9.7 cfm/sqft, on average – roughly half the leakage rate of homes that qualified for the exemption. The field studies found similar results in Pennsylvania, where "exempt" homes (with all ducts inside conditioned space) averaged 31 cfm/sqft leakage, while homes required to be tested averaged 18 cfm/sqft leakage.

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N1103.6

Mechanical Ventilation

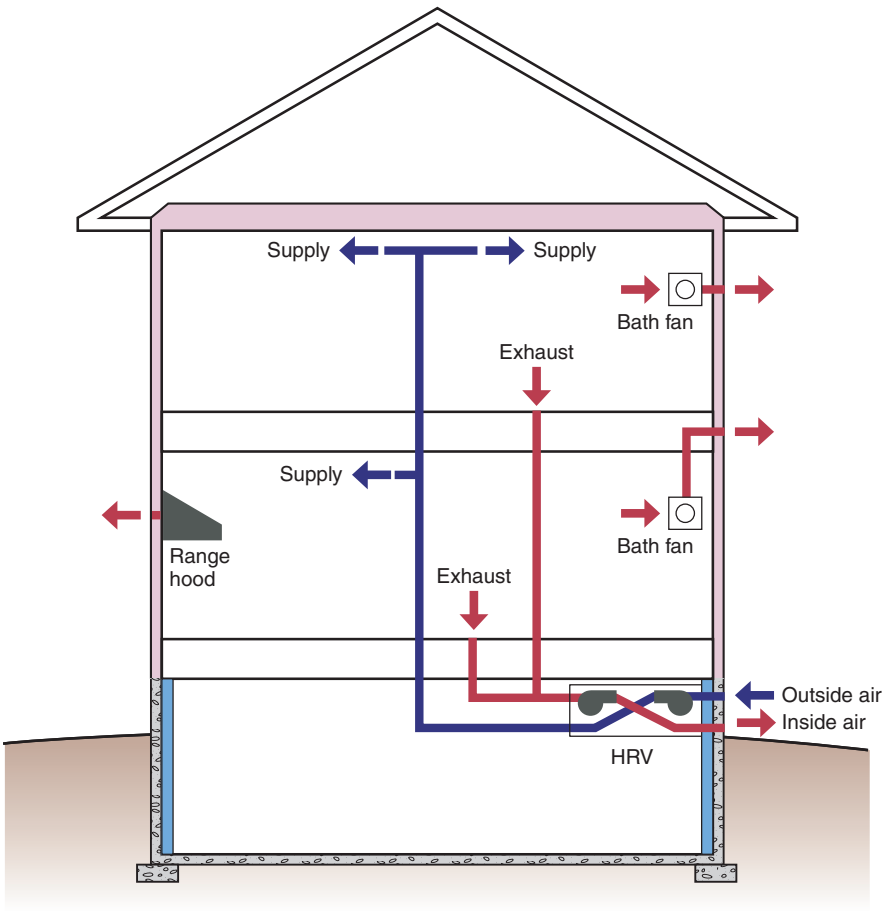
CHANGE TYPE: Addition

CHANGE SUMMARY: A heat or energy recovery ventilation system is required for Climate Zones 7 and 8. Mechanical ventilation systems now require testing.

2021 CODE: N1103.6 (R403.6) Mechanical ventilation ~~(Mandatory)~~. ~~The building~~ Buildings and dwelling units shall be provided with mechanical ventilation that complies with the requirements of Section M1505 or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

N1103.6.1 (R403.6.1) Heat or energy recovery ventilation. Dwelling units shall be provided with a heat recovery or energy recovery ventilation system in Climate Zones 7 and 8. The system shall be balanced with a minimum sensible heat recovery efficiency of 65 percent at 32°F (0°C) at a flow greater than or equal to the design airflow.

~~N1103.6.1 (R403.6.1)~~ N1103.6.2 (R403.6.2) Whole-~~house~~ dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-~~house~~ dwelling mechanical ventilation shall meet the efficacy requirements of Table ~~N1103.6.1~~ N1103.6.2 at one or more rating points. Fans shall be tested in accordance with HVI 916 and listed. The airflow



An HRV or ERV is required in Climate Zones 7 and 8.

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shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV, ERC, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch w.c. (49.82 Pa). Fan efficacy for ducted range hoods, bathroom, and utility room fans shall be determined at a static pressure of not less than 0.1 inch w.c. (24.91 Pa).

~~**Exception:** Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.~~

N1103.6.3 (R403.6.3) Testing. Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section N1103.6. Testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood or box, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals or grilles, outlet terminals or grilles, or in the connected ventilation ducts. Where required by the building official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the building official.

Exception: Kitchen range hoods that are ducted to the outside with 6 inch (152 mm) or larger duct and not more than one 90-degree elbow or equivalent in the duct run.

TABLE ~~N1103.6.1 (R403.6.1)~~ N1103.6.2 (R403.6.2) Whole-~~House~~ Dwelling Mechanical Ventilation System Fan Efficacy[a]

System Type ~~Fan Location~~	Air Flow Rate Minimum (cfm)	Minimum Efficacy (cfm/watt)[a]	~~Air Flow Rate Maximum (CFM)~~
HRV, ~~or~~ ERV or balanced	Any	1.2 cfm/watt	~~Any~~
~~Range hoods~~	~~Any~~	~~2.8 cfm/watt~~	~~Any~~
In-line supply or exhaust fan	Any	~~2.8~~ 3.8 cfm/watt	~~Any~~
Other exhaust fan ~~Bathroom, utility room~~	~~10~~ < 90	~~1.4~~ 2.8 cfm/watt	~~< 90~~
Other exhaust fan ~~Bathroom, utility room~~	≥ 90	~~2.8~~ 3.5 cfm/watt	~~Any~~
Air-handler that is integrated to tested and listed HVAC equipment	Any	1.2 cfm/watt	

For SI: 1 cubic foot per minute = 28.3 L/min.

~~a. When tested in accordance with HVI Standard 916.~~
a. Design outdoor airflow rate/watts of fan used.

CHANGE SIGNIFICANCE: Dwelling units located in the coldest Climate Zones 7 and 8 now require a heat recovery (HRV) or energy recovery ventilation (ERV) system to save energy, particularly in the colder months. With these systems, heat loss is minimized by using conditioned exhaust air to warm incoming air. An HRV only transfers heat energy and is most effective in cold, dry climates. ERVs are most effective in warm humid climates.

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The energy provisions require mechanical ventilation and the minimum ventilation rates are indicated in Section N1103.6. The testing experience gained through the verification of the EnergyStar program has demonstrated that ventilation fans are installed but are not always performing as required by the code. Fan rated flow does not necessarily equate to the flow that is actually produced once a fan has been installed. The quality of the installation of the duct from the fan to the termination of the duct to the outside as well as the quality of the termination device ultimately governs the amount of air that any fan can push. This new provision requires testing to ensure that the systems are not only there but have also been installed in such a way that they work as intended by the code.

This new provision applies to all compliance paths and is included in Table N1105.2 for the total building performance path and Table N1106.2 for the ERI compliance path. Requiring testing of spot (local) and whole house ventilation systems intends to move the building industry into compliance with the code by offering direct feedback on the fan choice and the installation. This feedback will guide fan choice and installation techniques that will be in compliance with the code.

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N1104

Lighting Equipment

CHANGE TYPE: Addition

CHANGE SUMMARY: High-efficacy lighting is now required in all permanent lighting fixtures. New provisions regulate lighting controls for interior and exterior lighting.

2021 CODE: N1104.1 (R404.1) Lighting equipment ~~(Mandatory)~~. ~~Not less than 90 percent of the~~ All permanently installed lighting fixtures, excluding kitchen appliance lighting fixtures, shall contain only high-efficacy lighting sources ~~lamps~~.

N1104.2 (R404.2) Interior Lighting Controls. Permanently installed lighting fixtures shall be controlled with a dimmer, an occupant sensor control or another control that is installed or built into the fixture.

Exception: Lighting controls shall not be required for the following:

1. Bathrooms
2. Hallways
3. Exterior lighting fixtures
4. Lighting designed for safety or security

N1104.3 (R404.3) Exterior lighting controls. Where the total permanently installed exterior lighting power is greater than 30 watts, the permanently installed exterior lighting shall comply with the following:

1. Lighting shall be controlled by a manual on and off switch that permits automatic shut off actions.

   Exception: Lighting serving multiple dwelling units.

2. Lighting shall be automatically shut off when daylight is present and satisfies the lighting needs.
3. Controls that override automatic shut off actions shall not be allowed unless the override automatically returns automatic control to its normal operation within 24 hours.



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Controls are required for exterior lighting exceeding 30 watts.

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All permanently installed lighting fixtures require high-efficacy light sources.

CHANGE SIGNIFICANCE: Section N1104 broadly addresses residential electrical power and lighting systems. Lighting uses about 10 percent of residential electrical power. New to the 2021 IRC electrical power and lighting provisions are grouped in the following categories:

- N1104.1 High-efficacy lighting sources for all permanent lighting fixtures
- N1104.2 Interior lighting controls
- N1104.3 Exterior lighting controls

Historically the IECC, and therefore Chapter 11 of the IRC, has not included specific requirements for residential lighting controls. However, as seen by its impact on the commercial market, controls applied to equipment and lighting can provide further energy efficiencies. The new Section N1104.2 requires interior lighting controls in the form of either a dimmer, occupant sensor, or some other control. Both dimmers and occupancy controls save energy. Dimmers can reduce energy use by about 20 percent, while occupant sensors reduce wasted energy by around 30 percent. These controls are essentially permanent, or at least have a long lifetime. This new provision applies to all compliance paths and is included in Table N1105.2, Requirements for Total Building Performance and Table N1106.2, Requirements for Energy Rating Index.

The new Section N1104.3 introduces residential exterior lighting provisions to the code. The new requirement includes controls for systems with greater than 30 watts – manual switches that allow automatic shutoff, automatic shutoff based on daylight, and overrides for the controls. The type of control is not specified, only what it must accomplish. The 2014 Consortium for Energy Efficiency (CEE) report "Lighting Controls Market Characterization Report," identified that the use of a photosensor or timer can save, on average, up to 60 KWh per year, based on the efficacy of the light source that is controlled. This new provision for exterior lighting applies only to the prescriptive compliance path.

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N1105 and Table N1105.2

Total Building Performance Analysis

CHANGE TYPE: Modification

CHANGE SUMMARY: The Total Building Performance compliance path has been retitled and reorganized with a new Table N1105.2 listing the related mandatory requirements that appear elsewhere in the code.

2021 CODE:

SECTION N1105 (R405)
~~SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)~~
TOTAL BUILDING PERFORMANCE

N1105.1 (R405.1) Scope. This section establishes criteria for compliance using ~~simulated energy~~ total building performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water heating energy only.

N1105.2 (R405.2) ~~Mandatory requirements.~~ Performance based compliance. Compliance ~~with this section~~ based on total building performance requires that ~~the mandatory provisions identified in Section N1101.13 be met.~~ a proposed design meets all of the following: ~~Supply and return ducts not completely inside the building thermal envelope shall be insulated to an *R*-value of not less than R-6.~~

1. The requirements of the sections indicated within Table N1105.2
2. The building thermal envelope greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 *International Energy Conservation Code.*
3. An annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the building official, such as the Department of Energy, Energy Information Administration's State



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Fenestration orientation and shading strategies are part of a Total Building Performance evaluation.

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Energy Data System Prices and Expenditures reports. The building official shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

TABLE N1105.2 (R405.2) Requirements for Total Building Performance

Section[a]	Title
General	
N1101.13.5	Additional energy efficiency
N1101.14	Certificate
Building Thermal Envelope	
N1102.1.1	Vapor Retarder
N1102.2.3	Eave Baffles
N1102.2.4.1	Access hatches and doors
N1102.2.10.1	Crawl space wall insulation installation
N1102.4.1.1	Installation
N1102.4.1.2	Testing
N1102.5	Maximum fenestration *U*-factor and SHGC
Mechanical	
N1103.1	Controls
N1103.3, including N1103.3.1.1, except Sections N1103.3.2, N1103.3.3, and N1103.3.6	Ducts
N1103.4	Mechanical system piping insulation
N1103.5.1	Heated water circulation and temperature maintenance systems
N1103.5.3	Drain water heat recovery units
N1103.6	Mechanical ventilation
N1103.7	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt system controls
N1103.10	Energy consumption of pools and permanent spas
N1103.11	Portable spas
N1103.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
N1104.1	Lighting equipment
N1104.2	Interior Lighting Controls

a. Reference to a code section includes all the relative subsections except as indicated in the table.

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~~**N1105.3 (R405.3) Performance-based compliance.** Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.~~

> ~~**Exception:** The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.~~

Note: Not all changes to Section N1105 are shown. Please refer to the 2021 IRC for the complete text.

CHANGE SIGNIFICANCE: Section N1105 contains the provisions for the Total Building Performance compliance option. This simulated performance alternative offers flexibility to determine the most cost-effective methods to design a code-compliant structure. This method uses software to predict the annual energy use of the proposed design compared to that of the standard design of building components listed in Table N1105.4.2(1), Specifications for the Standard Reference and Proposed Designs. If the proposed building's annual energy use is less than or equal to that of the standard design, the building complies with the code's goal of effective energy use. This method is useful to consider for any building designs that incorporate shading strategies to minimize air-conditioning loads in the summer and maximize heat gain in the winter.

The 2021 IECC and Chapter 11 of the IRC include restructuring of the section to clarify required provisions (formerly referred to as mandatory) and updates to the standard reference design.

The labels "prescriptive" and "mandatory" were introduced into the 2009 IRC. The terms have not been defined and have not been used consistently. These terms were applied to various section and subsection titles throughout Chapter 11 creating confusion for users. Furthermore, the labels were not requirements and were not enforceable.

Among long-time code users, it is generally understood that "mandatory" was intended to mean "nontradeable" when using performance compliance options, meaning that where the procedures or systems described within the "mandatory" section were included as part of the design, the requirements of that section had to be met and could not be traded off. "Prescriptive," on the other hand, was intended to mean "mandatory" when using the prescriptive path, but "tradeable" when using the performance path. However, this understanding was not explicitly based on code language and new users to the code have been confused about the use of the terms.

The 2021 IRC has eliminated the terms mandatory and prescriptive and instead all requirements applicable to the Total Building Performance compliance path are identified within Section N1105. Table N1105.2 lists the section number and title of all required provisions for this compliance path.

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Since the 2009 code, the Total Building Performance alternative has seen extensive use in Colorado and that experience continues to inform the language of the IECC and IRC Chapter 11. In the 2015 edition, the process by which the Simulated Performance path was successfully implemented in Colorado was included as language in the body of the code to help jurisdictions and builders better understand how to implement the pathway to gain flexibility of choice and trade-offs.

In the 2021 code the Colorado experience further informs the code, with an update of the compliance requirements. The changes provide clarification and simplification rather than actually changing requirements. For example, the requirements for the submittal to obtain a building permit and steps to achieve a certificate of occupancy are more clearly laid out. In addition, Section N1105.4.2.1 Compliance Report for Permit Application and Section N1105.4.2.2 Confirmed Compliance Report for Certificate of Occupancy, have been consolidated and reordered to more clearly identify the documentation needed to be reviewed to demonstrate compliance.

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N1106 and Table N1106.2

Energy Rating Index Analysis

CHANGE TYPE: Modification

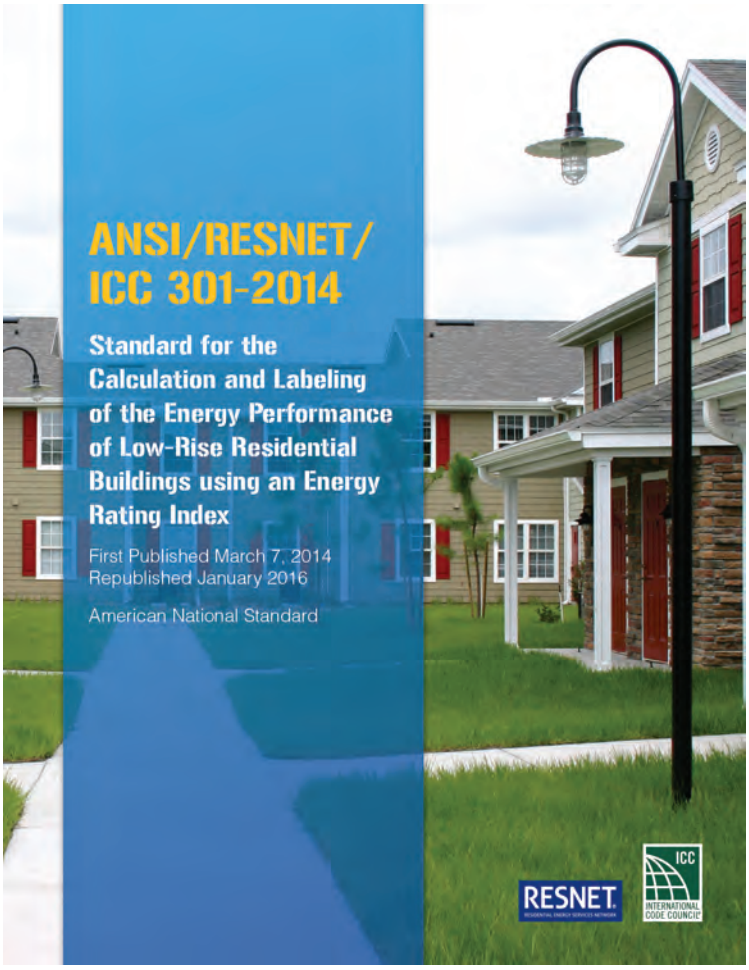
CHANGE SUMMARY: New Table N1106.2 lists the requirements associated with the Energy Rating Index (ERI) compliance path. ERI values have been lowered to improve energy efficiency.

2021 CODE:

SECTION N1106 (R406)
ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

N1106.1 (R406.1) Scope. This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

~~**N1106.2 (R406.2) Mandatory requirements.** Compliance with this section requires that the provisions identified in Sections N1101 through N1104 indicated as "Mandatory" and Section N1103.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table N1102.1.1 or N1102.1.3 of the 2009 International Energy Conservation Code.~~



The Energy Rating Index is determined in accordance with RESNET/ICC 301.

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~~**Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.~~

N1106.2 (R406.2) ERI Compliance. Compliance based on the Energy Rating Index (ERI) requires that the rated design meets all of the following:

1. The requirements of the sections indicated within Table N1106.2
2. Maximum energy rating index of Table N1106.5

TABLE N1106.2 (R406.2) Requirements for Energy Rating Index

Section[a]	Title
	General
N1101.13.5	Additional Efficiency Packages
N1101.14	Certificate
	Building Thermal Envelope
N1102.1.1	Vapor Retarder
N1102.2.3	Eave Baffles
N1102.2.4	Access hatches and doors
N1102.2.10.1	Crawl space wall insulation installations
N1102.4.1.1	Installation
N1102.4.1.2	Testing
	Mechanical
N1103.1	Controls
N1103.3 except sections N1103.3.2, N1103.3.3, and N1103.3.6	Ducts
N1103.4	Mechanical system piping insulation
N1103.5.3	Heated water circulation and temperature maintenance systems
N1103.5.3	Drain water heat recovery units
N1103.6	Mechanical ventilation
N1103.7	Equipment sizing and efficiency rating
N1103.8	Systems serving multiple dwelling units
N1103.9	Snow melt system controls
N1103.10	Energy consumption of pools and spas
N1103.11	Portable spas
N1103.12	Residential pools and permanent residential spas
	Electrical Power and Lighting Systems
N1104.1	Lighting equipment
N1104.2	Interior Lighting Controls
N1106.3	Building Thermal Envelope

a. Reference to a code section includes all of the relative subsections except as indicated in the table.

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N1106.3 Building Thermal Envelope.

N1106.3.1 On-site renewables are not included.

N1106.3.2 On-site renewables are included.

N1106.4 ~~N1106.3~~ Energy Rating Index.

N1106.5 ~~N1106.4~~ ERI-based compliance.

TABLE ~~N1106.4 (R406.4)~~ N1106.5 (R406.5) Maximum Energy Rating Index

Climate Zone	Energy Rating Index[a]
0-1	~~57~~ 52
2	~~57~~ 52
3	~~57~~ 51
4	~~62~~ 54
5	~~61~~ 55
6	~~61~~ 54
7	~~58~~ 53
8	~~58~~ 53

~~a. Where on-site renewable energy is included for compliance using the ERI analysis of Section N1106.4, the building shall meet the mandatory requirements of Section N1106.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table N1102.1.2 or Table N1102.1.4.~~

N1106.6 ~~N1106.5~~ Verification by approved agency.

N1106.7 ~~N1106.6~~ Documentation.

N1106.7.1 ~~N1106.6.1~~ Compliance software tools.

N1106.7.2 ~~N1106.6.2~~ Compliance report.

N1106.7.2.1 ~~N1106.6.2.1~~ Proposed compliance report for permit application.

Note: Due to space limitations, not all changes for Section N1106 are shown. Please refer to the 2021 IRC for the complete text.

CHANGE SIGNIFICANCE: Section N1106 contains the provisions for the ERI compliance path. Introduced into the 2015 code, it is another path that can be used to demonstrate compliance with the energy code. The ERI is an index scoring system with a number based on the ERI reference design value of 100. A residential building that uses no net purchased energy has an index value of 0. The ERI reference design is configured such that it meets the minimum requirements of the 2006 IECC. Each number on the scale represents a 1 percent change in the

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total energy use of the rated design relative to the total energy use of the ERI reference design benchmarked at 100 on the scale. The ERI score considers all energy used in the residential building.

The 2021 code includes restructuring of the section to clarify required provisions (formerly referred to as mandatory), updates the required ERI scores, and introduces provisions for renewable energy certificate documentation.

The labels "prescriptive" and "mandatory" were applied to various section and subsection titles throughout the code creating confusion for users. Furthermore, the labels were not requirements and were not enforceable.

The 2021 code has eliminated the terms mandatory and prescriptive and instead all requirements applicable to the N1106 Energy Rating Index are identified within Section N1106. New Table N1106.2 lists the section number and title of all required provisions for this compliance path.

Table N1106.5 is revised to restore the lower ERI target scores that appeared in the 2015 IECC and 2015 IRC. Coupled with the new requirements in Section N1101.13.5, Additional Energy Efficiency, the ERI compliance option will result in a significantly more efficient building than was required under the 2018 code. The additional energy efficiency measures require buildings complying under the energy rating index to use an ERI value that is at least 5 percent less than the ERI target specified in Table N1106.5 (already lowered in the 2021 code), making the ERI approach significantly more stringent than the other compliance paths.

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N1108

Additional Efficiency Package Options

CHANGE TYPE: Addition

CHANGE SUMMARY: The new requirement for choosing an energy efficiency package option, in addition to the prescriptive and total building performance compliance path options, will increase energy efficiency of new dwellings.

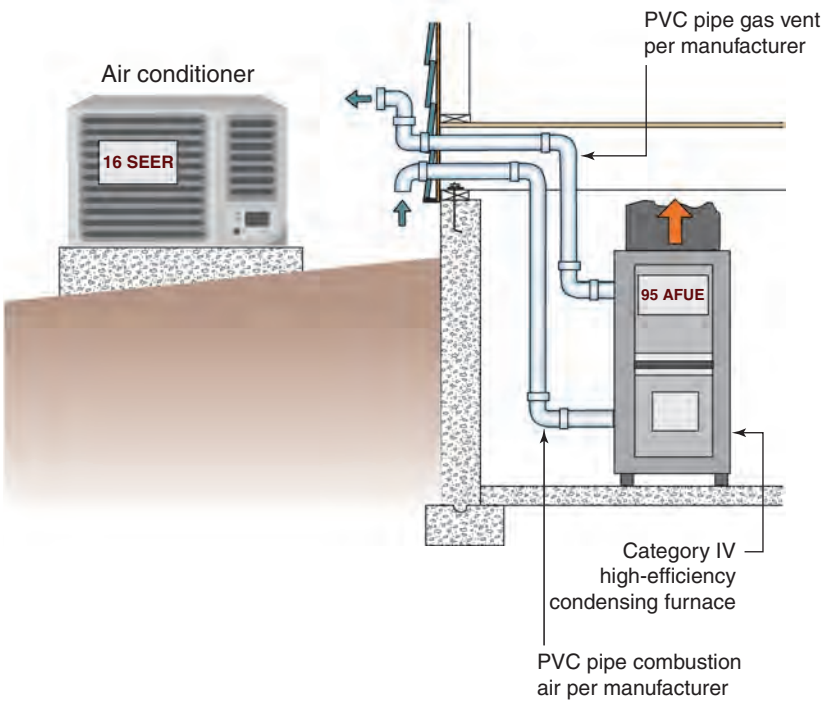
2021 CODE:

SECTION N1108 (R408)
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

N1108.1 (R408.1) Scope. This section establishes additional efficiency package options to achieve additional energy efficiency in accordance with Section N1101.13.5.

N1108.2 (R408.2) Additional efficiency package options. Additional efficiency package options for compliance with Section N1101.13.5 are set forth in Sections N1108.2.1 through N1108.2.5.

N1108.2.1 (R408.2.1) Enhanced envelope performance option The total building thermal envelope UA, the sum of *U*-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the *U*-factors in Table N1102.1.2 by the same assembly area as in the proposed building. The UA calculation shall be performed in accordance with Section N1102.1.5. The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration SHGC in Table N1102.1.2.



16 SEER AC and 95 AFUE furnace additional efficiency option.

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N1108.2.2 (R408.2.2) More efficient HVAC equipment performance option. Heating and cooling equipment shall meet one of the following efficiencies:

1. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner.
2. Greater than or equal to 10 HSPF/16 SEER air source heat pump.
3. Greater than or equal to 3.5 COP ground source heat pump. For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the heating design load.

N1108.2.3 (R408.2.3) Reduced energy use in service water-heating option. The hot water system shall meet one of the following efficiencies:

1. Greater than or equal to 82 EF fossil fuel service water-heating system.
2. Greater than or equal to 2.0 EF electric service water-heating system.
3. Greater than or equal to 0.4 solar fraction solar water-heating system.

N1108.2.4 (R408.2.4) More efficient duct thermal distribution system option. The thermal distribution system shall meet one of the following efficiencies:

1. 100 percent of ducts and air handlers located entirely within the building thermal envelope.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the building thermal envelope.
3. 100 percent of duct thermal distribution system located in conditioned space as defined by N1103.3.2.

N1108.2.5 (R408.2.5) Improved air sealing and efficient ventilation system option. The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an energy recovery ventilator (ERV) or heat recovery ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent sensible recovery efficiency (SRE), less than or equal to 1.1 cubic feet per minute per watt (0.03 m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent latent recovery/moisture transfer (LRMT).

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CHANGE SIGNIFICANCE: Arguably the most significant change to Chapter 11 of the IRC and the residential provisions of the 2021 IECC, new Section N1108 (IECC Section R408) coupled with scoping in Section N1101.13.5, represents additional requirements applied to the prescriptive and total building performance compliance paths.

The application of Section N1108 is established in N1101.13.5:

- Prescriptive compliance projects must include one package from Section N1108.
- Total building performance compliance projects must either include one package of additional requirements in the project, without including it in the proposed design calculations, or the proposed design must have an annual energy cost less than or equal to 95 percent of the standard reference design.

  Note: Projects complying via the ERI path do not require any of the additional efficiency package options in Section N1108, but must have a score at least 5 percent less than that in the ERI Table N1106.4.

The new Section N1108 largely mirrors the format of the 2012 through 2018 editions of the commercial provisions of IECC Section C406, Additional Efficiency Package Options. Like Section C406, new IRC Section N1108 with companion Section N1101.13.5 offers multiple improvements that will increase energy savings and reduce energy costs to the homeowner over the useful life of the building.

Section N1108 is modeled after code language adopted in states like Oregon and Washington that have successfully created a list of options available to builders to comply with improvements to the base residential code requirements. This approach is intended to allow flexibility for code users while advancing a building's energy efficiency.

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PART 5

Mechanical

Chapters 12 through 23



- **Chapter 12** Mechanical Administration
  No changes addressed
- **Chapter 13** General Mechanical System Requirements
  No changes addressed
- **Chapter 14** Heating and Cooling Equipment
  No changes addressed
- **Chapter 15** Exhaust Systems
- **Chapter 16** Duct Systems
  No changes addressed
- **Chapter 17** Combustion Air
  No changes addressed
- **Chapter 18** Chimneys and Vents
- **Chapter 19** Special Appliances, Equipment and Systems
  No changes addressed
- **Chapter 20** Boilers and Water Heaters
  No changes addressed
- **Chapter 21** Hydronic Piping
- **Chapter 22** Special Piping and Storage Systems No changes addressed
- **Chapter 23** Solar Thermal Energy Systems
  No changes addressed

As a comprehensive code that applies to all aspects of residential construction, the IRC contains provisions for the mechanical, fuel gas, plumbing and electrical systems of the building. These systems are covered in their respective parts of the IRC beginning with Part 5. Chapter 12 contains administrative provisions unique to the application and enforcement of regulations governing mechanical systems, as well as the technical provisions related to system design and installation in Chapters 13 through 23. Chapter 13 provides the general requirements for all mechanical systems and addresses the listing and labeling of appliances, types of fuel used, access to appliances, clearance to combustibles and other related issues. The remainder of Part 5 deals with requirements for specific mechanical systems related to heating and cooling, exhaust, ventilation, ducts, vents, boilers and hydronic piping. The last two chapters of Part 5 contain provisions specific to fuel oil piping and storage, and thermal solar energy systems. ■

M1505

Balanced Ventilation System Credit

M1802.4

Blocked Vent Switch for Oil-fired Appliances

M2101

Hydronic Piping Systems Installation

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M1505

Balanced Ventilation System Credit

CHANGE TYPE: Modification

CHANGE SUMMARY: The code now allows a 30 percent reduction to the mechanical ventilation airflow rate for balanced ventilation systems.

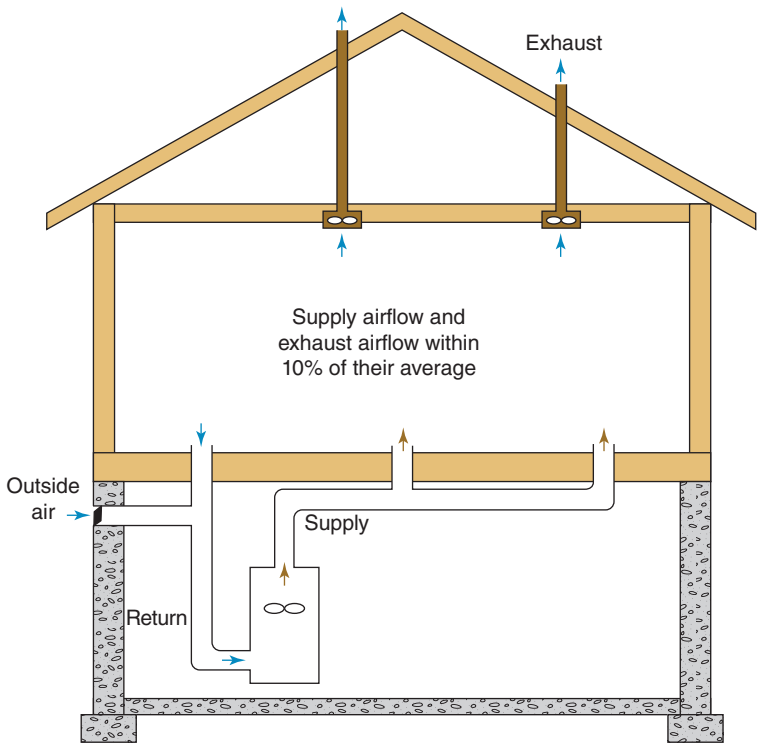
2021 CODE: **R202 Definitions.**

BALANCED VENTILATION SYSTEM. A ventilation system where the total supply airflow and total exhaust airflow are simultaneously within 10 percent of their average. The balanced ventilation system airflow is the average of the supply and exhaust airflows.

M1505.1 General. Where local exhaust or whole-house mechanical ventilation is provided, the ~~equipment~~ ventilation system shall be designed in accordance with this section.

M1505.3 Exhaust equipment. Exhaust ~~equipment serving single dwelling units~~ fans and whole-house mechanical ventilation fans shall be listed and labeled as providing the minimum required airflow in accordance with ANSI/AMCA 210-ANSI/ASHRAE 51.

M1505.4.2 System controls. The whole-house mechanical ventilation system shall be provided with controls that enable manual override. Controls shall include text or a symbol indicating their function.



Balanced ventilation system.

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M1505.4.3 Mechanical ventilation rate. The whole house mechanical ventilation system shall provide outdoor air at a continuous rate ~~as~~ not less than that determined in accordance with Table M1505.4.3(1) or not less than that determined by Equation 15-1.

[Equation 15-1]

Ventilation rate in cubic feet per minute = (0.01 x total square foot area of house) + [7.5 x (number of bedrooms + 1)]

Exceptions:

1. Ventilation rate credit. The minimum mechanical ventilation rate determined in accordance with Table M1505.4.3(1) or Equation 15-1 shall be reduced by 30%, provided that both of the following conditions apply:
   - 1.1. A ducted system supplies ventilation air directly to each bedroom and to one or more of the following rooms:
     - 1.1.1. Living room
     - 1.1.2. Dinning room
     - 1.1.3. Kitchen
   - 1.2. The whole-house ventilation system is a balanced ventilation system.
2. Programmed intermittent operation. The whole-house mechanical ventilation system is permitted to operate intermittently where the system has controls that enable operation for not less than 25 percent of each 4-hour segment and the ventilation rate prescribed in Table M1505.4.3(1) , by Equation 15-1, or by Exception 1 is multiplied by the factor determined in accordance with Table M1505.4.3(2).

TABLE M1505.4.4 Minimum Required Local Exhaust Rates for One- and Two-Family Dwellings

Area to be exhausted	Exhaust rates[a]
Kitchens	100 cfm intermittent or 25 cfm continuous
Bathrooms—Toilet Rooms	Mechanical exhaust capacity of 50 cfm intermittent or 20 cfm continuous

For SI: 1 cubic foot per minute = 0.0004719 m^3/s. 1 inch water column = 0.2488 kPa

a. The listed exhaust rate for bathrooms-toilet rooms shall equal or exceed the exhaust rate at a minimum static pressure of 0.25 inch wc in accordance with Section M1505.3.

CHANGE SIGNIFICANCE: Balanced mechanical ventilation systems provide superior ventilation to unbalanced systems. The new provisions for reduced air flow in balanced systems recognize the advantages of balanced systems and they are no longer required to provide the same airflow rate as less effective, unbalanced systems to provide equivalent ventilation. The credit to reduce the required airflow rate for balanced ventilation is based on a simplified version derived from ASHRAE 62.2-2016 Equation 4.2. The ASHRAE equation adjusts the balanced whole house ventilation flow rate as a function of building air leakage, building height, and weather and shielding

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factor (which approximates a corresponding climate zone). To simplify application of the ASHRAE calculation, the code recognizes a one-size-fits-all balanced system factor based on a methodology developed for a typical new, single-family detached home with one-, two- and three-stories. The assigned air leakage rates are conservative values assuming that the average home is slightly tighter than the maximum allowed leakage rates of the energy efficiency provisions.

To ensure that exhaust fans provide the minimum CFM required by the IRC, the 2015 edition added Table M1504.2 to provide prescriptive duct sizing based on fan exhaust rates taken at a static pressure of 0.25-inch water column. For consistency, footnote a has been added to Table 1505.4.4 to align the flow rate requirements with the duct sizing requirements of Table M1504.2 and the equipment listing requirements of Section M1505.3.

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M1802.4

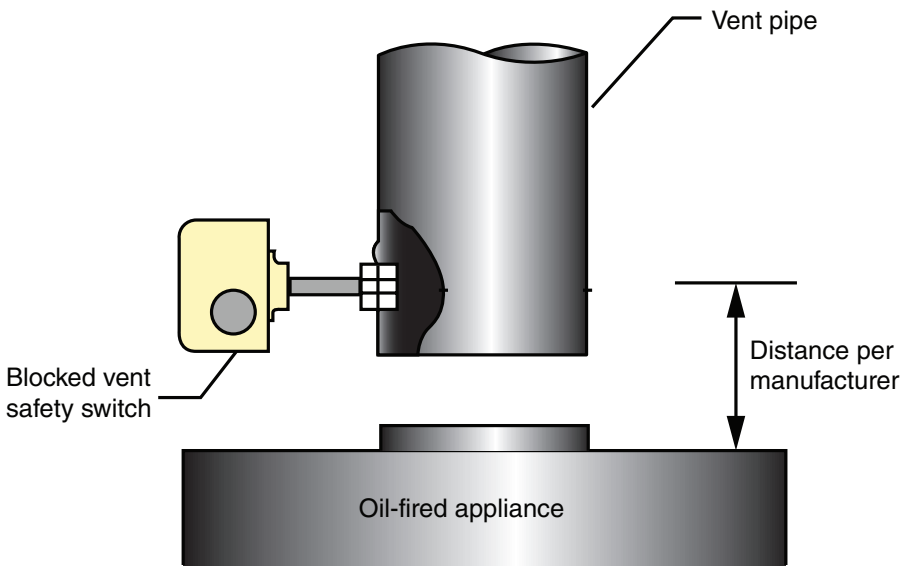
Blocked Vent Switch for Oil-fired Appliances

CHANGE TYPE: Addition

CHANGE SUMMARY: An additional safety device for oil-fired appliances has been added to be consistent with what is required for some gas-fired appliances.

2021 CODE: **M1802.4 Blocked vent switch.** Oil-fired appliances shall be equipped with a device that will stop burner operation in the event that the venting system is obstructed. Such device shall have a manual reset and shall be installed in accordance with the manufacturer's instructions.

CHANGE SIGNIFICANCE: Blocked (obstructed) vent switches are not new, but the code has not required them until now. Oil-fired appliances such as furnaces vent to masonry chimneys, factory-built chimneys or Type L vents. These venting systems, especially masonry chimneys, are subject to blockage by plant debris, animal nesting materials, bird and raccoon carcasses, deteriorated masonry and similar objects. A blocked vent switch detects spillage from the venting system, typically from a draft regulator installed between the appliance and the vent or chimney and shuts off the appliance. This function can prevent carbon monoxide poisoning in the event of an obstructed vent or chimney. The manual reset feature prevents the appliance from operating without intentional action by an occupant or an HVAC service person. If the blocked vent switch activates, the cause must be determined and remedied before the appliance can resume operation.



Blocked vent switch for oil-fired appliances.

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M2101

Hydronic Piping Systems Installation

CHANGE TYPE: Modification

CHANGE SUMMARY: The provisions for ground source heat pump loop piping systems in Section M2105 have been duplicated in Section M2101 to apply to all hydronic piping systems.

2021 CODE:

Section M2101
Hydronic Piping Systems Installation

M2101.11 Used materials. Used pipe, fittings, valves, and other materials shall not be reused in hydronic systems.

M2101.12 Material rating. Pipe and tubing shall be rated for the operating temperature and pressure of the system. Fittings shall be suitable for the pressure applications and recommended by the manufacturer for installation with the pipe and tubing material installed. Where used underground, materials shall be suitable for burial.

M2101.13 Joints and connections. Joints and connections shall be of an approved type. Joints and connections shall be tight for the pressure of the system. Joints used underground shall be approved for such applications.

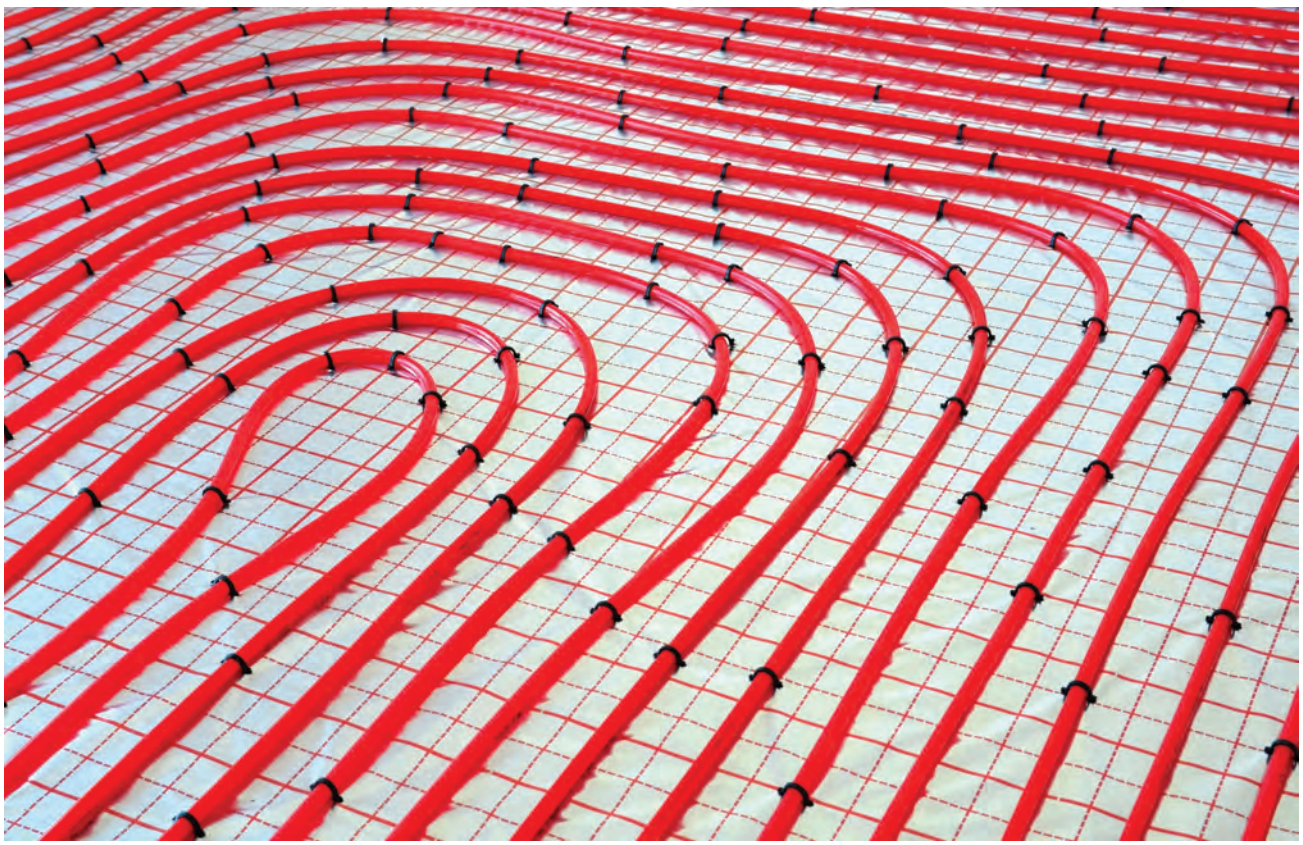


Photo courtesy of hamikus/iStock/Getty Images Plus/Getty Images

Hydronic radiant floor heating piping.

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M2101.13.1 Joints between different piping materials. Joints between different piping materials shall be made with approved transition fittings.

M2101.14 Preparation of pipe ends. Pipe shall be cut square and shall be free of burrs and obstructions. Pipe ends shall have full-bore openings and shall be prepared in accordance with the pipe manufacturer's instructions.

M2101.15 Joint preparation and installation. Where required by Sections M2101.16 through M2101.18, the preparation and installation of mechanical and thermoplastic-welded joints shall comply with Sections M2101.15.1 and M2101.15.2.

M2101.15.1 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

M2101.15.2 Thermoplastic-welded joints. Joint surfaces for thermoplastic-welded joints shall be cleaned by an approved procedure. Joints shall be welded in accordance with the manufacturer's instructions.

M2101.16 CPVC plastic pipe. Joints between CPVC plastic pipe or fittings shall be solvent-cemented in accordance with Section P2906.9.1.2. Threaded joints between fittings and CPVC plastic pipe shall be in accordance with Section M2101.16.1

M2101.16.1 Threaded joints. Threads shall conform to ASME B1.20.1. The pipe shall be Schedule 80, 40 or heavier plastic pipe and shall be threaded with dies specifically designed for plastic pipe. Thread lubricant, pipe-joint compound or tape shall be applied on the male threads only and shall be approved for application on the piping material.

M2101.17 Cross-linked polyethylene (PEX) plastic tubing. Joints between cross-linked polyethylene plastic tubing and fittings shall comply with Sections M2101.17.1 and M2101.17.2. Mechanical joints shall comply with Section M2101.15.1.

M2101.17.1 Compression-type fittings. Where compression-type fittings include inserts and ferrules or O-rings, the fittings shall be installed without omitting the inserts and ferrules or O-rings.

Section M2103
Floor Heating Systems

M2103.1 Piping materials. Piping for embedment in concrete or gypsum materials shall be standard-weight steel pipe, copper and copper-alloy pipe and tubing, cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-ALPEX) pressure pipe, chlorinated polyvinyl chloride (CPVC), ~~polybutylene,~~ cross-linked polyethylene (PEX) tubing, polyethylene of raised temperature (PE-RT) or polypropylene (PP) with a rating of not less than ~~100~~ 80 pounds per square inch at 180°F (~~690~~ 552 kPa at 82°C).

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Section M2105
Ground-Source Heat-Pump System Loop Piping

M2105.7 Preparation of pipe ends. Pipe shall be cut square~~, reamed~~, and shall be free of burrs and obstructions. ~~CPVC, PE and PVC pipe shall be chamfered.~~ Pipe ends shall have full-bore openings and shall ~~not be undercut~~ be prepared in accordance with the pipe manufacturer's instructions.

Note: Due to space limitations, not all changes are shown for Chapter 21. Please refer to the 2021 IRC for the complete text.

CHANGE SIGNIFICANCE: The general hydronic systems provisions have been expanded and updated to provide more detailed guidance for installations. Section M2101 now provides the same level of coverage as is currently provided for ground-source heat pump systems in Section M2105. Sections M2101.1 through M2101.10 remain without significant changes and cover basics such as piping and fitting standards, piping support and testing. The added Sections M2101.11 through M2101.30 are pulled directly from Section M2105 and primarily cover piping and fitting materials, joint and connection methods for the various materials, valves and pressure vessels and various other components and safeguards.

A change to Section M2103.1 Piping materials for floor heating systems, recognizes that piping for embedment in concrete or gypsum materials does not need to be rated at 100 psi. Hydronic heating systems are typically designed with operating pressures of 12 psi–20 psi, and these systems contain expansion tanks incorporated in them that are factory set to 12 psi. Safety relief valves on the boilers are typically set at 30 psi or 50 psi. The code now permits piping rated at 80 psi and is consistent with information in ASTM F2623, *Standard Specification for Polyethylene of Raised Temperature (PE-RT) SDR 9 Tubing*.

In Section M2105.7 dealing with preparation of pipe ends for ground source heat pump system loop piping, the text has been revised to accurately reflect procedures for the type of piping being used. This section is specific to plastic pipes and some of the existing language referred to terms such as "reamed" and "undercut" which only apply to metallic pipes. These terms have been deleted. The requirement for CPVC, PE and PVC pipe ends to be chamfered has also been removed. The revised language is more appropriate by requiring the pipe ends to be prepared in accordance with the manufacturer's instructions. The instructions will be specific to the type of plastic pipe being used.

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PART 6

Fuel Gas

Chapter 24



■ **Chapter 24** Fuel Gas

Fuel gas systems are covered in Part 6, including provisions for approved materials as well as the design and installation of fuel gas piping and other system components. The fuel gas provisions of the IRC are taken directly from the *International Fuel Gas Code* (IFGC). In order to make the correlation and coordination of the two codes easier, after each fuel gas section of the IRC the corresponding section of the IFGC is shown in parentheses. The fuel gas portion of the IRC contains its own specific definitions in Section G2403 in addition to the general definitions found in Chapter 2 of the IRC. The text, tables and figures in other sections of Chapter 24 address the technical issues of fuel gas systems, such as appliance installation; materials, sizing, and installation of fuel gas piping systems; piping support; flow controls; connections; combustion air; venting; and other related system requirements. ■

G2403
Definitions of Point of Delivery and Service Meter Assembly

G2414.8.3
Threaded Joint Sealing

G2415.5
Fittings in Concealed Locations

G2427.5.5.1
Chimney Lining

G2427.8
Through-the-wall Vent Terminal Clearances

G2439.5
Makeup Air for Dryer Installed in a Closet

G2447.2
Commercial Cooking Appliances Prohibited

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G2403

Definitions of Point of Delivery and Service Meter Assembly

CHANGE TYPE: Modification

CHANGE SUMMARY: Revisions to definitions clarify the portions of the gas piping system regulated by the serving utility and the portions regulated by the IRC fuel gas provisions downstream of the point of delivery.

2021 CODE:

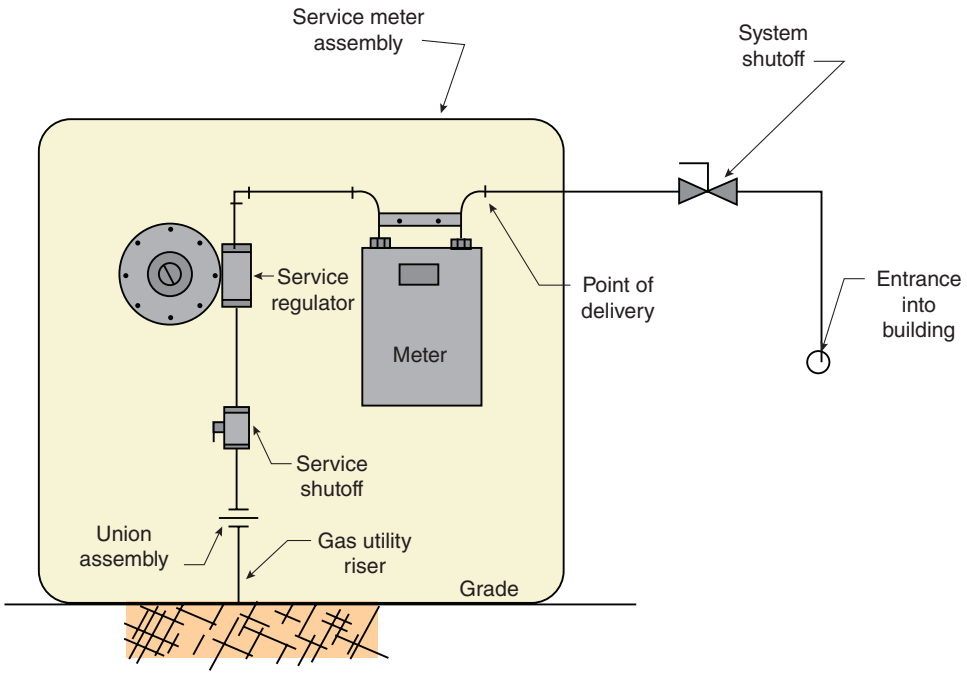
Section G2403 (202)
General Definitions

Point of Delivery. For natural gas systems, the point of delivery is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a system shutoff valve is provided ~~at~~ after the outlet of the service meter assembly, such valve shall be considered to be downstream of the point of delivery. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the service pressure regulator, exclusive of line gas regulators, in the system.

Service Meter Assembly. The meter, valve, regulator, piping, fittings and equipment installed by the service gas supplier before the point of delivery.

System Shutoff. A valve installed after the point of delivery to shut off the entire piping system.

Valve. A device used in piping to control the gas supply to any section of a system of piping or to an appliance.



Service meter assembly and point of delivery.

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Service Shutoff. A valve, installed by the serving gas supplier between the ~~service meter or~~ source of supply and the ~~customer piping system~~ point of delivery, to shut off the entire piping system.

CHANGE SIGNIFICANCE: The new and revised definitions intend to clarify the transition from the gas utility company service to the portion of gas piping system regulated by the IRC.

The "point of delivery" (POD) is the point where the fuel gas provisions of the code first take effect. Downstream of the POD is governed by the code and upstream of the POD is governed by the Department of Transportation (DOT) and the gas utility company. The definition of POD refers to the "service meter assembly," but this latter term has not previously been defined. The new definition clarifies what components are under the control of the gas utility company and are, therefore, upstream of the POD and not controlled by IRC provisions. The definition of "service shutoff" (valve) was revised to refer to the POD instead of the vague reference to "customer piping system." The new definition of "service meter assembly" includes the meter as one of several components that are upstream of the POD.

The definition of POD was also revised to include the newly defined term "system shutoff," which is an optional valve installed downstream of the service meter assembly. A system shutoff valve is installed by choice to allow the customer or building owner to shut off the gas to the entire building. This valve also allows the gas to be turned on by a party other than the gas utility, after the gas utility has set the service meter assembly.

The distinction between a service shutoff valve and a system shutoff valve is that the latter is owned and operated by the customer and the service shutoff valve is owned by the gas utility and can be operated only by qualified personnel working for the gas utility.

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G2414.8.3

Threaded Joint Sealing

CHANGE TYPE: Modification

CHANGE SUMMARY: Thread joint sealants are now required for assembling threaded joints in gas piping.

2021 CODE: ~~**G2414.9.3 (403.9.3)**~~ **G2414.8.3 (403.8.3) Threaded joint ~~compounds~~ sealing.** Threaded joints shall be made using a thread joint sealing material. Thread joint sealing materials ~~compounds~~ shall be nonhardening and shall be resistant to the ~~action of liquefied petroleum gas or to any other~~ chemical constituents of the gases to be ~~conducted~~ conveyed through the piping. Thread joint sealing materials shall be compatible with the pipe and fitting materials on which the sealing materials are used.

CHANGE SIGNIFICANCE: The code previously addressed pipe thread compounds, stating that when used, they would resist any chemical constituents of the gases. Until now, the code has not required the use of thread sealants on threaded joints. Thread sealants act primarily as a lubricant to allow the threads to make up tight to form a metal-to-metal seal. Any imperfections or voids in the threads are filled in by the thread sealant material. The most common thread sealants used as of this writing are pastes made with PTFE (Teflon) and Teflon tapes. Sealing compounds must be of material that does not harden over time so it remains effective and so that pipe joints can be disassembled when necessary. Shrinkage of the sealant is minimized so that the material remains resilient and resistant to vibration and movement. The code maintains the requirement that the sealant must resist the effects of any components of the gas being conveyed in the pipe. The reference to liquefied petroleum gas (LPG) has been removed because it was redundant. The reference to the chemical constituents of all gases to be conducted includes LPG.



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Threaded joint sealing tape.

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The thread sealant used must also be suitable for the pipe and fitting materials used. Although this is typically not an issue, some thread sealants can attack certain types of pipe and fitting materials. This is more of an issue with plastic threads used in plumbing piping, whereas threaded fittings for gas piping are always metal. Thread sealant container labels will state what pipe and fitting materials are suitable for use with the sealant.

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G2415.5

Fittings in Concealed Locations

CHANGE TYPE: Clarification

CHANGE SUMMARY: Plugs and caps have been added to the list of threaded fittings approved for concealed locations.

2021 CODE: G2415.5 (404.5) Fittings in concealed locations. Fittings installed in concealed locations shall be limited to the following types:

1. Threaded elbows, tees, ~~and~~ couplings, plugs and caps.
2. Brazed fittings.
3. Welded fittings.
4. Fittings listed to ANSI LC1/CSA 6.26 or ANSI LC4/CSA 6.32.

CHANGE SIGNIFICANCE: Threaded fittings, such as those used with steel gas piping, are allowed to be concealed, with the exception of unions. The list of approved fittings for concealment appear in Item 1 of Section G2415.5. The omission of threaded plugs and threaded caps was an oversight and did not intend to imply that these fittings could not be concealed. To correct the omission and to provide a complete list of approved fittings, plugs and caps have been added to the threaded fittings list. Although left/right couplings are sometimes viewed as a type of union, they are threaded couplings and are not prohibited.



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Threaded fittings permitted in concealed locations.

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G2427.5.5.1
Chimney Lining

CHANGE TYPE: Modification

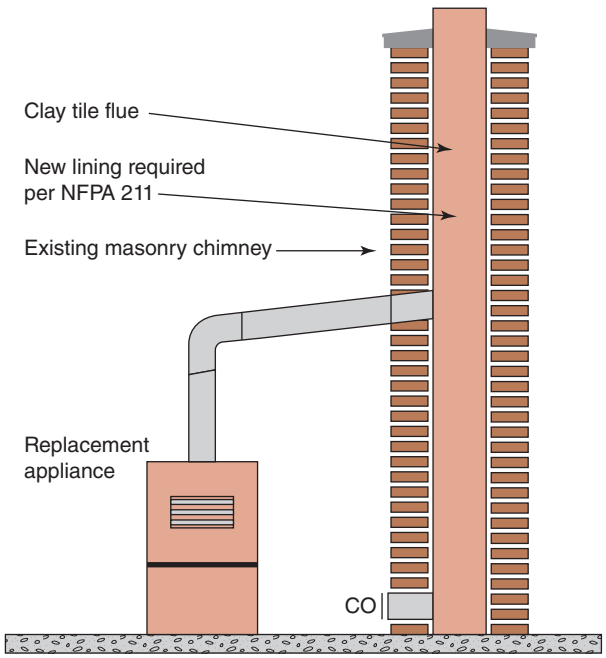
CHANGE SUMMARY: The exception allowing an existing chimney to vent replacement appliances has been deleted.

2021 CODE: **G2427.5.5.1 (503.5.6.1) Chimney lining.** Chimneys shall be lined in accordance with NFPA 211.

> **Exception:** ~~Where an existing chimney complies with Sections G2427.5.5 through G2427.5.5.3 and its sizing is in accordance with Section G2427.5.4, its continued use shall be allowed where the appliance vented by such chimney is replaced by an appliance of similar type, input rating and efficiency.~~

CHANGE SIGNIFICANCE: The exception to the chimney lining provisions previously allowed an existing unlined chimney to continue to be used when replacing the appliance vented by the chimney. The exception stipulated that the replacement appliance had to be similar in type, Btu/h input rating and thermal efficiency. The code has otherwise required a replacement appliance to comply with the provisions for a new appliance installation including venting.

The exception applied to all appliances. For example, a replacement water heater installation is required to be served by a code-compliant venting system, just as the initial water heater was. However, this exception allowed a noncode-compliant chimney to serve a new water heater installation, in conflict with a basic principle of the code, the appliance installation instructions and the appliance listing. The original purpose of the exception was to remove a potential financial hardship caused by requiring an old unlined existing chimney to be lined when the water



A chimney liner meeting NFPA 211 is required for replacement appliances.

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heater had to be replaced. The exception was based on the assumption that the previous water heater was venting properly and the existing unlined chimney was in serviceable condition. Because newer appliances change design, input ratings and efficiency, it is unlikely that a replacement appliance will be similar to the previous appliance. Serviceable unlined chimneys are also unusual. The exception was considered outdated and unnecessary, and has been deleted from the code.

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G2427.8

Through-the-wall Vent Terminal Clearances

CHANGE TYPE: Clarification

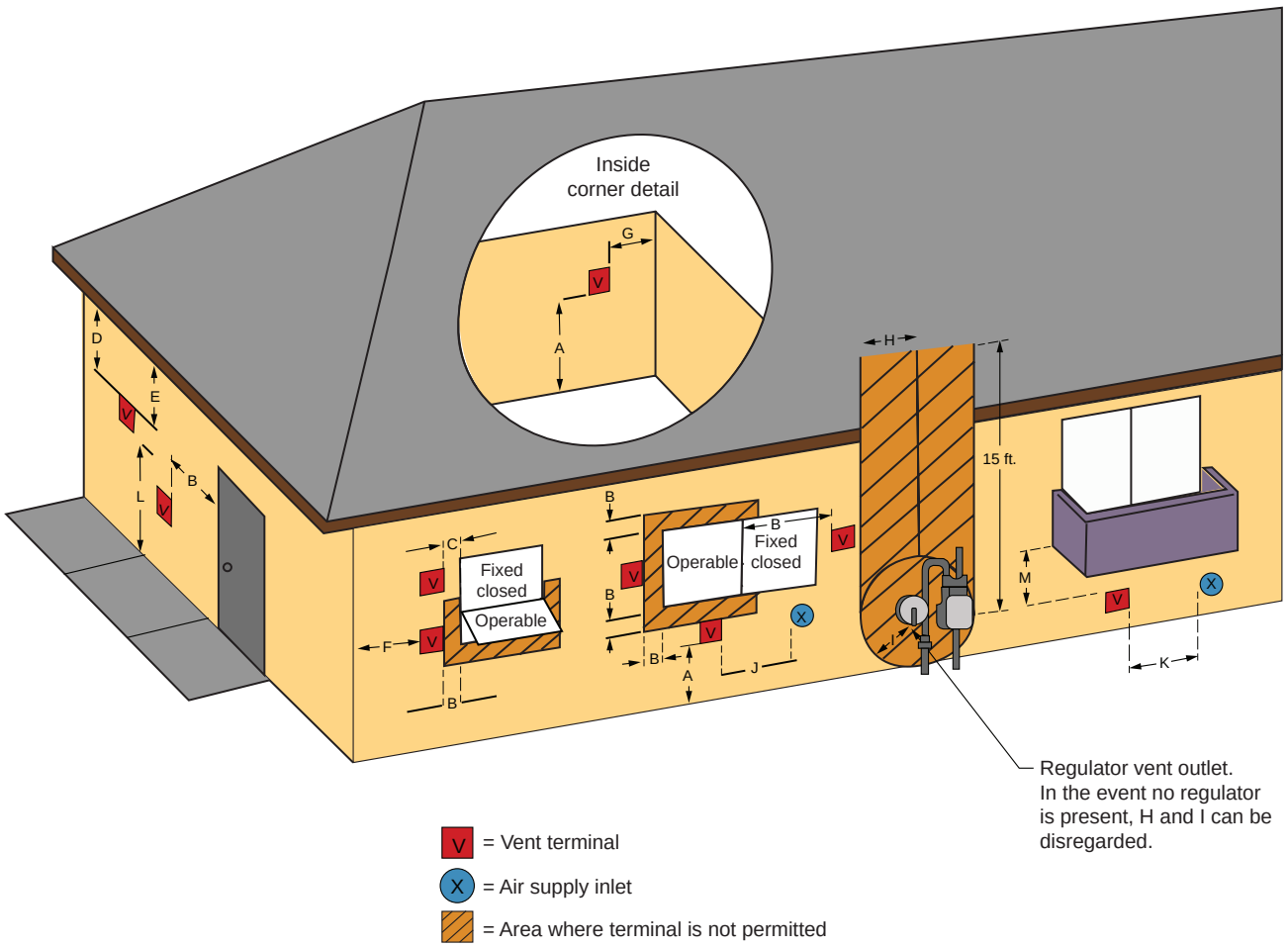
CHANGE SUMMARY: Through-the-wall vent terminal clearance distances have been placed in a new table with a corresponding figure for ease of use.

2021 CODE: G2427.8 (503.8) Venting system ~~termination location~~ terminal clearances. The clearances for through-the-wall direct-vent and nondirect-vent terminals shall be in accordance with Table G2427.8 and Figure G2427.8.

Exception: The clearances in Table G2427.8 shall not apply to the combustion air intake of a direct-vent appliance

~~The location of venting system terminations shall comply with the following (see Appendix C):~~

~~1. A mechanical draft venting system shall terminate not less than 3 feet (914 mm) above any forced-air inlet located within 10 feet (3048 mm).~~



Through-the-wall vent terminal clearances.

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Exceptions:

1. This provision shall not apply to the combustion air intake of a direct-vent appliance.
2. This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of listed outdoor appliances.

2. A mechanical draft venting system, excluding direct-vent appliances, shall terminate not less than 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window or gravity air inlet into any building. The bottom of the vent terminal shall be located not less than 12 inches (305 mm) above finished ground level.
3. The clearances for through-the-wall, direct-vent terminals shall be in accordance with Table G2427.8.
4. Through-the-wall vents for Category II and IV appliances and noncategorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves or other equipment. Where local experience indicates that condensate is a problem with Category I and III appliances, this provision shall also apply. Drains for condensate shall be installed in accordance with the appliance and vent manufacturer's instructions.
5. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building. This requirement shall not apply to vent terminals that are 2 feet (607 mm) or more above or 25 feet (7620 mm) or more below operable openings.

TABLE G2427.8 (503.8) Through-The-Wall, Direct-Vent Termination Clearances

Direct-Vent Appliance Input Rating (Btu/hr)	Through-The-Wall Vent Terminal Clearance from Any Air Opening into the Building (inches)
< 10,000	6
≥ 10,000 ≤ 50,000	9
> 50,000 ≤ 150,000	12
> 150,000	In accordance with the appliance manufacturer's instructions and not less than the clearances specified in Section G2427.8, Item 2

For SI: 1 inch = 25.4 mm, 1 Btu/hr = 0.2931 W.

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TABLE G2427.8 (503.8) Through-the-Wall Vent Terminal Clearances

Figure Clearance	Clearance Location	Minimum clearances for Direct- Vent Terminals	Minimum clearances for Non-Direct Vent Terminals
A	Clearance above finished grade level, veranda, porch, deck, or balcony	12 inches	
B	Clearance to window or door that is openable	6 inches: Appliances ≤ 10,000 Btu/hr 9 inches: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr 12 inches: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for non-direct vent terminals in Row B	4 feet below or to side of opening or 1 foot above opening
C	Clearance to non-openable window	None unless otherwise specified by the appliance manufacturer	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the center line of the terminal	None unless otherwise specified by the appliance manufacturer	
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
H	Clearance to each side of center line extended above regulator vent outlet	3 feet up to a height of 15 feet above the regulator vent outlet	
I	Clearance to service regulator vent outlet in all directions	3 feet for gas pressures up to 2 psi 10 feet for gas pressures above 2 psi	
J	Clearance to non-mechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for row B	
K	Clearance to a mechanical air supply inlet	10 feet horizontally from inlet or 3 feet above inlet	
L	Clearance above paved sidewalk or paved driveway located on public property	7 feet and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard	
M	Clearance to underside of veranda, porch deck, or balcony	12 inches where the area beneath the veranda, porch deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.	

For SI units, 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 Btu/hr = 0.293 W

CHANGE SIGNIFICANCE: The reformatting of Section G2427.8 is not meant to make any technical changes to the through-the-wall vent terminal clearance provisions. Reorganizing the content and placing all of the clearance requirements into a single table makes the information easier to locate and understand than the previous layout of the material. In addition, new Figure G2427.8 illustrates the location and clearances for the vent terminations. The identifying letter in the table corresponds to the lettered locations in the figure. The figure is similar to the figure that has appeared in Appendix C of the IRC.

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G2439.5

Makeup Air for Dryer Installed in a Closet

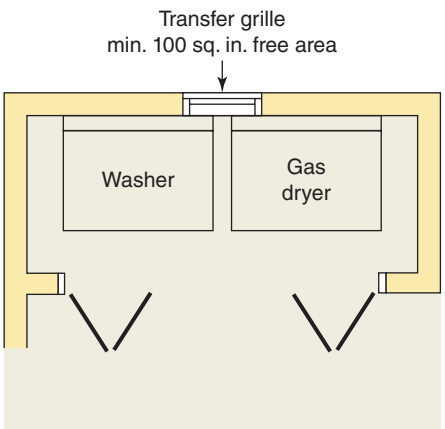
CHANGE TYPE: Clarification

CHANGE SUMMARY: The requirement for a transfer opening for supplying makeup air to a closet designed for a gas dryer has been moved into a separate section.

2021 CODE: **G2439.5 (614.7) Makeup air.** Installations exhausting more than 200 cfm (0.09 m^3/s) shall be provided with makeup air. ~~Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (645 mm2) for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.~~

G2439.5.1 (614.7.1) Closet Installation. Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (645 mm^2) for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.

CHANGE SIGNIFICANCE: Section G2439.5 requires all dryers exhausting greater than 200 cfm to be provided with a makeup air supply because of the concern for creating negative pressure in the space and starving the dryer for airflow. This requirement is separate from the requirement for providing an opening in closet enclosures that contain dryers. Including both in one section has caused some confusion. With both requirements in one section in the 2018 edition, the code appeared to require the closet opening only for dryers that exhaust over 200 cfm. Section G2439.5 now addresses only the requirement to provide makeup air for dryers that exceed the 200 cfm threshold and Section G2439.5.1 addresses the requirement to have an opening in the closet enclosure to allow makeup air into the closet. Without the opening into the closet, the dryer would be isolated from its source of makeup air and the closet would experience significant negative pressure. The requirement for closets in Section G2439.5.1 applies to all dryers, regardless of the exhaust rate.



Makeup air required for gas dryer installed in a closet.

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G2447.2

Commercial Cooking Appliances Prohibited

CHANGE TYPE: Modification

CHANGE SUMMARY: The exception allowing a commercial cooking appliance in a dwelling unit when the installation is designed by an engineer has been removed from the code.

2021 CODE: **G2447.2 (623.2) Prohibited location.** Cooking appliances designed, tested, listed and labeled for use in commercial occupancies shall not be installed within dwelling units or within any area where domestic cooking operations occur.

Exceptions:

1. ~~1.~~ Appliances that are also listed as domestic cooking appliances.
2. ~~2. Where the installation is designed by a licensed Professional Engineer, in compliance with the manufacturer's installation instructions.~~

CHANGE SIGNIFICANCE: Commercial cooking appliances are manufactured to different standards and do not incorporate the same safety features as domestic cooking appliances. For example, commercial ranges operate at higher temperatures, have higher input ratings, have less insulation to protect the user, require greater clearances to combustibles, may require a noncombustible floor and lack child-safe features. Adequate ventilation and makeup air also become a concern with the installation of commercial cooking appliances with high velocity range hoods. For those reasons, the fuel gas provisions have historically prohibited installation of commercial cooking appliances within dwelling units. The 2015 IRC fuel gas provisions introduced an exception to allow appliances that were listed for both commercial and domestic use. Trends in recent years have seen an increase in large homes with the latest in kitchen appliances



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Cooking appliances must be listed for domestic use.

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installed in very large kitchens. In turn there has been an increased demand for commercial-type cooking appliances in residences. Some states and local jurisdictions have recognized this by amending their ordinances to allow commercial appliances under certain conditions. In a new exception in the 2018 IRC, installation of commercial cooking appliances within dwelling units was specifically permitted by the code provided the installation was designed by a licensed professional engineer and the design complied with the manufacturer's instructions. That exception has been removed from the 2021 code.

The marketplace has taken care of the demand for commercial-style appliances. Appliance manufacturers currently offer many commercial-style appliances that are dual listed as both commercial and household appliances. This dual listing is already addressed in the first exception.

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PART 7

Plumbing

Chapters 25 through 33



- **Chapter 25** Plumbing Administration
- **Chapter 26** General Plumbing Requirements
  No changes addressed
- **Chapter 27** Plumbing Fixtures
- **Chapter 28** Water Heaters
  No changes addressed
- **Chapter 29** Water Supply and Distribution
- **Chapter 30** Sanitary Drainage
- **Chapter 31** Vents
  No changes addressed
- **Chapter 32** Traps
  No changes addressed
- **Chapter 33** Storm Drainage
  No changes addressed

Part 7 of the IRC contains provisions for plumbing systems and begins with a chapter on the specific and unique administrative issues related to plumbing code enforcement. Subsequent chapters cover technical subjects for the overall design and installation of plumbing systems in buildings. General plumbing issues such as protection of plumbing systems from damage, piping support, and certification of products are covered in Chapter 26. The other chapters of Part 7 are specific to requirements for plumbing fixtures, water heaters, water supply and distribution, sanitary drainage, vents, traps, and storm drainage. ■

P2503.5.1

Drain, Waste and Vent Systems Testing

P2708.4, P2713.3

Shower and Bathtub Control Valves

P2904

Installation Practices for Residential Sprinklers

P2905.3

Length of Hot Water Piping to Fixtures

P3005.2.10.1

Removable Fixture Traps as Cleanouts

P3011

Relining of Building Sewers and Building Drains

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P2503.5.1

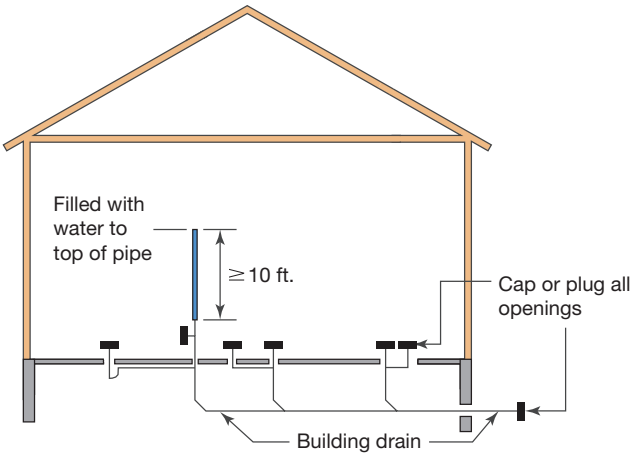
Drain, Waste and Vent Systems Testing

CHANGE TYPE: Modification

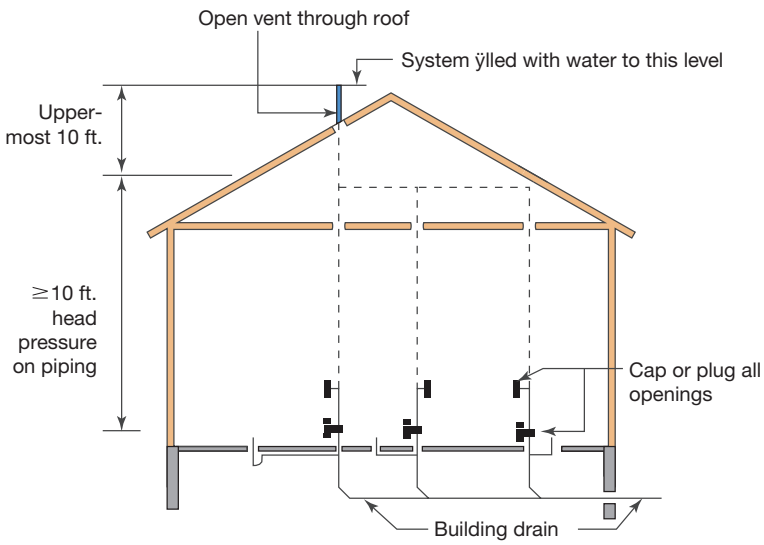
CHANGE SUMMARY: The head pressure for a water test of drain, waste and vent (DWV) systems has increased from 5 feet to 10 feet. Air vacuum testing is now permitted for plastic piping DWV systems.

2021 CODE: **P2503.5.1 Rough plumbing.** DWV systems shall be tested on completion of the rough piping installation by water ~~or~~, by air for piping systems other than plastic, ~~by air,~~ or by a vacuum of air for plastic piping systems, without evidence of leakage. ~~Either~~ The test shall be applied to the drainage system in its entirety or in sections after rough-in piping has been installed, as follows:

1. Water test. Each section shall be filled with water to a point not less than ~~5~~ 10 feet (~~1524~~ 3048 mm) above the highest fitting connection in that section, or to the highest point in the completed



Phase 1 - below slab



Phase 2 - above ground

Water test on DWV system.

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system. Water shall be held in the section under test for a period of 15 minutes. The system shall prove leak free by visual inspection.

2. Air test. The portion under test shall be maintained at a gauge pressure of 5 pounds per square inch (psi) (34 kPa) or 10 inches of mercury column (34 kPa). This pressure shall be held without introduction of additional air for a period of 15 minutes.
3. Vacuum Test. The portion under test shall be evacuated of air by a vacuum type pump to achieve a uniform gauge pressure of -5 pounds per square inch or a negative 10 inches of mercury column (- 34 kPa). This pressure shall be held without the removal of additional air for a period of 15 minutes.

CHANGE SIGNIFICANCE: Prior to the 2015 edition, the IRC required a 10-foot head pressure for testing drain, waste and vent (DWV) systems with water. In the 2015 code, the head pressure was reduced to 5 feet. Although the 10-foot head pressure has been a long-standing tradition, the change in 2015 was based on an assumption that the actual head pressure is not nearly as critical as the visual nature of the test, and that a 10-foot head test was unlikely to reveal any leaks or defects that would not be detected by a 5-foot head water test.

In the 2021 IRC, the test pressure has been changed back to 10 feet. Reasons for changing back included inconsistency with the required air pressure (when testing with air), which was not decreased in the 2015 IRC. The 5-foot height also does not match the 10-foot height required in the *International Plumbing Code* (IPC).

In this water test, the DWV systems are filled with water to a point 10 feet higher than the piping being tested and the piping and joints are visually inspected for any leaks that might develop. The duration of the water test is 15 minutes to ensure that the system is water tight. The top 10 feet of the DWV systems, which is typically the highest vent through the roof, is only filled with water to the top of the vent terminal. Adding an additional 10-foot standpipe above the vent terminal would not be easily accomplished and would not provide any benefit because the vent will not carry water and not be under pressure in service.

New to the 2021 IRC, a vacuum air test is permitted for testing plastic DWV systems. This alternate test is a means for testing plastic piping systems when the ambient temperatures are below freezing and testing with water presents a challenge. There is no safety hazard in testing with a vacuum such as has occurred in the past with a positive air pressure test on plastic piping. The equipment to perform the test is readily available on the market and a number of contractors are performing the test. Vacuum air testing provides an additional option for testing of plastic piping systems.

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P2708.4, P2713.3

Shower and Bathtub Control Valves

CHANGE TYPE: Clarification

CHANGE SUMMARY: The code now addresses field adjustment and access to shower control valves. Lower flow shower heads need to be compatible with the shower control mixing valve.

2021 CODE: **P2708.4 Shower control valves.** Individual shower and tub/shower combination valves shall be ~~equipped with control valves of the pressure-balance~~ balanced-pressure, thermostatic~~-mixing~~ or combination balanced-pressure~~balance/thermostatic-mixing valve types with a high limit stop in accordance with~~ /thermostatic valves that conform to the requirements of ASSE 1016/ASME A112.1016/CSA B125.16~~. The high limit stop shall be set to limit the water temperature to not greater than 120°F (49°C).~~ or ASME A112.18.1/CSA B125.1. Shower control valves shall be rated for the flow rate of the installed showerhead. Such valves shall be installed at the point of use. Shower and tub/shower combination valves required by this section shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturer's instructions to provide water at a temperature not to exceed 120ºF. In-line thermostatic valves shall not be ~~used~~ utilized for compliance with this section.

P2713.3 Bathtub and whirlpool bathtub valves. ~~Hot water supplied to bathtubs~~ Bathtub and whirlpool ~~bathtubs~~ bathtub valves shall ~~be limited to a temperature of not greater than 120°F (49°C)~~ have or be supplied by a water-temperature limiting device that conforms to ASSE 1070/ASME A112.1070/CSA B125.70 ~~or CSA B125.3~~, except where such ~~protection is otherwise provided by a~~ valves are combination tub/shower valves in accordance with Section P2708.4. The water temperature limiting device required by this section shall be equipped with a means to limit the maximum setting of the device to 120ºF (49ºC), and, where adjustable,



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Shower mixing valve.

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shall be field adjusted in accordance with the manufacturer's instructions to provide hot water at a temperature not to exceed 120ºF (49ºC). Access shall be provided to water temperature limiting devices that conform to ASSE 1070/ASME A112.1070/CSA B125.70.

Exception: Access is not required for non-adjustable water temperature limiting devices that conform to ASSE 1070/ASME A112.1070/CSA B125.70 and are integral with a fixture fitting, provided that the fixture fitting itself can be accessed for replacement.

CHANGE SIGNIFICANCE: The IRC requires a shower head flow rate not greater than 2.5 gallons per minute (gpm). Shower controls (mixing valves) complying with the requirements of the product standards in the code are designed to safety operate at that flow. However, there are many different types of shower heads available in the market that have lower flow rates. These lower flows might not provide enough motive power within a mixing valve to allow for the valve to self-adjust to prevent temperature shock to the user when a supply pressure or temperature change occurs. Not all shower controls (mixing valves) are designed and tested to accommodate lower than 2.5 gpm flows. Section P2708.4 now specifically requires shower control valves to be rated for the flow rate of the installed showerhead to provide the scald and thermal shock protection required by the recognized standard. For bathtubs and whirlpool bathtubs, the code also stipulates that access must be provided to water temperature limiting devices for field adjustment, unless they are nonadjustable water temperature limiting devices.

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P2904

Installation Practices for Residential Sprinklers

CHANGE TYPE: Modification

CHANGE SUMMARY: Revisions throughout Section P2904 expand installation practices to more closely align with NFPA 13D.

2021 CODE: **P2904.2.1 Temperature rating and separation from heat sources.** Except as provided for in Section P2904.2.2, sprinklers shall have a temperature rating of not less than 135°F (57°C) and not more than ~~170°F (77°C)~~ 225°F (107°C). Sprinklers shall be separated from heat sources as required by the sprinkler manufacturer's installation instructions.

P2904.2.3 Freezing areas. Piping shall be protected from freezing as required by Section P2603.5 or by using one of the following:

1. A dry pipe automatic sprinkler system that is listed for residential occupancy applications.
2. ~~Where sprinklers are required in areas that are subject to freezing, dry-~~ Dry side-wall or dry-pendent sprinklers extending from a nonfreezing area into a freezing area ~~shall be installed~~.

P2904.3.2 Shutoff valves prohibited. With the exception of shutoff valves for the entire water distribution system or a single master control valve for the automatic sprinkler system that is locked in the open position, valves shall not be installed in any location where the valve would isolate piping serving one or more sprinklers.

P2904.4 Determining system design flow. The flow for sizing the sprinkler piping system shall be based on ~~the flow rating of each sprinkler in accordance with Section P2904.4.1 and the calculation in accordance with Section P2904.4.2.~~ Sections P2904.4.1 and P2904.4.2.



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Sprinkler system piping.

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P2904.4.1 Determining required flow rate for each sprinkler. The minimum required flow for each sprinkler shall be determined using the sprinkler manufacturer's published data for the specific sprinkler model based on all of the following:

1. The area of coverage.
2. The ceiling configuration, in accordance with Sections P2904.4.1.1 through P2904.4.1.3.
3. The temperature rating.
4. Any additional conditions specified by the sprinkler manufacturer.

P2904.4.1.1 Ceiling configurations. Manufacturer's published flow rates for sprinklers tested under a ceiling 8 feet (2438 mm) in height, in accordance with the sprinkler listing, shall be used for the following ceiling configurations, provided that the ceiling surface does not have significant irregularities, lumps or indentations and is continuous in a single plane.

1. Ceilings that are horizontal or that have a slope not exceeding 8 units vertical in 12 units horizontal (67 percent), without beams, provided that the ceiling height, measured to the highest point, does not exceed 24 feet (7315 mm) above the floor. Where the slope exceeds 2 units vertical in 12 units horizontal (17 percent), the highest sprinkler installed along the sloped portion of a ceiling shall be positioned above all communicating openings connecting the sloped ceiling compartment with an adjacent space.
2. Ceilings that are horizontal or that have a slope not exceeding 8 units vertical in 12 units horizontal (67 percent), with beams, provided that the ceiling height, measured to the highest point, does not exceed 24 feet (7315 mm) above the floor. Beams shall not exceed 14 inches (350 mm) in depth, and pendent sprinklers shall be installed under the beams as described at the end of this section. The compartment containing the beamed ceiling shall not exceed 600 square feet (56 m^2) in area. Where the slope does not exceed 2 units vertical in 12 units horizontal (17 percent), the highest sprinkler in the compartment shall be above all communicating openings connecting the compartment with an adjacent space. Where the slope exceeds 2 units vertical in 12 units horizontal (17 percent) the highest sprinkler installed along the sloped portion of a ceiling shall be positioned above all communicating openings connecting the sloped ceiling compartment with an adjacent space.
3. Ceilings that have a slope exceeding 2 units vertical in 12 units horizontal (17 percent) but not exceeding 8 units vertical in 12 units horizontal (67 percent), with beams of any depth, provided that the ceiling height, measured to the highest point, does not exceed 24 feet (7315 mm) above the floor. Sidewall or pendent sprinklers shall be installed in each pocket formed by beams. The compartment containing the sloped, beamed ceiling shall not exceed 600 square feet (56 m^2) in area.

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Pendent, recessed pendent, and flush-type pendent sprinklers installed directly under a beam having a maximum depth of 14 inches (356 mm) shall have the sprinkler deflector located not less than 1 inch (25 mm) or more than 2 inches (51 mm) below the bottom of the beam. Pendent sprinklers installed adjacent to the bottom of a beam having a maximum depth of 14 inches (356 mm) shall be positioned such that the vertical centerline of the sprinkler is no more than 2 inches (51 mm) from the edge of the beam, with the sprinkler deflector located not less than 1 inch (25 mm) or more than 2 inches (51 mm) below the bottom of the beam. Pendent sprinklers shall also be permitted to be installed less than 1 inch (25 mm) below the bottom of a beam where in accordance with manufacturer's instructions for installation of flush sprinklers.

P2904.4.1.3 Other Ceiling Configurations. For ceiling configurations not addressed by Sections P2904.4.1.1 or P2904.4.1.2, the flow rate shall be subject to approval by the building official.

TABLE P2904.6.2(2) Minimum Water Meter Pressure Loss (PL_m)[a]

Flow Rate (gallons per minute, gpm)[b]	5/8-Inch Meter Pressure Loss (pounds per square inch, psi)	3/4-Inch Meter Pressure Loss (pounds per square inch, psi)	1-Inch Meter Pressure Loss (pounds per square inch, psi)
8	~~2~~ 3	~~1~~ 3	1
10	3	~~1~~ 3	1
12	4	~~1~~ 3	1
14	~~5~~ 6	~~2~~ 5	1
16	7	~~3~~ 6	1
18	9	~~4~~ 7	~~1~~ 2
20	11	~~4~~ 9	2
~~22~~ 23	~~NP~~ 14	~~5~~ 11	~~2~~ 3
~~24~~	~~NP~~	~~5~~	~~2~~
26	~~NP~~ 18	~~6~~ 14	~~2~~ 3
~~28~~	~~NP~~	~~6~~	~~2~~
~~30~~ 31	~~NP 26~~	~~7~~ 22	~~2~~ 4
~~32~~ 39	~~NP~~ 38	~~7~~ 35	~~3~~ 6
~~34~~	~~NP~~	~~8~~	~~3~~
~~36~~ 52	NP	~~8~~ NP	~~3~~ 10

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.063 L/s. NP = Not permitted unless the actual water meter pressure loss is known.

a. Table P2904.6.2(2) establishes conservative values for water meter pressure loss or installations where the water meter loss is unknown. Where the actual water meter pressure loss is ~~known~~ published and available from the meter manufacturer, PL_m shall be the ~~actual loss.~~ published pressure loss for the selected meter.

b. Flow rate from Section P2904.4.2. Add 5 gpm to the flow rate required by Section P2904.4.2 where the water service pipe supplies more than one dwelling.

Note: Not all changes to Section P2904 are shown. Please refer to the 2021 IRC for the complete text.

CHANGE SIGNIFICANCE: Section P2904 for dwelling unit fire sprinkler systems has been revised to reflect current installation practices and to correlate with some common acceptable methods in NFPA 13D. Section P2904 states that installations must comply with either NFPA 13D or Section P2904, and that Section P2904 is considered equivalent to NFPA 13D.

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NFPA 13D allows intermediate temperature sprinklers to be used in lieu of ordinary temperature sprinklers in dwelling units, even where elevated ambient temperatures are not expected. Provided the sprinkler qualifies as a residential sprinkler, there is no reason for activation temperature to be limited in the IRC. Permitting intermediate temperature sprinklers to be used may help ensure that intermediate temperature sprinklers will be present in locations where elevated ambient temperatures are anticipated. Adding this option to the IRC allows more flexibility.

In areas subject to freezing, the code has required dry sidewall or drypendent sprinklers extending from a nonfreezing area into a freezing area. The code now permits a dry pipe automatic sprinkler system listed for residential occupancy to be installed as a viable option that is currently permitted in NFPA 13D.

In another correlation change with NFPA 13D, a control valve is now allowed on a standalone sprinkler system. Although NFPA 13D allows such valves to be electronically monitored in lieu of locking, the new language in the IRC requires that the valve be locked open, which could be accomplished by simply providing a nylon strap to secure the valve handle. Although this adds an allowance to have a master control valve, there is no mandate to include one.

Revisions to Section P2904.4.1 on flow rates based on ceiling configuration have been expanded to provide necessary information on sloped and beamed ceiling configurations. A 2010 Fire Protection Research Foundation study helped standardize sprinkler protection criteria for ceilings with slopes and beams by determining that many sloped and beamed ceilings can be suffciently protected using the same design criteria that apply to horizontal ceilings. This prompted NFPA to add model design criteria to their sprinkler standards and manufacturers are now amending cut sheets to delete criteria for ceiling configurations that are covered by NFPA's standards. The IRC now also provides suffcient guidance for protection of sloped or beamed ceilings in sprinklered dwellings.

The water meter table has been revised to better correlate with NFPA 13D. Revised Table P2904.6.2(2) includes NFPA 13D correlated values for 5/8-inch, 3/4-inch and 1-inch meters, and it retains entries for flows less than 18 gpm. NFPA 13D does not include these lesser flows, but the IRC has always included them since low-flow systems are an option for affordable housing. The table does not include values for 1 ½-inch and 2-inch meters, which are included in NFPA 13D because these meter sizes are unnecessary for flow demands associated with home fire sprinkler systems.

The following is a summary of significant changes to Section P2904:

- Section P2904.2.1: Permits intermediate temperature sprinklers to be used in lieu of ordinary temperature sprinklers
- Section P2904.2.3: Allows a listed dry pipe residential sprinkler system for freeze protection
- Section P2904.3.2: Permits a control valve on a standalone sprinkler system
- Section P2904.4.1: Correlates with NFPA 13D and current installation practices for protecting spaces with sloped or beamed ceilings
- Table P2904.6.2(2): Revises the water meter table in the IRC to better correlate with the water meter table in NFPA 13D

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P2905.3

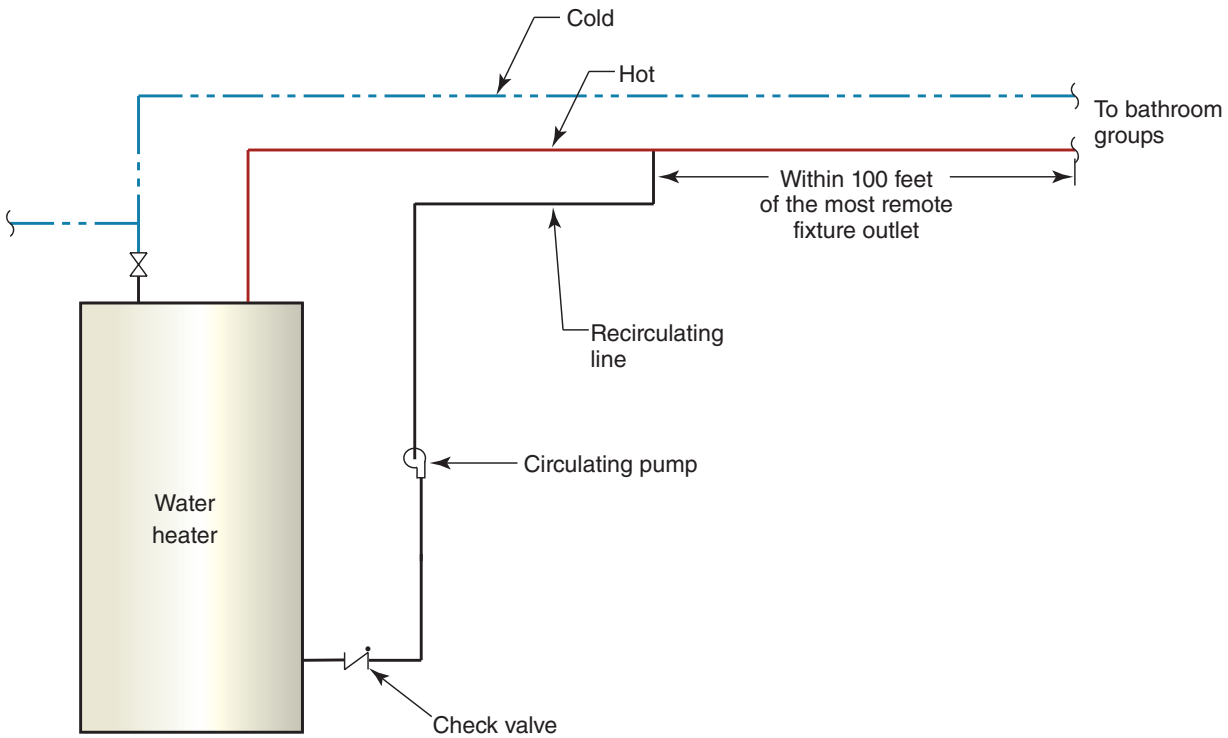
Length of Hot Water Piping to Fixtures

CHANGE TYPE: Addition

CHANGE SUMMARY: The code now limits the length of hot water piping serving fixtures.

2021 CODE: **P2905.3 Hot water supply to fixtures.** The developed length of hot water piping, from the source of hot water to the fixtures that require hot water, shall not exceed 100 feet (30 480 mm). Water heaters and recirculating system piping shall be considered to be sources of hot water.

CHANGE SIGNIFICANCE: A new section limits the hot water supply line length to 100 feet measured from the source of hot water to the fixtures that require hot water. This provision is similar to existing language in IPC Section 607.2, except the IPC limits the length to not greater than 50 feet. Hot water supply lines greater than 100 feet waste water (proportional to pipe size) while occupants wait for hot water to reach fixtures for bathing, washing and culinary purposes. Even when hot water supply lines are insulated, the hot water remaining in the lines between demand periods cools down. Limiting the length and consequent volume of heated water in the supply lines reduces the amount of wasted water and occupant waiting time.



Hot water piping is limited to 100 feet from the source.

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P3005.2.10.1

Removable Fixture Traps as Cleanouts

CHANGE TYPE: Clarification

CHANGE SUMMARY: Removable traps and removeable fixtures with integral traps are acceptable for use as cleanouts.

2021 CODE: **P3005.2.10.1 Cleanout Equivalent.** A fixture trap or a fixture with an integral trap, removable without altering the concealed piping shall be acceptable as a cleanout equivalent.

CHANGE SIGNIFICANCE: Removable traps and removeable fixtures with integral traps such as water closets have long been considered as acceptable access to the drainage system for clearing stoppages. New Section P3005.2.10.1 verifies acceptance of these practices. Note that the existing exception to Section P3005.2.5 (Exception 1) only allows cleanout access through a removable P-trap for the same or one size larger pipe size. Section P3005.2.3 prohibits removal of a water closet to serve as cleanout access to a building sewer.



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Removable fixture trap as cleanout equivalent.

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P3011

Relining of Building Sewers and Building Drains

CHANGE TYPE: Modification

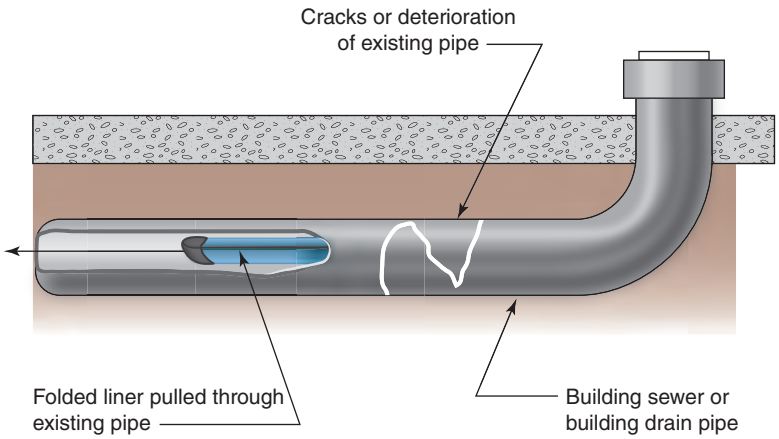
CHANGE SUMMARY: The code recognizes various available technologies for relining of existing building sewer and building drainage piping and clarifies the inspection procedures.

2021 CODE:

Section P3011
~~Replacement~~ Relining of ~~Underground~~ Building Sewers ~~by PVC Fold and Form Methods~~ Building Drains

P3011.1 General. This section shall govern the ~~replacement~~ relining of existing building sewer ~~piping by PVC Fold and Form methods~~ and building drainage piping.

P3011.2 Applicability. The ~~replacement~~ relining of existing building sewer piping ~~by PVC fold and form methods~~ and building drainage piping shall be limited to gravity drainage piping 4 inches (102 mm) ~~to 18 inches (457 mm). The replacement~~ in diameter and larger. The relined piping shall be of the same nominal size as the existing piping.



Fold and form method of pipe relining.

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P3011.3 Preinstallation ~~inspection~~ requirements. ~~The~~ Prior to commencement of the relining installation, the existing piping sections to be ~~replaced~~ relined shall be descaled and cleaned. After the cleaning process has occurred and water has been flushed through the system, the piping shall be inspected internally by a recorded video camera survey. ~~The survey shall include notations of the position of cleanouts and the depth of connections to the existing piping.~~

P3011.3.1 Pre-installation recorded video camera survey. The video survey shall include verification of the project address location. The video shall include notations of the cleanout and fitting locations, and the approximate depth of the existing piping. The video shall also include notations of the length of piping at intervals no greater than 25 feet (7620 mm).

P3011.4 Permitting. Prior to issuing a permit for relining, the building official shall review and evaluate the preinstallation recorded video camera survey to determine whether the piping system is able to be relined in accordance with the proposed lining system manufacturer's installation requirements and applicable referenced standards.

~~**P3011.4 Pipe.** The replacement piping shall be manufactured in compliance with ASTM F1504 or ASTM F1871.~~

P3011.5 Prohibited applications. Where the preinstallation recorded video camera survey reveals that piping systems are not installed correctly, or defects exist, relining shall not be permitted. The defective portions of piping shall be exposed and repaired with pipe and fittings in accordance with this code. Defects shall include, but are not limited to, backslope or insufficient slope, complete pipe wall deterioration or complete separations such as from tree root invasion or improper support.

~~**P3011.5 Installation.** The piping sections to be replaced shall be cleaned and flushed. Remediation shall be performed where there is groundwater infiltration, roots, collapsed pipe, dropped joints, offsets more than 12 percent of the inside pipe diameter or other obstructions.~~

P3011.6 Relining materials. The relining materials shall be manufactured in compliance with applicable standards and certified as required in Section P2609. Fold-and-form pipe reline materials shall be manufactured in compliance with ASTM F1504 or ASTM F1871.

~~**P3011.6 Cleanouts.** Where the existing building sewer did not have cleanouts meeting the requirements of this code, cleanout fittings shall be installed as required by this code.~~

P3011.7 Installation. The installation of relining materials shall be performed in accordance with the manufacturer's installation instructions, applicable referenced standards and this code.

P3011.7.1 Material data report. The installer shall record the data as required by the relining material manufacture and applicable standards. The recorded data shall include but is not limited to the location of the

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project, relining material type, amount of product installed and conditions of the installation. A copy of the data report shall be provided to the building official prior to final approval.

~~**P3011.7 Post-installation inspection.** The completed replacement piping shall be inspected internally by a recorded video camera survey. The video survey shall be reviewed and approved by the building official prior to pressure testing of the replacement piping system.~~

P3011.8 Post-installation recorded video camera survey. The completed relined piping system shall be inspected internally by a recorded video camera survey after the system has been flushed and flow tested with water. The video survey shall be submitted to the code official prior to finalization of the permit. The video survey shall be reviewed and evaluated to provide verification that no defects exist. Any defects identified shall be repaired and replaced in accordance with this code.

~~**P3011.8 Pressure testing.** The replacement piping system as well as the connections to the replacement piping shall be tested in accordance with Section P2503.4.~~

P3011.9 Certification. Certification shall be provided in writing to the building official, from the permit holder, that the relining materials have been installed in accordance with the manufacturer's installation instructions, the applicable standards and this code.

P3011.10 Approval. Upon verification of compliance with the requirements of Sections P3011.1 through P3011.9, the building official shall approve the installation.

CHANGE SIGNIFICANCE: Pipe relining technology reduces or eliminates the need for open trench excavations. The IRC previously recognized relining of underground building sewers by the PVC fold and form method. A factory-made extruded thermoplastic "folded" liner is pulled into a cleaned existing pipe, expanded with air and steam (steam for softening the liner to allow unfolding) and then allowed to cool (using air pressure only) to form a new pipe within the existing pipe. There are other technologies currently available to reline piping systems, which are being approved through the alternate material and methods provisions without guidance from the code. Section 3011 has been expanded to include other approved materials and technologies currently available in the industry. Changes also recognize that pipe relining for restoring existing piping is suitable for building drains in addition to building sewers. The new text provides installation and acceptance criteria for the available methodologies to promote consistent application.

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PART 8

Electrical

Chapters 34 through 43



- **Chapter 34** General Requirements
  No changes addressed
- **Chapter 35** Electrical Definitions
  No changes addressed
- **Chapter 36** Services
- **Chapter 37** Branch Circuit and Feeder Requirements
- **Chapter 38** Wiring Methods
  No changes addressed
- **Chapter 39** Power and Lighting Distribution
- **Chapter 40** Devices and Luminaires
  No changes addressed
- **Chapter 41** Appliance Installation
  No changes addressed
- **Chapter 42** Swimming Pools
  No changes addressed
- **Chapter 43** Class 2 Remote-Control, Signaling and Power-Limited Circuits No changes addressed

The electrical part of the IRC is extracted, by permission, from NFPA 70 *National Electrical Code* (NEC) published by the National Fire Protection Association (NFPA). The corresponding NEC section number appears in brackets at the end of each IRC section. Similar to the mechanical, fuel gas, and plumbing parts of the IRC, Part 8 is divided into several chapters, starting with general requirements applicable to all residential electrical systems and followed by chapters of technical provisions covering design and installation. Chapter 34 covers general requirements such as component identification, equipment location, clearances, protection from damage and conductor connections. Chapter 35 of the IRC provides definitions specific to electrical installations and that supplement (and in some cases supersede) the general definitions found in Chapter 2. Subsequent chapters cover electrical services, branch circuits, feeders, wiring methods, outlet locations, receptacles, lighting fixtures and appliance installation for electrical systems of buildings under the scope of the IRC. A separate chapter covers the unique hazards and special requirements related to electrical installations for swimming pools, hot tubs, and whirlpool bathtubs. Limited-voltage circuits are addressed in Chapter 43. ■

E3601.8

Emergency Service Disconnects

E3606.5

Service Surge-Protective Device

E3703.4

Bathroom Branch Circuits

E3703.5

Garage Branch Circuits

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E3901.4

Kitchen Countertop and Work Surface Receptacles

E3902

GFCI Protection for 250-Volt Receptacles

E3902.5

GFCI Protection for Basement Receptacles

E3902.10

GFCI Protection for Indoor Damp and Wet Locations

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E3601.8

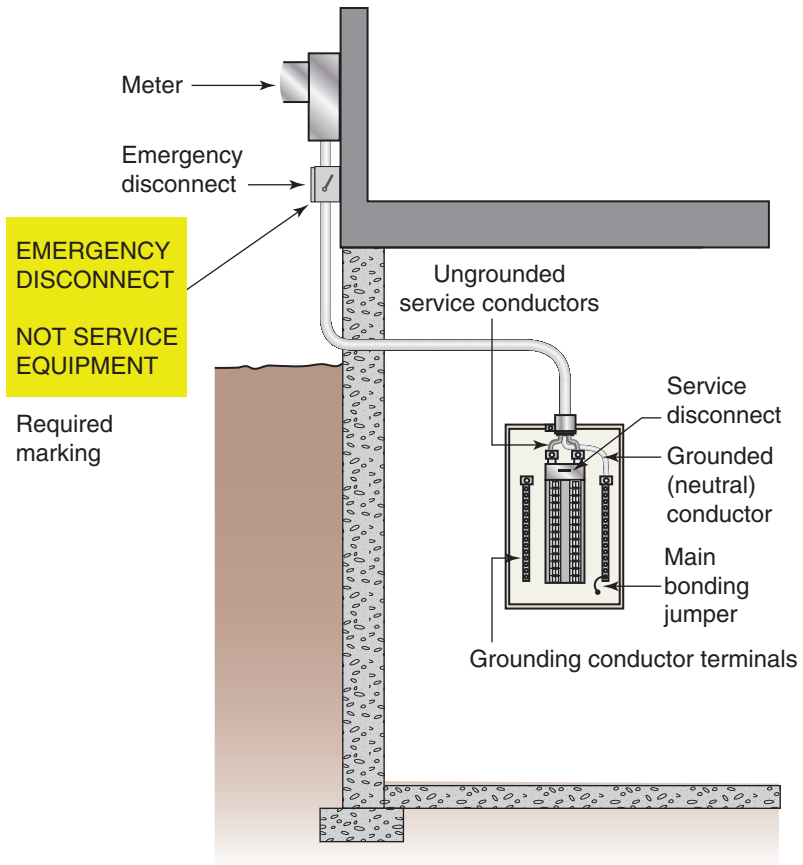
Emergency Service Disconnects

CHANGE TYPE: Addition

CHANGE SUMMARY: An emergency service disconnect is required in a readily accessible outdoor location.

2021 CODE: **E3601.8 Emergency disconnects.** For one- and two-family dwelling units, all service conductors shall terminate in disconnecting means having a short-circuit current rating equal to or greater than the available fault current, installed in a readily accessible outdoor location. If more than one disconnect is provided, they shall be grouped. Each disconnect shall be one of the following.

1. Service disconnects marked as follows: EMERGENCY DISCONNECT, SERVICE DISCONNECT
2. Meter disconnect switches that have a short-circuit current rating equal to or greater than the available fault current and all metal housings and service enclosures are grounded in accordance with Section E3908.7 and bonded in accordance with Section E3609.



Emergency disconnect required at a readily accessible outdoor location.

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A meter disconnect switch shall be capable of interrupting the load served and shall be marked as follows: EMERGENCY DISCONNECT, METER DISCONNECT, NOT SERVICE EQUIPMENT

3. Other listed disconnect switches or circuit breakers on the supply side of each service disconnect that are suitable for use as service equipment and marked as follows: EMERGENCY DISCONNECT, NOT SERVICE EQUIPMENT

Markings shall comply with Section E3404.12. [230.82(3), 230.85]

CHANGE SIGNIFICANCE: The electrical provisions have long required a service disconnecting means either outside of the building or inside the building at a location nearest the point of entrance of the service conductors. Location of the service disconnecting means varies across the United States and is sometimes influenced by geographic and climatic criteria or traditions. In areas with basements, the service disconnect is often in the basement. In other areas, it is inside the garage. In some parts of the country the disconnect is outside the dwelling.

New to the 2021 code, an emergency disconnect is required at a readily accessible location outside the building. The main purpose of the emergency disconnect is to allow first responders to quickly and safely shut down power to the building in an emergency situation. In such a case it is difficult and often unsafe to enter the building to shut down power, particularly if the service disconnect is in the basement. Often first responders may resort to pulling the meter on the outside, a risky endeavor, or they may have to wait for the utility company to disconnect service to the building. Requiring a service disconnect outside intends to resolve these issues.

The outside emergency disconnect may be a separate device mounted outside near the service entrance. Or it may also be the service disconnect, if located outside, or it may be a meter disconnect. In any case a sign or marker is required with text matching the wording specified by the code. The sign or marking must indicate that the device is an emergency disconnect and also whether it serves as a meter disconnect or service disconnect.

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E3606.5

Service Surge-Protective Device

CHANGE TYPE: Addition

CHANGE SUMMARY: A surge-protective device (SPD) is now required at the service panel.

2021 CODE: **E3606.5 Surge protection.** All services supplying one- and two-family dwelling units shall be provided with a surge-protective device (SPD) installed in accordance with Sections E3606.5.1 through E3606.5.3.

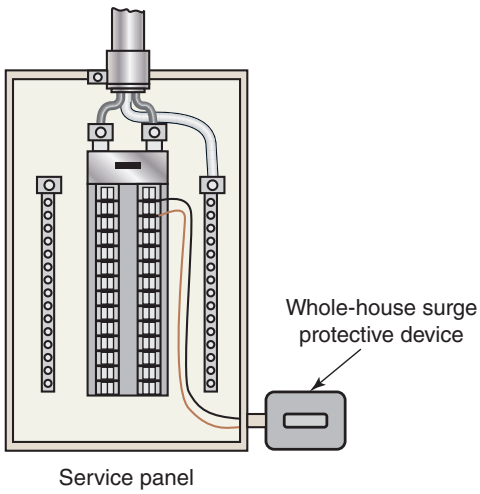
E3606.5.1 Location. The SPD shall be an integral part of the service equipment or shall be located immediately adjacent thereto.

> **Exception:** The SPD shall not be required to be located in the service equipment if located at each next-level distribution equipment downstream toward the load.

E3606.5.2 Type. The SPD shall be a Type 1 or Type 2 SPD.

E3606.5.3 Replacement. Where service equipment is replaced, all of the requirements of this section shall apply. [230.67]

CHANGE SIGNIFICANCE: Modern day electronics are prevalent in homes and have become more sensitive to electrical surges, which may damage components or result in data loss. The code now requires a surge-protective device (SPD) located integral to or immediately adjacent to the service equipment. This requirement also applies to replacement service equipment. The SPD must be either a Type 1 or Type 2 device. Type 1 devices are rated for and typically installed on the line (supply) side before the main service disconnect, although they are permitted in Type 2 locations as well. Type 2 devices are only permitted on the load (downstream) side of the main disconnect. The new requirement is in response to an identified need for surge protection of sensitive electronic devices including appliances, GFCI and AFCI devices and smoke alarms.



Surge protective device required for service of dwelling unit.

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E3703.4

Bathroom Branch Circuits

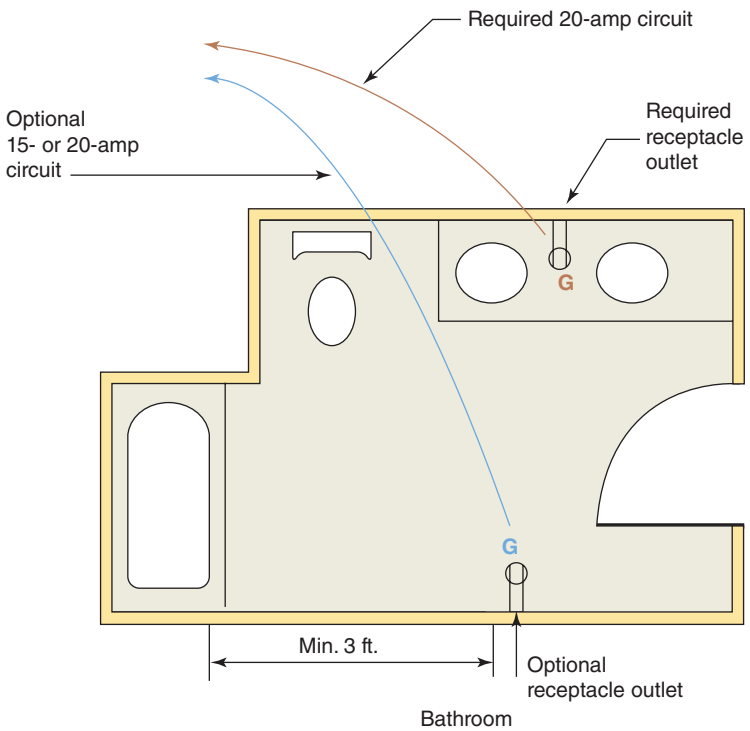
CHANGE TYPE: Clarification

CHANGE SUMMARY: Only the required bathroom receptacle outlets or those serving a countertop need to be on the dedicated 20-amp bathroom circuit.

2021 CODE: **E3703.4 Bathroom branch circuits.** A minimum of one 20-ampere branch circuit shall be provided to supply bathroom receptacle outlet(s) required by Section E3901.6 and any countertop or similar work surface receptacle outlets. Such circuits shall have no other outlets. [210.11(C)(3)]

> **Exception:** Where the 20-ampere circuit supplies a single bathroom, outlets for other equipment within the same bathroom shall be permitted to be supplied in accordance with Section E3702. [210.11(C)(3) Exception]

CHANGE SIGNIFICANCE: Section E3703 sets the minimum requirements for branch circuits, including those serving receptacle outlets in specific areas of the dwelling unit. For example, at least two 20-amp circuits are required to serve kitchen countertop receptacle outlets and are permitted to serve other outlets in the kitchen and dining area. For laundry areas and garages, each requires a separate 20-amp circuit for receptacle outlets and these circuits cannot serve other outlets (an exception permits a readily accessible outdoor receptacle outlet to be served by the garage circuit). The rule for bathroom circuits has been a little less well understood. A minimum of one 20-amp branch circuit



20-amp branch circuit provided to supply receptacle outlets serving bathroom countertop.

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is required to serve bathroom receptacle outlets. The code states that this circuit (or circuits) cannot serve other outlets, which would include lighting outlets in the bathrooms, but does permit the circuit to serve multiple bathrooms. However, if the 20-amp circuit supplies only one bathroom, other outlets in that bathroom including lighting outlets may be placed on that circuit. Some have interpreted this provision as requiring any receptacle outlet in the bathroom to be on this 20-amp circuit. That has not been the intent. The 20-amp circuit is intended to serve the required receptacle outlet within 36 inches of the lavatory basin in accordance with Section E3901.6. Other bathroom receptacle outlets are permitted but not required to be on the same circuit. The new text clarifies that only receptacle outlets required by Section E3901.6 and any receptacle outlet serving a countertop or work surface must be on the 20-amp circuit. Other general-purpose receptacle outlets in bathrooms are permitted to be on other 15- or 20-amp circuits.

Note that a new provision in Section E4002.11 prohibits receptacle outlets within 3 feet horizontally from the bathtub rim or shower stall threshold.

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E3703.5

Garage Branch Circuits

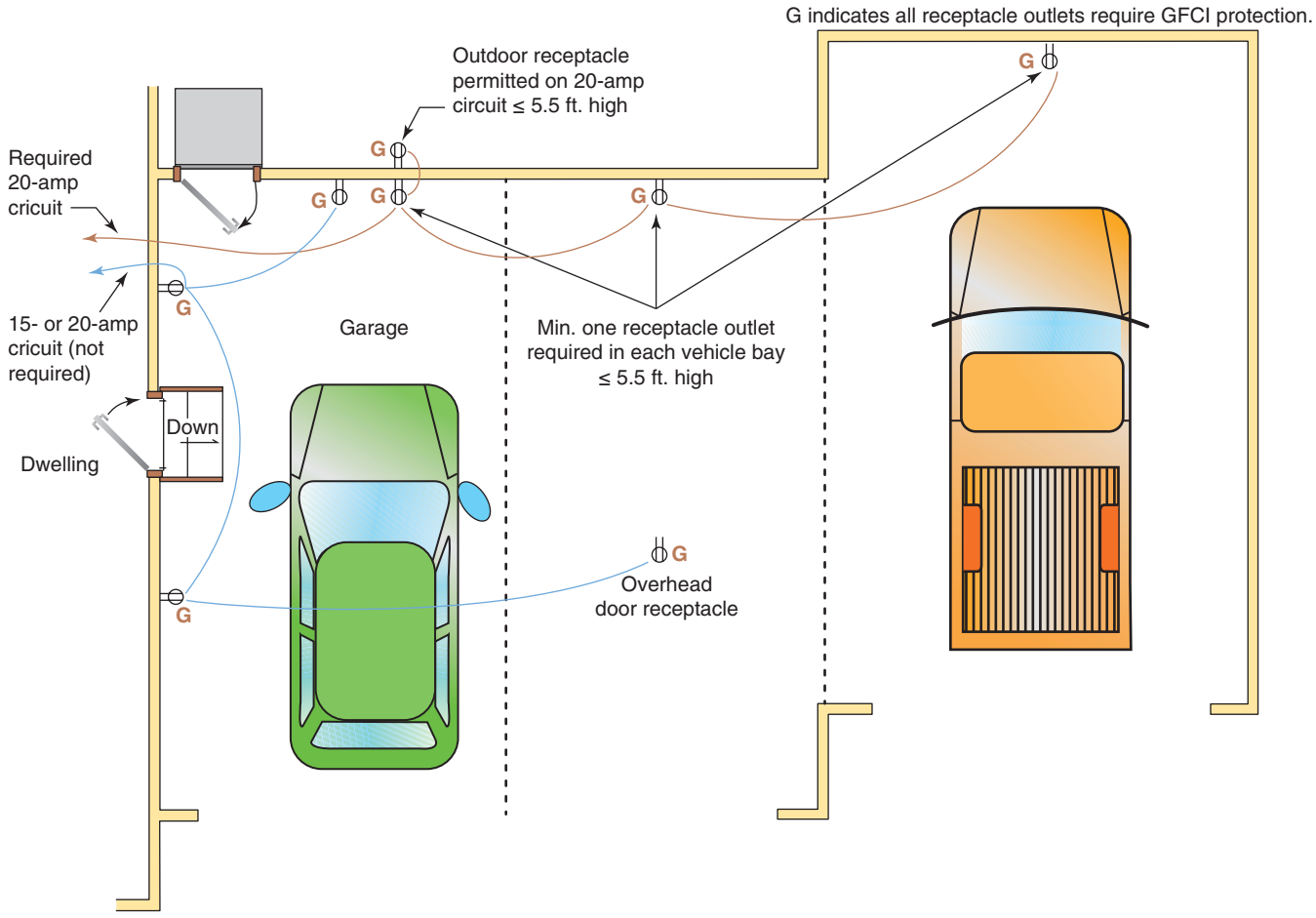
CHANGE TYPE: Modification

CHANGE SUMMARY: Only the required receptacle outlets must be on the 20-amp dedicated circuit for garages.

2021 CODE: **E3703.5 Garage Branch Circuits.** In addition to the number of branch circuits required by other parts of this section, not less than one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets required by Section E3901.9 in attached garages and in detached garages with electric power. This circuit shall not have other outlets.

Exception: This circuit shall be permitted to supply readily accessible outdoor receptacle outlets.

CHANGE SIGNIFICANCE: Section E3703 sets requirements for the minimum number of branch circuits for a dwelling unit and prescribes the instances requiring separate circuits. For example, a separate branch circuit is required for central heating equipment. Separate 20-amp circuits have been required in three instances – two circuits for kitchen/dining



Three stall garage

20-amp branch circuit supplies receptacle outlets required by Section E3901.9.

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areas and one each for bathrooms and laundry rooms. The requirement for a separate branch circuit to serve a garage first appeared in the electrical provisions of the 2015 IRC in Section E3901.9. In this case, either a 15- or 20-amp circuit satisfied the code requirement. In the 2018 IRC, the minimum rating for the garage circuit was changed to 20 amps and limited the circuit to serving only the garage receptacle outlets. An exception allows an exterior receptacle outlet on this circuit provided the receptacle has ready access. Lighting outlets in garages are served by 15- or 20-amp general purpose circuits. The new language in the 2021 code specifies that only the required receptacle outlets need to be supplied by this dedicated 20-amp circuit. Section E3109.9 requires a receptacle outlet in each vehicle bay and not greater than 5 feet 6 inches above the floor. Section E3703.5 now permits optional receptacle outlets in the garage, for example the outlet serving the garage door opener, to be on a general purpose 15- or 20-amp circuit.

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E3901.4

Kitchen Countertop and Work Surface Receptacles

CHANGE TYPE: Modification

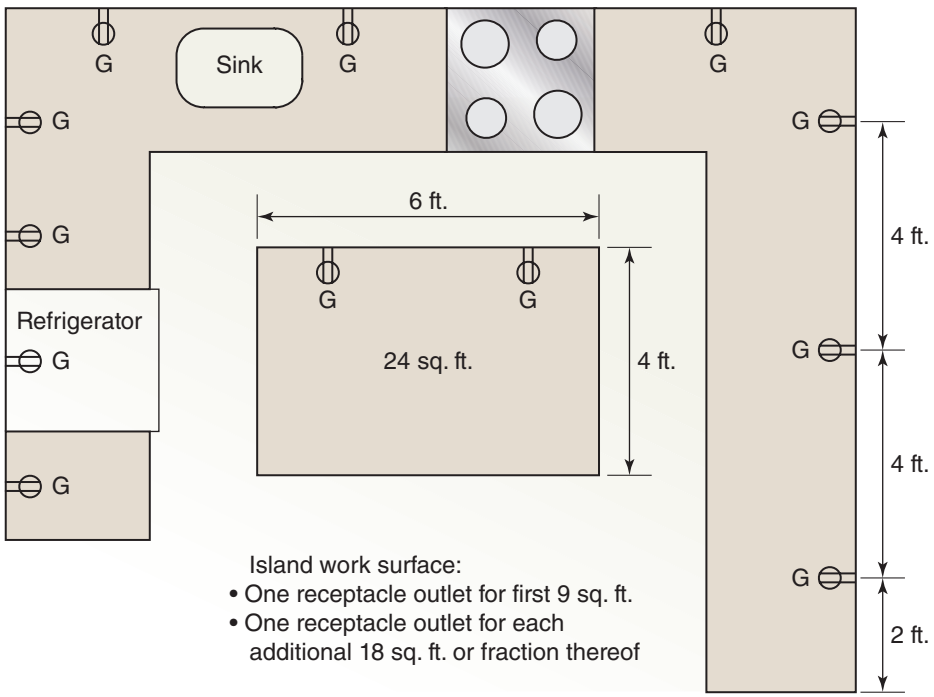
CHANGE SUMMARY: The number of receptacle outlets required for peninsular and island countertops in kitchens is determined by the area of the countertop surface.

2021 CODE: **E3901.4 Countertop and work surface receptacles.** In kitchens, pantries, breakfast rooms, dining rooms and similar areas of dwelling units, receptacle outlets for countertop and work surfaces that are 12 inches (305 mm) or wider shall be installed in accordance with Sections E3901.4.1 through ~~E3901.4.5~~ E3901.4.3 ~~(see Figure E3901.4)~~ and shall not be considered as the receptacle outlets required by Section E3901.2.

For the purposes of this section, where using multi-outlet assemblies containing two or more receptacles, each 12 inches (305 mm) of multi-outlet assembly containing two or more receptacles installed in individual or continuous lengths shall be considered to be one receptacle outlet. (see Figure E3901.4) [210.52(C)]

E3901.4.1 Wall countertop spaces. ~~A receptacle outlet shall be installed at each wall countertop and work surface that is 12 inches (305 mm) or wider.~~ Receptacle outlets shall be installed so that no point along the wall line is more than 24 inches (610 mm), measured horizontally, from a receptacle outlet in that space. [210.52(C)(1)]

Exception: Receptacle outlets shall not be required on a wall directly behind a range, counter-mounted cooking unit or sink in the installation described in Figure E3901.4.1. [210.52(C)(1) Exception]

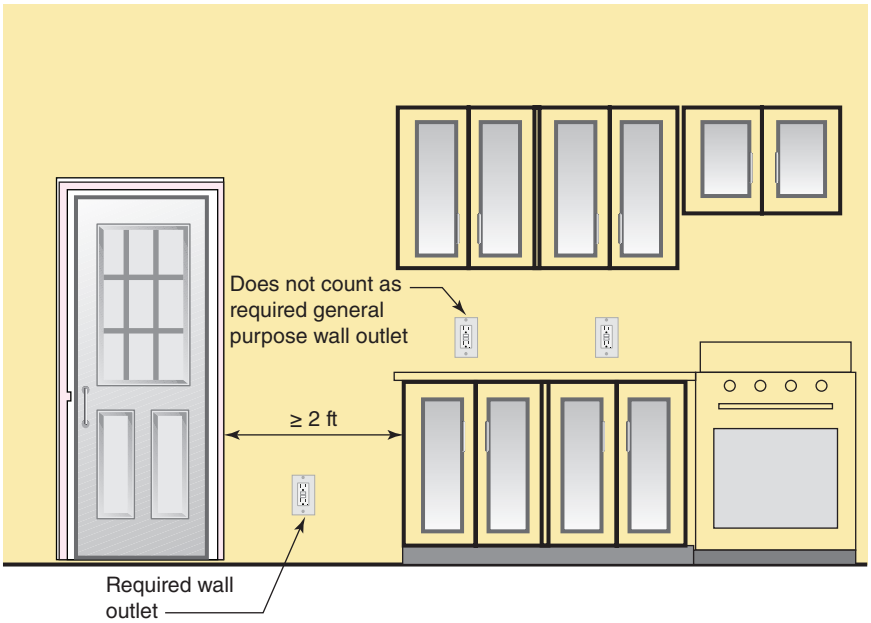


Required receptacle outlets serving kitchen countertops and island work surface.

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Kitchen countertop receptacle outlet does not count for general purpose wall space outlet.

E3901.4.2 Island and peninsular countertops and work surfaces spaces. Receptacle outlets shall be installed in accordance with the following: [210.52(C)(2)]

1. At least one receptacle outlet shall be ~~installed at each island countertop space with a long dimension of 24 inches (610 mm) or greater and a short dimension of 12 inches (305 mm) or greater.~~ provided for the first 9 square feet (0.84 m^2), or fraction thereof, of the countertop or work surface. A receptacle outlet shall be provided for every additional 18 square feet (1.7 m^2), or fraction thereof, of the countertop or work surface. [210.52(C)(2)(a)]
2. At least one receptacle outlet shall be located within 2 feet (600 mm) of the outer end of a peninsular countertop or work surface. Additional required receptacle outlets shall be permitted to be located as determined by the installer, designer of building owner. The location of the receptacle outlets shall be in accordance with Section E3901.4.3. [210.52(C)(2)(b)]

A peninsular countertop shall be measured from the connected perpendicular wall. [210.52(C)(2)]

~~**3901.4.3 Peninsular countertop space.** Not less than one receptacle outlet shall be installed at each peninsular countertop long dimension space having a long dimension of 24 inches (610 mm) or greater and a short dimension of 12 inches (305 mm) or greater. A peninsular countertop is measured from the connected perpendicular wall. [210.52(C)(3)]~~

Note: Not all changes to Section E3901.4 are shown. Please refer to the 2021 IRC for the complete text.

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CHANGE SIGNIFICANCE: The kitchen countertop receptacle outlet requirements apply to all of the associated spaces adjoining the kitchen, including dining, breakfast and pantry areas. For kitchen area peninsular and island countertops, the code previously required at least one receptacle outlet for each, provided they met the minimum size requirements of 12 inches by 24 inches. Large kitchens with very large island and peninsular work surfaces are not unusual in modern homes. To adequately serve the various small appliances that may be used on these surfaces, the code now bases the minimum number of outlets on the counter surface area. One receptacle outlet is required for a surface area up to 9 square feet and an additional outlet is required when the area is greater than 9 square feet. For very large counters exceeding 27 square feet, a third outlet is required (an additional outlet for each additional 18 square feet or any fraction of that 18 square feet).

In another minor change, the code clarifies that countertop and work surface receptacles in kitchen areas cannot be counted as a required general-purpose wall space receptacle outlet.

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E3902

GFCI Protection for 250-Volt Receptacles

CHANGE TYPE: Modification

CHANGE SUMMARY: Ground-fault circuit-interrupter (GFCI) protection is required for up to 250-volt receptacles in the areas previously identified as requiring GFCI protection for 125-volt receptacles. The 20-amp limitation has been removed.

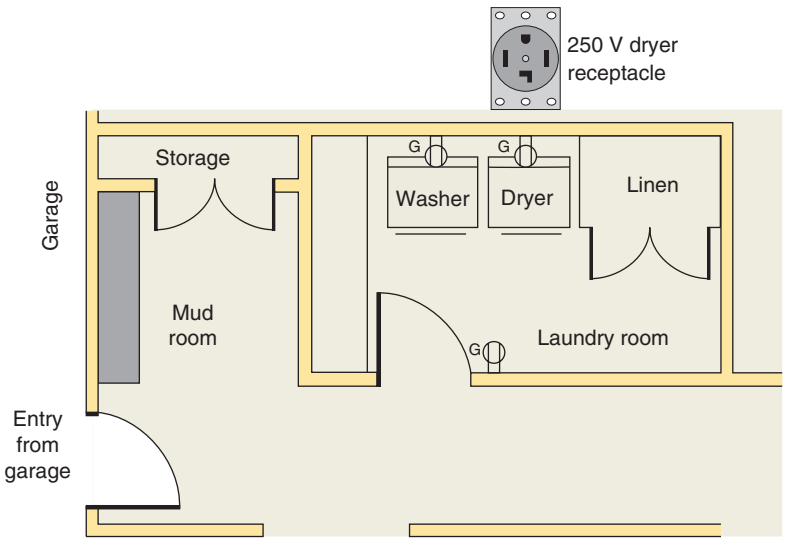
2021 CODE: **E3902.1 Bathroom receptacles.** 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles installed in bathrooms and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(1)]

E3902.2 Garage and accessory building receptacles. 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles installed in garages and grade-level portions of unfinished accessory buildings used for storage or work areas and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(2)]

E3902.3 Outdoor receptacles. 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles installed outdoors and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(3)]

> **Exception:** Receptacles as covered in Section E4101.7. [210.8(A)(3) Exception]

E3902.4 Crawl space receptacles and lighting outlets. Where a crawl space is at or below grade level, 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles installed in such spaces and supplied by single-phase branch circuits rated 150 volts or less to ground



250-volt receptacle outlets requiring GFCI protection.

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shall have ground-fault circuit-interrupter protection for personnel. Lighting outlets not exceeding 120 volts shall have ground-fault circuit-interrupter protection. [210.8(A)(4), 2108(E)]

E3902.5 ~~Unfinished b~~Basement receptacles. 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles installed in ~~unfinished~~ basements and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. ~~For purposes of this section, unfinished basements are defined as portions or areas of the basement not intended as habitable rooms.~~ [210.8(A)(5)]

> **Exception:** A receptacle supplying only a permanently installed fire alarm or burglar alarm system. Receptacles installed in accordance with this exception shall not be considered as meeting the requirement of Section E3901.9. [210.8(A)(5) Exception]

E3902.6 Kitchen receptacles. 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles that serve countertop surfaces and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(6)]

E3902.7 Sink receptacles. 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles that are located within 6 feet (1829 mm) of the top inside edge of the bowl of the sink and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(7)]

E3902.8 Bathtub or shower stall receptacles. 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles that are located within 6 feet (1829 mm) of the outside edge of a bathtub or shower stall and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(~~8~~9)]

E3902.9 Laundry areas. 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles installed in laundry areas and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(~~9~~10)]

CHANGE SIGNIFICANCE: GFCI devices protect people from shock hazards by de-energizing a circuit or receptacle when a fault current to ground is detected. For many years the code has required GFCI protection for 125-volt, 15- and 20-amp receptacles in locations where occupants are most susceptible to shock hazards, typically wet or damp locations, areas where water is used, or areas with concrete floor surfaces that might provide a conductive path to ground. The amperage limitation of 15- and 20-amp receptacles has been removed from the GFCI provisions and the 125-volt designation has been expanded to include receptacles up to 250 volts. In the list of 11 specific areas requiring GFCI protection, this code section now applies to all receptacle outlets from 125 to 250 volts with no limitation on amperage.

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The change was based on a concern that the higher voltage receptacles in dwelling units also posed a shock hazard to occupants in these specified areas. Typically, the new requirement will apply to 240-volt 30-amp dryer receptacles in laundry rooms. However, any receptacle for a 240-volt appliance in a designated area will require GFCI protection.

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E3902.5

GFCI Protection for Basement Receptacles

CHANGE TYPE: Modification

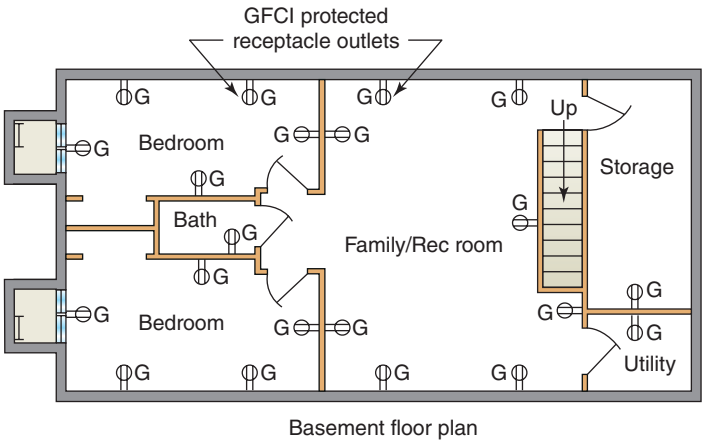
CHANGE SUMMARY: The requirement for GFCI protection in unfinished basement areas has been expanded to include all basement areas.

2021 CODE: **E3902.5 ~~Unfinished b~~Basement receptacles.** 125-volt through 250-volt~~, single-phase, 15- and 20-ampere~~ receptacles installed in ~~unfinished~~ basements and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. ~~For purposes of this section, unfinished basements are defined as portions or areas of the basement not intended as habitable rooms.~~ [210.8(A)(5)]

> **Exception:** A receptacle supplying only a permanently installed fire alarm or burglar alarm system. Receptacles installed in accordance with this exception shall not be considered as meeting the requirement of Section E3901.9. [210.8(A)(5) Exception]

CHANGE SIGNIFICANCE: The GFCI requirements have been expanded in most 3-year code cycles since 2006. In the 2009 IRC, exceptions related to receptacles serving appliances that were not readily accessible in garages and unfinished basement areas were removed. As a result, all receptacle outlets in unfinished basements (except those for permanently installed fire and burglar alarm systems) and all receptacle outlets in garages have since required GFCI protection. Additional locations requiring GFCI protection appeared in the 2015 edition. Added to the list were 125-volt, single-phase, 15- and 20-amp receptacles located in laundry rooms, which was seen as consistent with GFCI requirements for bathrooms. The kitchen dishwasher branch circuit also first appeared in the 2015 code as requiring GFCI protection. In the 2018 code, lighting outlets in crawl spaces were added to the list.

In the 2021 IRC electrical provisions, GFCI protection is required for all basement areas, whether finished or unfinished. This requirement now applies to habitable space in basements, such as bedrooms, recreation rooms or family rooms and spaces not considered habitable such as



Basement floor plan

All basement receptacles require GFCI protection.

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storage or utility areas. The impetus for the change involved concerns about conductive floor surfaces, such as concrete or grouted ceramic tile, in habitable spaces creating potential shock hazards to occupants in areas that may be damp or subject to occasional foundation leakage or flooding. The exemption for receptacles serving fire alarm or burglar alarm system equipment in basements remains in the code. Note that the GFCI provisions now apply to receptacles rated up to 250 volts with no limit on amperage, as discussed in the previous pages for Section E3902.

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E3902.10

GFCI Protection for Indoor Damp and Wet Locations

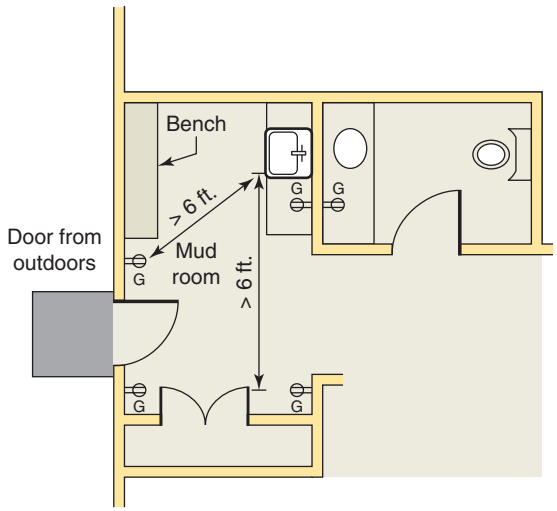
CHANGE TYPE: Addition

CHANGE SUMMARY: GFCI protection is now required for indoor damp and wet locations not included in the other specific locations requiring GFCI protection.

2021 CODE: **E3902.10 Indoor damp and wet locations.** 125-volt through 250-volt, receptacles installed in indoor damp and wet locations and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel. [210.8(A)(11)]

CHANGE SIGNIFICANCE: The primary concern for shock hazards are those areas with damp or wet surfaces that provide a more conductive path to ground for electricity and are more susceptible to electrical shock incidents. GFCI devices protect people from shock hazards by de-energizing a circuit or receptacle when a fault current to ground is detected. The code prescribes GFCI protection for receptacles in most wet and damp locations related to residential buildings in the IRC. For example, coverage includes outdoor locations, garages, basements, bathrooms and laundry rooms for GFCI protection. The new language is intended to cover any other damp or wet locations that might create similar shock hazards. While this gives another tool to the jurisdiction in protecting the safety of building occupants, this provision will present some interpretation challenges for the building official, who will need to determine its intent and application. The building official has the authority to make such interpretations and to develop consistent policies and procedures under Section R104.1.

As examples, a mud room with access directly from the outdoors or a pet bathing and grooming area might be considered a wet or damp area. Although there may be a sink in these areas and the code already requires GFCI protection for receptacles within 6 feet of a sink, there might be receptacles that are farther than 6 feet from the sink, but still considered part of the wet or damp area. Such factors will need to be evaluated by the building official in determining the level of hazard to occupants of the building.



GFCI protection is required for indoor damp or wet locations.

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PART 9

Appendices

Appendix A through W



- **Appendices A–E** No changes addressed
- **Appendix F** Radon
- **Appendices G–T** No changes addressed
- **Appendix U** Cob Construction
- **Appendix V** Board of Appeals No changes addressed
- **Appendix W** 3D Printed Buildings

As stated in Chapter 1 of the IRC, provisions in the appendices do not apply unless specifically referenced in the adopting ordinance. The appendices are developed in much the same manner as the main body of the model code. However, the appendix information is judged to be outside the scope and purpose of the code at the time of code publication. Many times an appendix offers supplemental information, alternative methods, or recommended procedures. The information may also be specialized and applicable or of interest to only a limited number of jurisdictions. Although an appendix may provide some guidelines or examples of recommended practices or assist in the determination of alternative materials or methods, it will have no legal status and cannot be enforced until it is specifically recognized in the adopting legislation. Appendix chapters or portions of such chapters that gain general acceptance over time can move into the main body of the model code through the code-development process. The 2021 IRC introduces a new Appendix U for cob construction, also called monolithic adobe construction, as well as provisions for 3D printing in Appendix W. ■

AF104

Radon Testing

APPENDIX U

Cob Construction

APPENDIX W

3D Printed Buildings

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AF104

Radon Testing

CHANGE TYPE: Addition

CHANGE SUMMARY: Procedures for radon testing are added to Appendix F.

2021 CODE TEXT:

SECTION AF104
TESTING

AF104 Testing. Where radon-resistant construction is required, radon testing shall be as specified in Items 1 through 11:

1. Testing shall be performed after the dwelling passes its air tightness test.
2. Testing shall be performed after the radon control system and HVAC installations are complete. The HVAC system shall be operating during the test. Where the radon system has an installed fan, the dwelling shall be tested with the radon fan operating.



Photo courtesy of BanksPhotos/E+/ Getty Images

Radon testing apparatus.

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3. Testing shall be performed at the lowest occupied floor level, whether or not that space is finished. Spaces that are physically separated and served by different HVAC systems shall be tested separately.
4. Testing shall not be performed in a closet, hallway, stairway, laundry room, furnace room, bathroom or kitchen.
5. Testing shall be performed with a commercially available radon test kit or testing shall be performed by an approved third party with a continuous radon monitor. Testing with test kits shall include two tests, and the test results shall be averaged. Testing shall be in accordance with this section and the testing laboratory kit manufacturer's instructions.
6. Testing shall be performed with the windows closed. Testing shall be performed with the exterior doors closed, except when being used for entrance or exit. Windows and doors shall be closed for at least 12 hours prior to the testing.
7. Testing shall be performed by the builder, a registered design professional, or an approved third party.
8. Testing shall be conducted over a period of not less than 48 hours or not less that the period specified by the testing device manufacturer, whichever is longer.
9. Written radon test results shall be provided by the test lab or testing party. The final written test report with results less than 4 picocuries per liter (pCi/L) shall be provided to the code official.
10. Where the radon test result is 4 pCi/L or greater, the fan for the radon vent pipe shall be installed as specified in Sections AF103.9 and AF103.12.
11. Where the radon test result is 4 pCi/L or greater, the system shall be modified and retested until the test result is less than 4 pCi/L.

Exception: Testing is not required where the occupied space is located above an unenclosed open space.

CHANGE SIGNIFICANCE: Radon is a tasteless colorless radioactive gas that can cause lung cancer. Soil under residences can contain no, low, moderate or high levels of radon. If a jurisdiction decides radon-resistant construction is required, it may adopt *International Residential Code* (IRC) Appendix F. Generally, adoption of Appendix F occurs in Radon Zone 1 and testing of indoor air after the building is completed identifies whether radon levels exceed the established action level. Control systems specified in Appendix F are intended to limit radon entering a residence, but testing is required to determine if further mitigation is needed. Homeowners, potential renters and builders want to know that a radon mitigation system is functional.

The test procedure allows use of either a radon test kit sent to a lab for analysis or a continuous radon monitor. The new test procedures outline when and where testing should occur, whether multiple locations should be tested within a building due to installation of multiple HVAC systems and when retesting is required.

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Where radon reduction systems are required, the test procedure serves as the radon system's commissioning process. If a test result is below 4 pCi/L, the level of radon in the building is deemed to be below the action level and further mitigation is not required. Written test results provide a building official and the homeowner with confirmation that a building's radon level is within the prescribed limits. Many buildings pass testing without fan installation, described in Appendix F, by use of a passive radon system. When a passive system does not meet the 4 pCi/L limit, adding a fan typically lowers the radon level below the specified limit.

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Appendix AU

Cob Construction

CHANGE TYPE: Addition

CHANGE SUMMARY: Appendix AU adds a new section on cob construction which has requirements that differ from light straw-clay and strawbale construction.

2021 CODE TEXT:

APPENDIX AU
Cob Construction (Monolithic Adobe)

SECTION AU101
GENERAL

AU101.1 Scope. This appendix provides prescriptive and performance-based requirements for the use of natural cob as a building material. Buildings using cob walls shall comply with this code except as otherwise stated in this appendix.



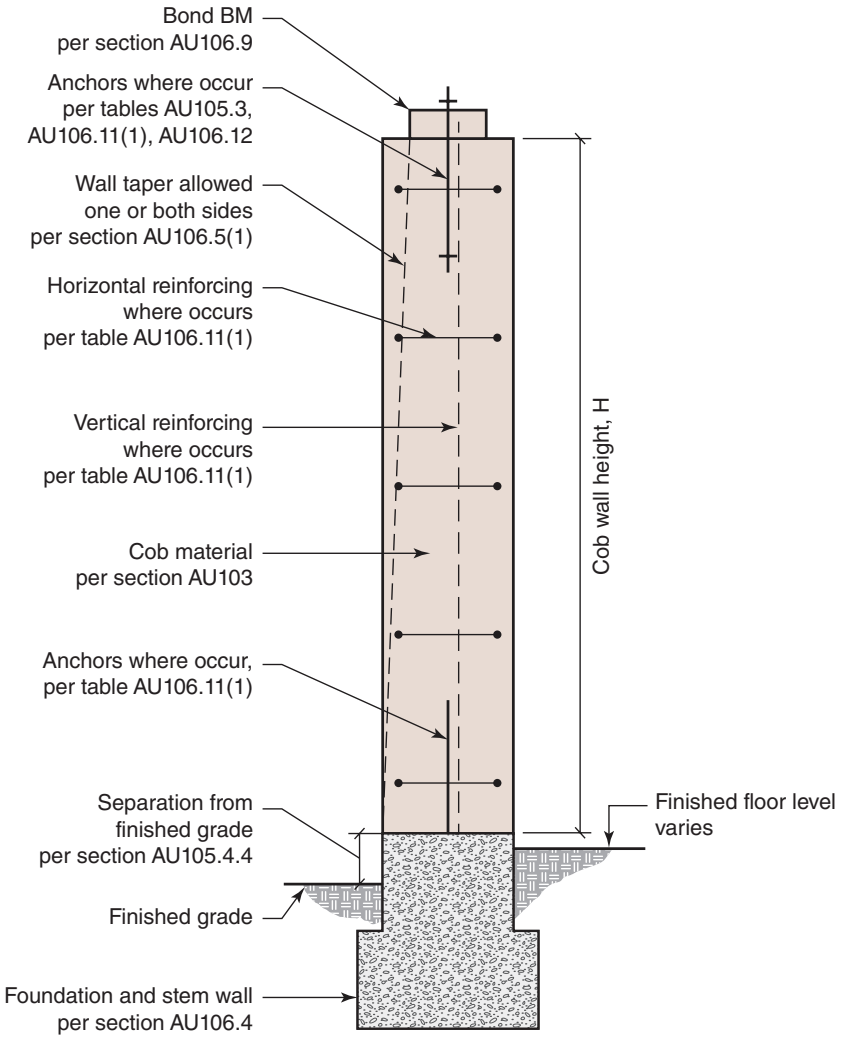
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Cob construction with clay exterior finish.

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Typical cob wall.

AU101.2 Intent. In addition to the intent described in Section R101.3, the purpose of this appendix is to establish minimum requirements for cob structures that provide flexibility in the application of certain provisions of the code to permit the use of site-sourced and local materials, and to permit combinations of proven historical and modern techniques.

(Only a portion of the appendix is show for brevity and clarity.)

CHANGE SIGNIFICANCE: Cob is an earthen material mix of clay-soil, sand, straw and water, placed onto a wall in layers to create a monolithic wall. Because the material mix and density of cob are very similar to those of adobe bricks, cob is sometimes known as monolithic adobe. Used for thousands of years around the world, the term cob derives from an Old English word for lump, since historical structures were often constructed one handful at a time. Today, cob is often mixed mechanically using a tractor or mortar mixer, but wall construction is still generally manual.

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Cob buildings typically feature raised impermeable foundations and extended roof eaves to protect walls from moisture and weather. Walls are often plastered with clay, lime or gypsum plasters that protect the cob without leading to moisture problems associated with less vapor-permeable finishes such as cement stucco, more common on historic adobe structures.

Since the 1990s, there has been interest in cob construction in the United States and much of the world. Cob is highly recyclable, and with good design, construction and maintenance, can withstand centuries of use. Constituent materials are inexpensive compared with lumber, steel, concrete and other commonly used building materials. Cob is noncombustible and nontoxic in all stages of construction and use. The thermal mass and moisture management properties modulate interior temperature and humidity, creating a healthy building.

The cob construction appendix is based on New Zealand's earthen building standards, on U.S. standards for related earthen building systems of adobe and straw-clay and on the experience and testing of cob buildings since the late 1990s.

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Appendix AW

3D Printed Buildings

CHANGE TYPE: Addition

CHANGE SUMMARY: Appendix AW adds requirements for 3D printed homes.

2021 CODE TEXT:

Appendix AW
3D PRINTED BUILDING CONSTRUCTION

SECTION AW101
GENERAL

AW101 Scope. Buildings, structures and building elements fabricated in whole or in part using 3D printed construction techniques shall be designed, constructed and inspected in accordance with the provisions contained in this Appendix and other applicable requirements in this code.

AW102.1 Definitions. The words and terms in Section AW102 shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 of this code for general definitions.

SECTION AW102
DEFINITIONS

3D PRINTED BUILDING CONSTRUCTION. A process for fabricating buildings, structures and building elements from 3D model data using automated equipment that deposits construction material in a layer upon layer fashion.



Photo courtesy of ICON

3D printing of a home.

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ADDITIVE MANUFACTURING MATERIALS. Materials used by the 3D printer to produce the building structure or system components of the building.

FABRICATION PROCESS. Preparation of the job site and construction material, and the deposition, curing, finishing, insertion of components and other methods used to construct building elements such as walls, partitions, roof assemblies and structural components, and the means used to connect assemblies together.

PRODUCTION EQUIPMENT. The equipment, including 3D printer, its settings, nozzles and other accessories used in the fabrication process.

SYSTEM COMPONENTS. Devices, equipment and appliances that are installed in the building elements as part of the wiring, plumbing, HVAC and other systems. These include, but are not limited to, electrical outlet boxes, conduit, wiring, piping, tubing, and HVAC ducts, each of which is covered by a product standard or installation code requirement.

SECTION AW103
BUILDING DESIGN

AW103.1 Design organization. 3D printed buildings, structures and building elements shall be designed by an organization certified in accordance with UL 3401 by an approved agency and approved by the building official in accordance with this section.

AW103.2 Design approval. The structural design, construction documents, and UL 3401 report of findings shall be submitted for review and approval in accordance with Section 104.11 of this code.

SECTION AW104
BUILDING CONSTRUCTION

AW104.1 Construction. 3D printed buildings, structures and building elements shall be constructed in accordance with this section.

AW104.2 Construction method. The building construction method, consisting of the manufacturer's production equipment and fabrication process shall be in accordance with the UL 3401 report of findings. The unique identifier of the construction method used shall match the identifier in the UL 3401 report of findings.

AW104.3 Additive manufacturing materials. Only the listed additive manufacturing materials identified in the UL 3401 report of findings shall be used to fabricate the building structure or system components. Containers of the additive manufacturing materials shall be labeled.

AW104.4 Depositing of manufacturing materials. Manufacturing materials shall only be deposited where ambient temperature and environmental conditions at the job site are within limits specified in the

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UL 3401 report of findings. The maximum number of layers permitted, specified curing time and any surface preparation or finishing shall be performed as specified in the UL 3401 report of findings.

SECTION AW105
SPECIAL INSPECTIONS

AW105.1 Initial inspection. An initial inspection of the production equipment, including 3D printer, and the fabrication process shall be performed after the production equipment is located onsite and before building fabrication has begun. The inspection shall be conducted by representatives of the approved agency that evaluated the fabrication process for compliance with UL 3401. The inspection shall verify that the fabrication process, including production equipment, 3D printing parameters and additive manufacturing materials are in accordance with the UL 3401 report of findings, and the proprietary information in the UL 3401 detailed report of findings.

> **Exception:** Where approved by the building official, inspections of the production equipment, including 3D printer, and the fabrication process used in a single housing tract shall be conducted on the first building to be constructed, and on a selected number of subsequent buildings, where the same equipment, equipment operators and fabrication process are used on all buildings. The number of inspections to be performed shall be determined by the building official.

SECTION AW106
REFERENCED STANDARDS

AW106.1 General. See Table AW106.1 for standards that are referenced in various sections of this appendix. Standards are listed by the standard identification with the effective date, standard title, and the section or sections of this appendix that reference the standard.

TABLE AW106.1 Referenced Standards

Standard Acronym	Standard Name	Sections Herein Referenced
UL 3401-19	Outline of Investigation for 3D Printed Building Construction	AW103.2, AW104.2, AW104.3, AW104.4, AW105.1

CHANGE SIGNIFICANCE: 3D building construction has moved from a conceptual stage to reality, and projects are being proposed in an increasing number of jurisdictions. IRC prescriptive design and construction requirements are not applicable to 3D printed fabrication techniques, so code officials have to approve this construction based on limited equivalency evaluations that may not take into account variations in material properties introduced by the 3D printing process, or variation in the physical characteristics of the construction materials used.

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UL 3401, *Outline of Investigation for 3D Printed Building Construction*, was developed to evaluate critical aspects of this construction process so that 3D-printed building techniques comply with an equivalent level of safety and performance as legacy construction techniques in the building code.

Appendix AW includes definitions and requirements for 3D-printed building design, construction and special inspections, which rely on designs being evaluated in advance by an approved agency for compliance with UL 3401. Resulting compliance reports include information needed by contractors and code officials to verify applicable code compliance and that the 3D-printing process and on-site materials are the same as those indicated during UL 3401 evaluation and testing. Special inspection is required as portions of the fabrication process such as 3D printer settings, deposition rates and thicknesses and curing processes require special evaluation expertise, particularly when proprietary formulations, equipment and settings are included.

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Fred Grable, P.E.
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Preface

The purpose of *Significant Changes to the International Plumbing Code®*, *International Mechanical Code®*, *International Fuel Gas Code®* 2021 Edition is to familiarize plumbing and mechanical officials, building officials, fire officials, plans examiners, inspectors, design professionals, contractors and others in the building construction industry with many of the important changes to these codes. This publication is designed to assist code users in identifying the specific code changes that have occurred and, more importantly, in understanding the reasons behind the changes. It is also a valuable resource for jurisdictions in their code-adoption process.

Only portions of the total number of code changes to the *International Plumbing Code*, *International Mechanical Code* and *International Fuel Gas Code* are discussed in this book. The changes selected were identified for a number of reasons, including their frequency of application, special significance or change in application. However, the importance of the changes not included is not to be diminished. Further information on all code changes can be found in the *Complete Revision History to the 2021 I-Codes: Successful and Public Comments,* available in 2021 from the International Code Council® (ICC®) online store, http://shop.iccsafe.org. This resource collection provides the published documentation for each successful code change contained in the 2021 *International Plumbing Code* and *International Mechanical Code*.

Throughout this *Significant Changes* book, each change is accompanied by a photograph or an illustration to assist in and enhance the reader's understanding of the specific change. A summary and a discussion of the significance of the change are also provided. Each code change is identified by type, be it an addition, modification, clarification or deletion.

The code change itself is presented in a legislative format similar to the style utilized for code-change proposals. Deleted code language is shown with a strikethrough, and new code text is indicated by underlining. As a result, the actual 2021 code language is provided as well as a comparison with the 2018 language, so the user can easily determine changes to the specific code text.

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As with any code-change text, *Significant Changes to the International Plumbing Code*, *International Mechanical Code, International Fuel Gas Code* 2021 Edition is best used as a companion to the 2021 IPC, 2021 IMC and 2021 IFGC. Because only a limited discussion of each change is provided, the reader should reference the code itself to gain a more comprehensive understanding of the code change and its application.

The commentary and opinions set forth in this text are those of the authors and do not necessarily represent the official position of ICC. In addition, they may not represent the views of any enforcing agency, as such agencies have the sole authority to render interpretations of the IPC, IMC and IFGC. In many cases, the explanatory material is derived from the reasoning expressed by code-change proponents.

Comments concerning this publication are encouraged and may be directed to ICC at *significantchanges@iccsafe.org*.

About the *International Plumbing Code, International Mechanical Code* and *International Fuel Gas Code*

Code officials, design professionals, contractors and others involved in the building construction industry recognize the need for modern, up-to-date codes addressing the design and installation of plumbing, mechanical and fuel gas systems through both prescriptive and performance requirements. The 2021 editions of the *International Plumbing Code* (IPC®), *International Mechanical Code* (IMC®) and *International Fuel Gas Code* (IFGC®) are intended to meet these needs through model code regulations that safeguard the public health and safety in all communities, large and small. The IPC, IMC and IFGC are kept up to date through ICC's open code-development process. The provisions of the 2018 editions, along with those code changes approved through 2019, make up the 2021 editions.

The IPC, IMC and IFGC are three codes in a family of International Codes® published by ICC. These comprehensive codes establish minimum regulations for plumbing, mechanical and fuel gas systems by means of prescriptive and performance-related provisions, and are founded on broad-based principles that make possible the use of new materials and new system designs. The IPC, IMC and IFGC are available for adoption and use by jurisdictions internationally. Their use within a governmental jurisdiction is intended to be accomplished through adoption by reference, in accordance with proceedings establishing the jurisdiction's laws.

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Gregg Gress, author of the IMC and IFGC portions of this book, thanks fellow ICC staff, the graphic artists and all those who donated photographs.

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Senior Staff Engineer, Technical Services

Fred Grable, ICC Senior Staff Engineer and former master plumber, brings extensive experience as both a plumbing contractor and engineer. He has nearly two decades of experience as an engineer for an industrial pressure piping manufacturer and in wastewater treatment equipment field services. He also founded his own plumbing company and managed new construction, remodeling, and repair of residential and commercial plumbing and gas systems. Fred is a registered professional engineer in two states. He has worked for the ICC for over ten years in the Codes and Standards Department and is the Secretariat for the *International Plumbing Code* (IPC) and the plumbing portion of the *International Residential Code*® (IRC®), the *International Private Sewage Disposal Code*® (IPSDC®), the *International Swimming Pool and Spa Code*® (ISPSC®) and the residential provisions of the *International Energy Conservation Code*® (IECC®).

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International Code Council

Senior Technical Staff, Technical Services

Gregg Gress is a former Senior Technical Staff member of the ICC and was responsible for the maintenance of the *International Mechanical Code* (IMC) and *International Fuel Gas Code* (IFGC), the commercial portion of the *International Energy Conservation Code* (IECC) and the mechanical and electrical parts of the *International Residential Code* (IRC). He is also an author of the IMC, IRC and IFGC Commentary books and has provided training and code interpretations of the ICC codes. Gregg was formerly a code official for a municipality and has worked in the plumbing, mechanical/HVAC and electrical trades and has been employed by BOCA and the ICC for 25 years. Gregg has served on multiple AGA, NFPA and ASHRAE project committees.

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About the International Code Council®

The International Code Council is a nonprofit association that provides a wide range of building safety solutions including product evaluation, accreditation, certification, codification and training. It develops model codes and standards used worldwide to construct safe, sustainable, affordable and resilient structures. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance, fostering safe and sustainable design and construction.

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SIGNIFICANT CHANGES TO THE

INTERNATIONAL PLUMBING CODE®

2021 EDITION

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PART 1

International Plumbing Code

Chapters 1 through 15

- **Chapter 1** Scope and Administration No changes addressed
- **Chapter 2** Definitions
- **Chapter 3** General Regulations
- **Chapter 4** Fixtures, Faucets and Fixture Fittings
- **Chapter 5** Water Heaters
- **Chapter 6** Water Supply and Distribution
- **Chapter 7** Sanitary Drainage
- **Chapter 8** Indirect/Special Waste No changes addressed
- **Chapter 9** Vents
- **Chapter 10** Traps, Interceptors and Separators
- **Chapter 11** Storm Drainage
- **Chapter 12** Special Piping and Storage Systems
- **Chapter 13** Nonpotable Water Systems
- **Chapter 14** Subsurface Landscape Irrigation Systems No changes addressed
- **Chapter 15** Referenced Standards No changes addressed

Chapter 1 of the *International Plumbing Code*® (IPC®) clarifies how the code will be enforced by code officials. Chapter 2 contains definitions of plumbing code terminology. General regulations in Chapter 3 identify requirements not listed in other code chapters, such as testing and inspections. Fixtures and water heaters are addressed in Chapters 4 and 5, respectively. Chapters 6 and 7 regulate water and drainage piping systems. Indirect and special waste is covered in Chapter 8. Chapter 9 details acceptable venting methodologies with in-depth provisions for piping arrangements. Chapter 10 contains the provisions for traps and various receptors. Storm drainage, with its collection system piping provisions, is covered in Chapter 11. Installation, design, storage, handling and use of nonflammable medical gas systems are addressed in Chapter 12. Nonpotable water systems such as those for the storage, treatment, and use of gray water, rainwater, reclaimed water and alternate on-site nonpotable water are addressed in Chapter 13. Methods for the use of nonpotable water for subsurface irrigation are addressed in Chapter 14. Standards referenced by the code sections are indicated in Chapter 15 along with specific details about the applicable edition year and title. Appendices A through E cover nonmandatory provisions for permit fees, rainfall rates, degree design temperature, water (piping) sizing methods and structural integrity protection rules for the notching of and boring of holes in wood and steel members. New Appendix F establishes rules for a board of appeals. ■

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Two Water Service Pipes for Group I-2, Condition 2 Healthcare Facilities

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609.2.1

Tracer Wire for Buried Nonmetallic Water Service Piping

TABLE 702.3

ABS Building Sewer Pipe Standard

705.2.4, 705.10.4

PVC and ABS Push-fit DWV Fittings

708.1.6

Removable Fixture Traps Serving as Cleanouts

717, 718

Methods for Restoring Building Sewer Piping

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Protected Outdoor Vent Termination Method

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Food Waste Disposers on Combination Waste and Vent Systems

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Direct Connection to Hydromechanical Grease Interceptor

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Fixture Drains Serving as a Trap Priming Method

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Definition of Copper Alloy

CHANGE TYPE: Clarification

CHANGE SUMMARY: The term "copper alloy" is used in numerous locations in the code text. The new definition broadly describes the entire range of copper alloy materials that a manufacturer might use for a product.

2021 CODE: **COPPER ALLOY.** A metal alloy where the principle component is copper.

CHANGE SIGNIFICANCE: The addition of this definition to the code is a simple clarification to support the use of the term "copper alloy" throughout the code. Long ago, the term for alloys of copper used in the plumbing industry was "brass" (e.g., typically red brass or yellow brass). However, brasses are only one group of a wider array of copper alloys that a manufacturer might wish to use for products. In 1974, a unified numbering system (UNS) was created to classify copper alloys. Because the term "brass" may not necessarily be technically correct for all products, "copper alloy" is used to cover all possible materials that are alloys of copper.

Unified Numbering System Ranges for Copper Alloys

Wrought Products
C100xx-C150xx Cu Commercially Pure Copper
C151xx-C199xx Age Hardenable Cu (w/ Cd, Be, Cr, Fe)
C2xxxx Cu-Zn alloys Brasses
C3xxxx Cu-Zn-Pb alloys Leaded brasses
C4xxxx Cu-Zn-Sn alloys Tin bronzes
C5xxxx Cu-Sn and Cu-Sn-Pb Phosphor bronze alloys
C6xxxx Cu-Al and Cu-Si Bronzes
C7xxxx Cu-Ni Copper Nickel and Cu-Ni-Zn Nickel Silver
Cast Products
C800xx-C811xx Commercially Pure Coppers
C813xx-C828xx 95-99% Copper
C833xx-C899xx Cu-Zn alloys containing Sn, Pb, Mn, or Si
C9xxxx Other alloys, including tin bronze, aluminum bronze, copper nickel

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202

Definition of Public and Private

CHANGE TYPE: Modification

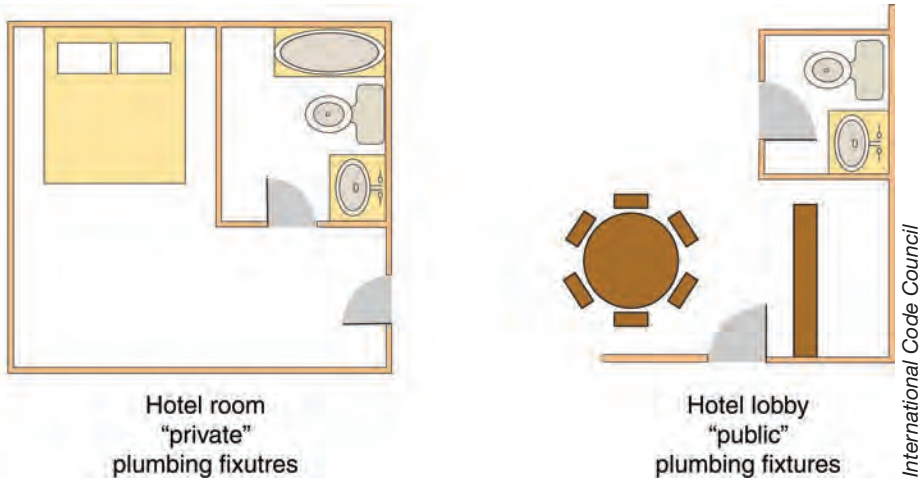
CHANGE SUMMARY: The definitions of "public" and "private" are simplified to make a clearer distinction as to which plumbing fixtures are intended to be configured for public use.

2021 CODE: **PUBLIC OR PUBLIC UTILIZATION.** In the classification of plumbing fixtures, "public" applies to fixtures ~~in general toilet rooms of schools, gymnasiums, hotels, airports, bus and railroad stations, public buildings, bars, public comfort stations, office buildings, stadiums, stores, restaurants and other installations where a number of fixtures are installed so that their utilization is similarly unrestricted~~ with unrestricted exposure to walk-in traffic.

PRIVATE. In the classification of plumbing fixtures, "private" applies to fixtures ~~in residences and apartments, and to fixtures in nonpublic toilet rooms of hotels and motels and similar installations in buildings where the plumbing fixtures are intended for utilization by a family or an individual~~ that are not public.

CHANGE SIGNIFICANCE: The definition of "public" is aligned with that of standards ASME A112.18.1, *Plumbing Supply Fittings*, and ASHRAE 90.1, *Energy Standard for Buildings*, to minimize the number of lavatory fixture fittings (faucets) that must comply with the code's public use requirements for 1) discharging only tempered water and 2) having a flow rate of not greater than 0.5 gpm.

Public lavatory faucets are the only plumbing fixtures required by the code to discharge tempered (between 85 and 110°F) water. The revised definitions have little, if any, impact on public lavatories. However, as the terms "public" and "private" are used throughout the code for purposes beyond identifying lavatory types, the revised definitions could give new meaning to other code sections even though the approved proposal may not have intended to change the meaning in those contexts.



Public versus private uses

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CHANGE TYPE: Modification

CHANGE SUMMARY: A bottled water unit is no longer defined by the code as a water dispenser.

2021 CODE: **WATER DISPENSER.** A plumbing fixture that is manually controlled by the user for the purpose of dispensing potable drinking water into a receptacle such as a cup, glass or bottle. Such fixture is connected to the potable water distribution system of the premises. ~~This definition includes a freestanding apparatus for the same purpose that is not connected to the potable water distribution system and that is supplied with potable water from a container, bottle or reservoir.~~

CHANGE SIGNIFICANCE: Section 410.4 uses the term "water dispenser" concerning a substitution for drinking fountains. The definition change results in the elimination of bottled water units and other self-contained potable water dispensing apparatus as a code-sanctioned alternative to some number of drinking fountains. Although the proposal's reason statement did not mention this impact, referencing the term's revised definition when interpreting Section 410.4 may lead the reader to that conclusion.

202

Definition of Water Dispenser



International Code Council

Bottled water unit is not a water dispenser

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308.9

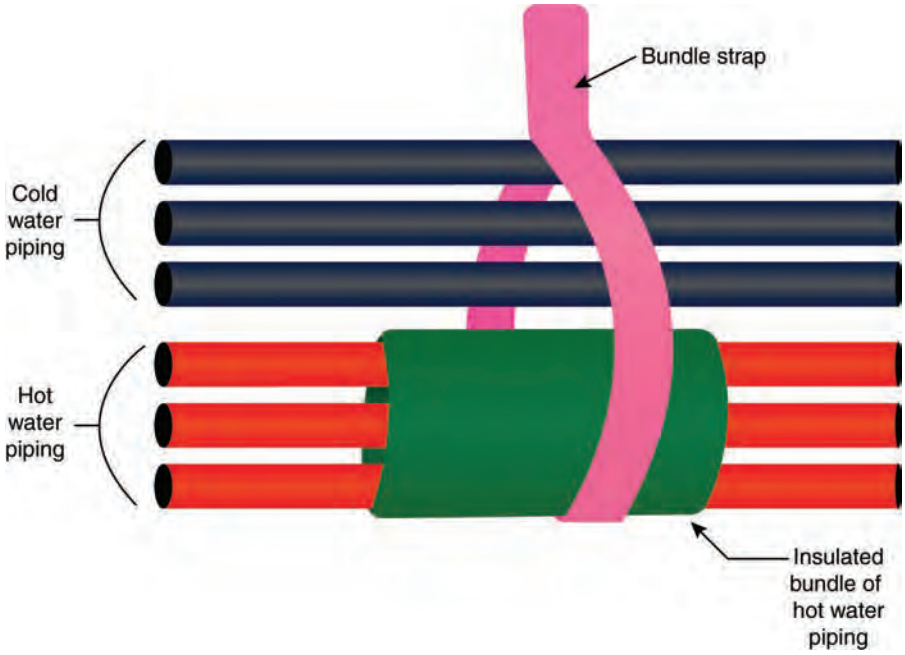
Bundled Hot Water Piping Insulation

CHANGE TYPE: Modification

CHANGE SUMMARY: Where hot water piping for a manifold system is in a bundle with cold water piping, the hot water piping is required to be insulated but not necessarily individually insulated.

2021 CODE: **308.9 Parallel water distribution systems.** Piping bundles for manifold systems shall be supported in accordance with Table 308.5. Support at changes in direction shall be in accordance with the manufacturer's instructions. Where hot water piping is bundled with cold ~~or hot~~ water piping, ~~each~~ hot water ~~pipe~~ piping shall be insulated in accordance with Section 607.5.

CHANGE SIGNIFICANCE: The bundling of piping from manifold systems is often required very near the manifold. Individually insulating each hot water pipe (tube) in these bundles results in very large openings needed in framing members for the bundles to pass through. In those situations, the bundle of hot water piping can be insulated. The reference to Section 607.5 directs the code user to the requirements for pipe insulation.



Hot water piping bundled with cold water piping

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403.1.1

Fixture Quantity Calculations for Multiple User Facilities

CHANGE TYPE: Modification

CHANGE SUMMARY: The minimum fixture quantities for multiple-user toilet facilities designed to serve all genders must be calculated 100 percent based on total occupant load.

2021 CODE: **403.1.1 Fixture calculations.** To determine the occupant load of each sex, the total occupant load shall be divided in half. To determine the required number of fixtures, the fixture ratio or ratios for each fixture type shall be applied to the occupant load of each sex in accordance with Table 403.1. Fractional numbers resulting from applying the fixture ratios of Table 403.1 shall be rounded up to the next whole number. For calculations involving multiple occupancies, such fractional numbers for each occupancy shall first be summed and then rounded up to the next whole number.

Exceptions:

1. The total occupant load shall not be required to be divided in half where approved statistical data indicate a distribution of the sexes of other than 50 percent of each sex.
2. Where multiple-user facilities are designed to serve all genders, the minimum fixture count shall be calculated 100 percent, based on total occupant load. In such multiple-user facilities, each fixture type shall be in accordance with ICC A117.1 and each urinal that is provided shall be located in a stall.
3. Distribution of the sexes is not required where single-user water closets and bathing room fixtures are provided in accordance with Section 403.1.2.

Plumbing Fixture Calculations

Multiple-User Facility for Serving All Genders

Given: Business Use having an Occupant Load of 60. Toilet facility design chosen to be one multiple-user facility to serve all genders.

Per Table 403.1:
Water Closet Ratio: 1 per 25 for the first 50 and 1 per 50 for the remainder exceeding 50
Lavatory Ratio: 1 per 40 for the first 80 and 1 per 80 for the remainder exceeding 80

Calculations:
WCs: 50/25 + (60 − 50)/50 = 2.2 Round up to 3.
LAVs: 60/40 = 1.5 Round up to 2.

Single-User Facilities

Given: Business Use having an Occupant Load of 60. Toilet facility design chosen to be all single-user facilities.

Per Table 403.1:
Water Closet Ratio: 1 per 25 for the first 50 and 1 per 50 for the remainder exceeding 50
Lavatory Ratio: 1 per 40 for the first 80 and 1 per 80 for the remainder exceeding 80

Calculations:
WCs: 50/25 + (60 − 50)/50 = 2.2 Round up to 3.
LAVs: 60/40 = 1.5 Round up to 2. However, because each single-user facility requires a LAV, the required number of LAVs = 3.

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CHANGE SIGNIFICANCE: The new Exception 2 introduces the concept of multiple-user toilet facilities designed to serve all genders. In the context of this exception, gender does not mean sex. Such multiple-user facilities are available for any person to use, regardless of their gender identity. Along with Exception 6 of Section 403.2, additional requirements for this type of facility are few. Many arrangements are possible and other than urinal locations, additional privacy features, beyond what is already required in any multiple-user toilet room intended for use by the same sex, are not required. The design need only serve all genders.

The requirement, "the minimum fixture count shall be calculated 100 percent, based on the total occupant load," attempts to override the requirement of the base section for dividing the total occupant load of the building in half (assuming a 50-50 male/female distribution) when applying the fixture ratios of Table 403.1. Calculations are straight forward where the male and female fixture ratios in the table are identical. Where different table ratios are indicated, calculations will require adjustments to accommodate the difference.

Where a building is designed to have single-user toilet facilities (the subject of Section 403.1.2), and the male and female fixture ratios in the table are identical, Exception 2 (proposal P15) allows the calculations to be straight forward (i.e., distribution of sexes is not required). However, where different table ratios are indicated, calculations will require adjustments to accommodate the difference.

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403.1.2

Fixtures in Single-user Toilet Rooms Count Towards Total Required Quantities

CHANGE TYPE: Clarification

CHANGE SUMMARY: The numbers of plumbing fixtures in all single-user toilet rooms and bathing rooms count towards the total number required for a building.

2021 CODE: **403.1.2 Single-user toilet ~~facility~~ and bathing room fixtures.** The plumbing fixtures located in single-user toilet ~~facilities~~ and bathing rooms, including family or assisted-use toilet and bathing rooms that are required by Section 1109.2.1 of the *International Building Code*, shall contribute toward the total number of required plumbing fixtures for a building or tenant space. Single-user toilet ~~facilities~~ and bathing rooms, and family or assisted-use toilet rooms and bathing rooms shall be identified as being available for use ~~either~~ by all persons regardless of their sex.

The total number of fixtures shall be permitted to be based on the required number of separate facilities or based on the aggregate of any combination of single-user or separate facilities.

CHANGE SIGNIFICANCE: The required number of plumbing fixtures for a building or space can be located in single-user facilities, separate facilities or a combination thereof. Given that single-user facilities serve all persons (not sex separated), the number of plumbing fixtures in those rooms count towards the total number of fixtures required for a building.



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Fixtures in all single-user toilet rooms count toward total required

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Fixtures in all single-user toilet rooms count toward total required

A mixture of Single-User toilet facilities and Multiple-User toilet facilities

Given: Business Use having an Occupant Load of 360. Design chosen to have 5 single-user toilet facilities and two multiple-user "separate sex" toilet facilities.

Per Table 403.1:
Water Closet Ratio: 1 per 25 for the first 50 and 1 per 50 for the remainder exceeding 50
Lavatory Ratio: 1 per 40 for the first 80 and 1 per 80 for the remainder exceeding 80

Calculations:
Occupant load for males = 360/2 = 180
Occupant load for females = 360/2 = 180

Males:
WCs: 50/25 + (180 − 50)/50 = 4.6 Round up to 5.
LAVs: 80/40 + (180 − 80)/40 = 4.5 Round up to 5.

Females:
WCs: 50/25 + (180 − 50)/50 = 4.6 Round up to 5.
LAVs: 80/40 + (180 − 80)/40 = 4.5 Round up to 5.

Total required WCs = 10
Total required LAVs = 10

Five single-user toilet facilities requires 5 WC and 5 Lavs. Five WCs and 5 Lavs remain for the multiple-user "separate sex" toilet facilities.

Distribute 2 WCs and 2 Lavs for male toilet facility and, 3 WCs and 3 LAVs for female toilet facility.

OR

Distribute 2 WCs and 2 Lavs for female toilet facility and, 3 WCs and 3 LAVs for male toilet facility.

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403.2

Multiple-user Nonseparated Toilet Facilities

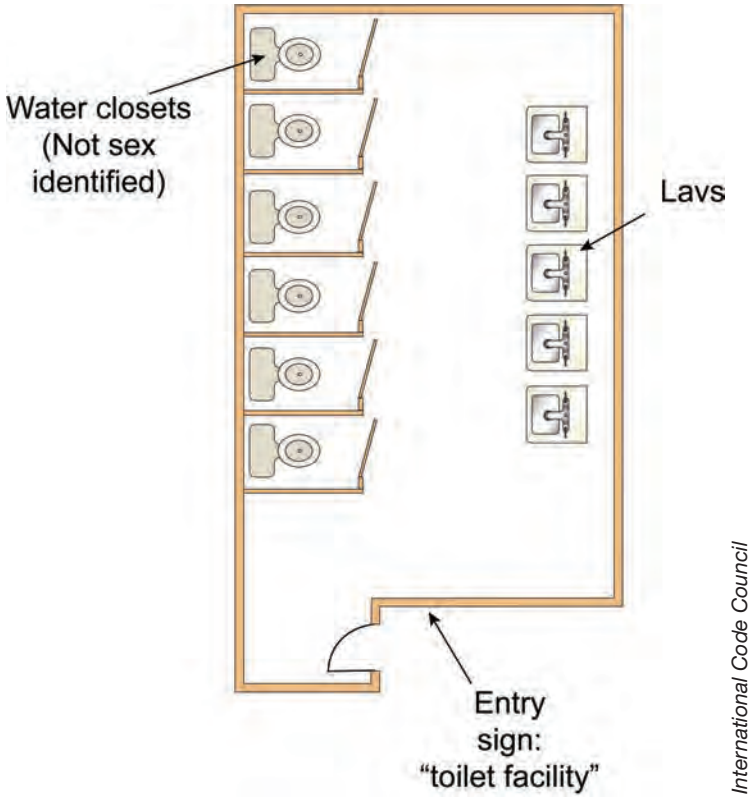
CHANGE TYPE: Modification

CHANGE SUMMARY: Designs for multiple-user facilities serving both sexes are possible.

2021 CODE: **403.2 Separate facilities.** Where plumbing fixtures are required, separate facilities shall be provided for each sex.

Exceptions:

1. through 4. remain unchanged.
5. Separate facilities shall not be required to be designated by sex where single-user toilets rooms are provided in accordance with Section 403.1.2.
6. Separate facilities shall not be required where rooms having both water closets and lavatory fixtures are designed for use by both sexes and privacy for water closets is provided in accordance with Section 405.3.4. Urinals shall be located in an area visually separated from the remainder of the facility or each urinal that is provided shall be located in a stall.



Multiple-user nonseparated toilet facilities

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CHANGE SIGNIFICANCE: Exception 5 provides an allowance for single-user toilet rooms to not be designated by sex. However, for 2021, Section 403.1.2 requires that single-user toilet facilities not be designated by sex, making this exception unnecessary.

Exception 6 introduces the new concept of multiple-user toilet facilities designed to serve both sexes. Similar to the new concept introduced in Section 403.1.1 (multiple-user toilet facilities to serve all genders), this exception allows multiple-user facilities to be labeled for use by both sexes (male/female). As Section 405.3.4 was not changed for the 2021 edition, multiple-user separate sex toilet facility designs that were compliant with the 2018 code edition could comply with this exception, provided that any urinals are in stalls.

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403.3.1, 403.5

Facilities and Drinking Fountains on Accessible Routes

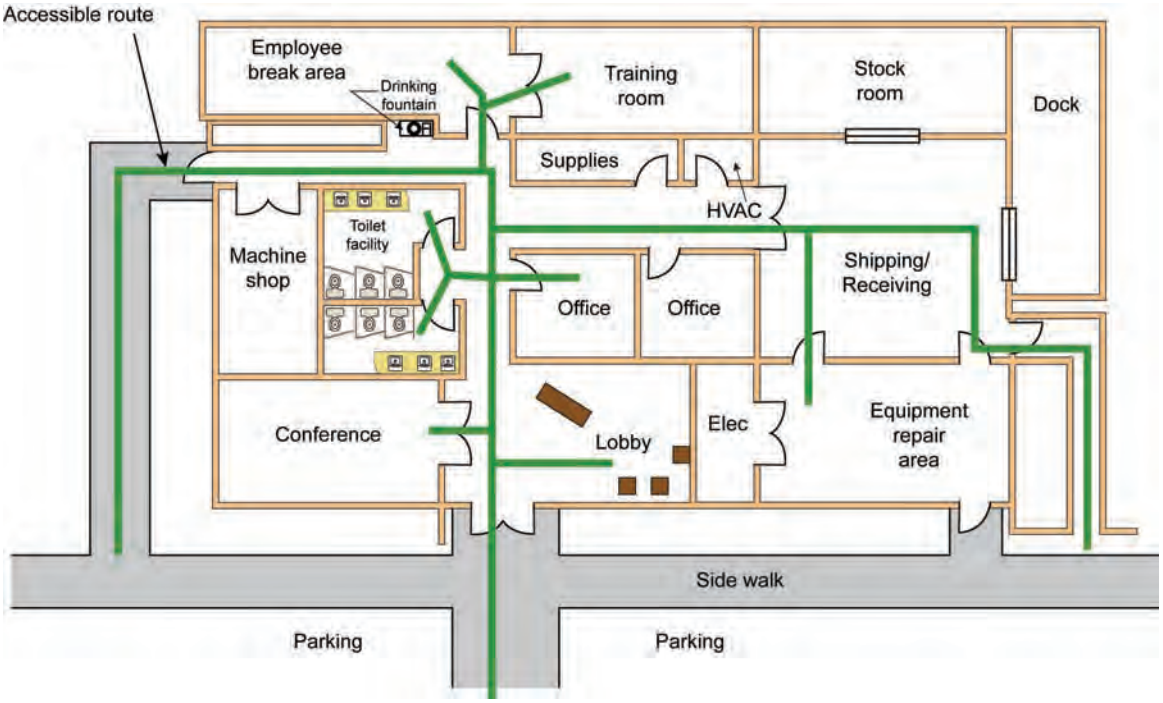
CHANGE TYPE: Clarification

CHANGE SUMMARY: Because accessibility is covered by the requirements of Section 404 and those requirements include specifics concerning accessible routes, there is no need to repeat the accessible route requirement in these sections.

2021 CODE: **403.3.1 Access.** The route to the public toilet facilities required by Section 403.3 shall not pass through kitchens, storage rooms or closets. Access to the required facilities shall be from within the building or from the exterior of the building. ~~Routes shall comply with the accessibility requirements of the *International Building Code*.~~ The public shall have access to the required toilet facilities at all times that the building is occupied.

403.5 Drinking fountain location. Drinking fountains shall not be required to be located in individual tenant spaces provided that public drinking fountains are located within a distance of travel of 500 feet (152 m) of the most remote location in the tenant space and not more than one story above or below the tenant space. Where the tenant space is in a covered or open mall, such distance shall not exceed 300 feet (91 m). ~~Drinking fountains shall be located on an accessible route.~~

CHANGE SIGNIFICANCE: This change does not remove the requirement for toilet facilities and drinking fountains to be on accessible routes. Section 404 already properly covers this matter by referring to the *International Building Code* where Chapter 11 has full details (along with exceptions) about where accessible routes are and are not needed.



International Code Council

Accessible routes

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403.3.3

Group S Toilet Facility Location

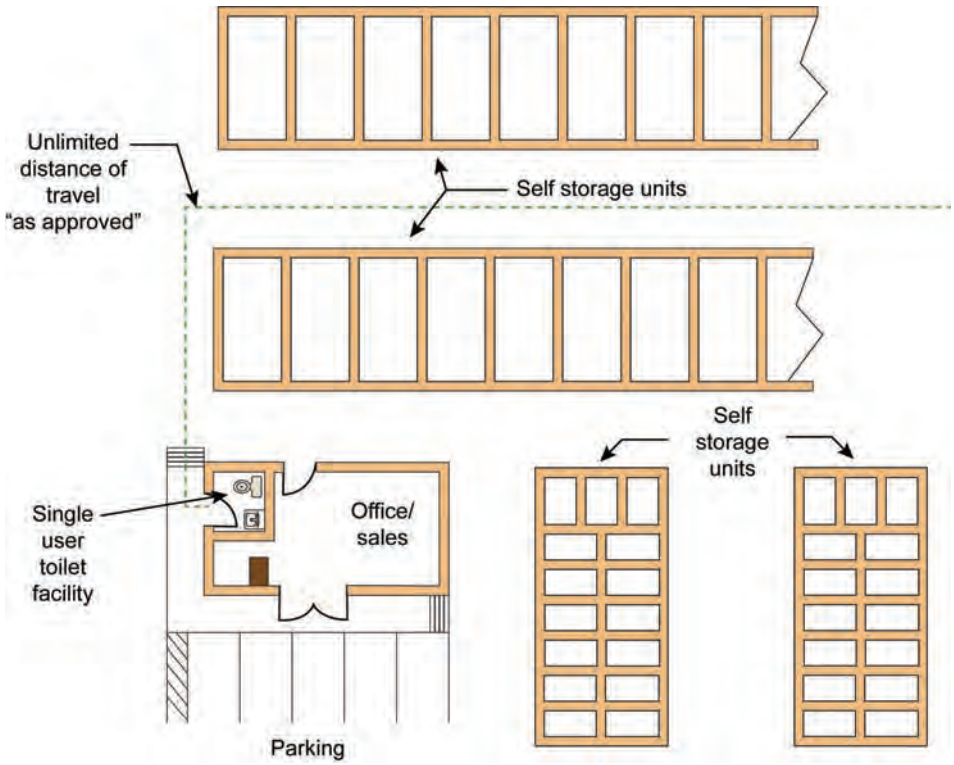
CHANGE TYPE: Modification

CHANGE SUMMARY: The location of toilet facilities in Group S occupancies can exceed the location and maximum distance limitations provided that the arrangement is approved.

2021 CODE: **403.3.3 Location of toilet facilities in occupancies other than malls.** In occupancies other than covered and open mall buildings, the required public and employee toilet facilities shall be located not more than one story above or below the space required to be provided with toilet facilities, and the path of travel to such facilities shall not exceed a distance of 500 feet (152 m).

Exceptions:

1. The location and maximum distances of travel to required employee facilities in factory and industrial occupancies shall be permitted to exceed that required by this section, provided that the location and maximum distances of travel are approved.
2. The location and maximum distances of travel to required public and employee facilities in Group S occupancies shall be permitted to exceed that required by this section, provided that the location and maximum distances of travel are approved.



Storage facility with toilet facility at office

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CHANGE SIGNIFICANCE: As some Group S occupancies have few people in them, it is not a cost-effective use of space or resources to require a duplication of toilet facilities simply because the maximum distance or number of stories was exceeded. One example is a large, multiple-level self-storage facility with an office at the facility entrance. Allowing the only employee (and public) toilet facility to be at the office is a common practice.

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403.6

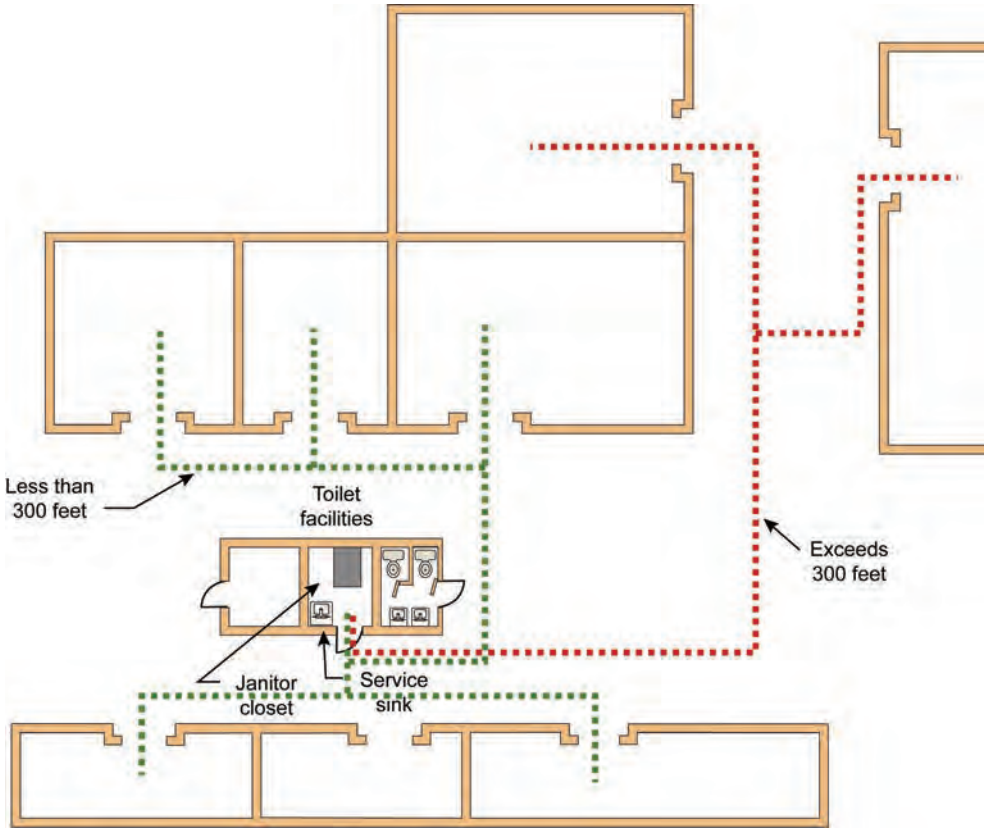
Service Sink Location

CHANGE TYPE: Addition

CHANGE SUMMARY: Where a service sink is not located within a tenant space in a covered mall, the travel distance to a service sink is limited.

2021 CODE: **403.6 Service sink location.** Service sinks shall not be required to be located in individual tenant spaces in a covered mall provided that service sinks are located within a distance of travel of 300 feet (91 m) of the most remote location in the tenant space and not more than one story above or below the tenant space. Service sinks shall be located on an accessible route.

CHANGE SIGNIFICANCE: Although the code doesn't necessarily require a service sink to be located in individual tenant spaces of a covered mall, where the building arrangement requires service sinks in tenant spaces, this section allows those sinks to be located outside the tenant space, provided that they are within travel distance limitations.



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Location of service sink

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405.4.3

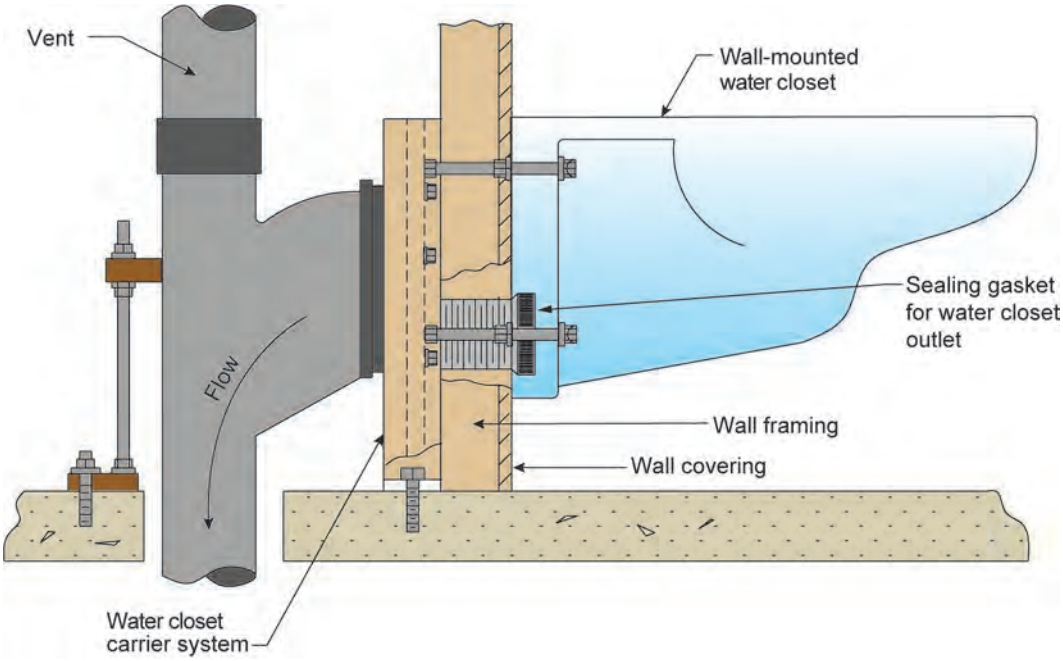
Wall Hung Fixture Carrier Standard for Water Closets

CHANGE TYPE: Modification

CHANGE SUMMARY: A new standard for water closet carriers is added.

2021 CODE: **405.4.3 Securing wall-hung water closet bowls.** Wall-hung water closet bowls shall be supported by a concealed metal carrier that is attached to the building structural members so that strain is not transmitted to the ~~closet~~ fixture connector or any other part of the plumbing system. The carrier shall conform to ASME A112.6.1M or ASME A112.6.2.

CHANGE SIGNIFICANCE: Wall-mounted ("wall-hung") water closets require structural support within the wall. A new standard is provided for those carriers.



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Wall-hung water closet carrier

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407.2

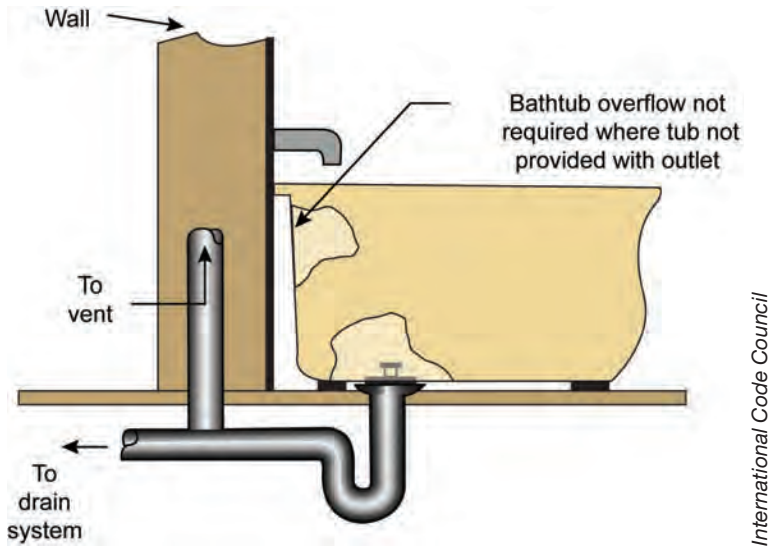
Bathtubs are Not Required to have Overflow Outlets

CHANGE TYPE: Modification

CHANGE SUMMARY: A bathtub does not require an overflow outlet.

2021 CODE: **407.2 Bathtub waste outlets and overflows.** Bathtubs shall be equipped with a waste outlet ~~and an overflow outlet. The outlets shall be connected to waste tubing or piping~~ that is not less than 1½ inches (38 mm) in diameter. The waste outlet shall be equipped with a watertight stopper. Where an overflow is installed, the overflow shall be not less than 1½ inches (38 mm) in diameter.

CHANGE SIGNIFICANCE: Bathtub overflow outlets are not designed to prevent overflows of a bathtub. The flow from a tub filler faucet can easily be more flow than a typical overflow outlet can drain out of the tub. Even though an overflow outlet does allow for excess water to drain out of a tub when someone immerses themselves in a full tub (i.e., at the level of the overflow), the excess water does not instantly drain away. Protecting a tub from overflow is the bather's responsibility.



Overflow not required

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CHANGE TYPE: Addition

410.3.2

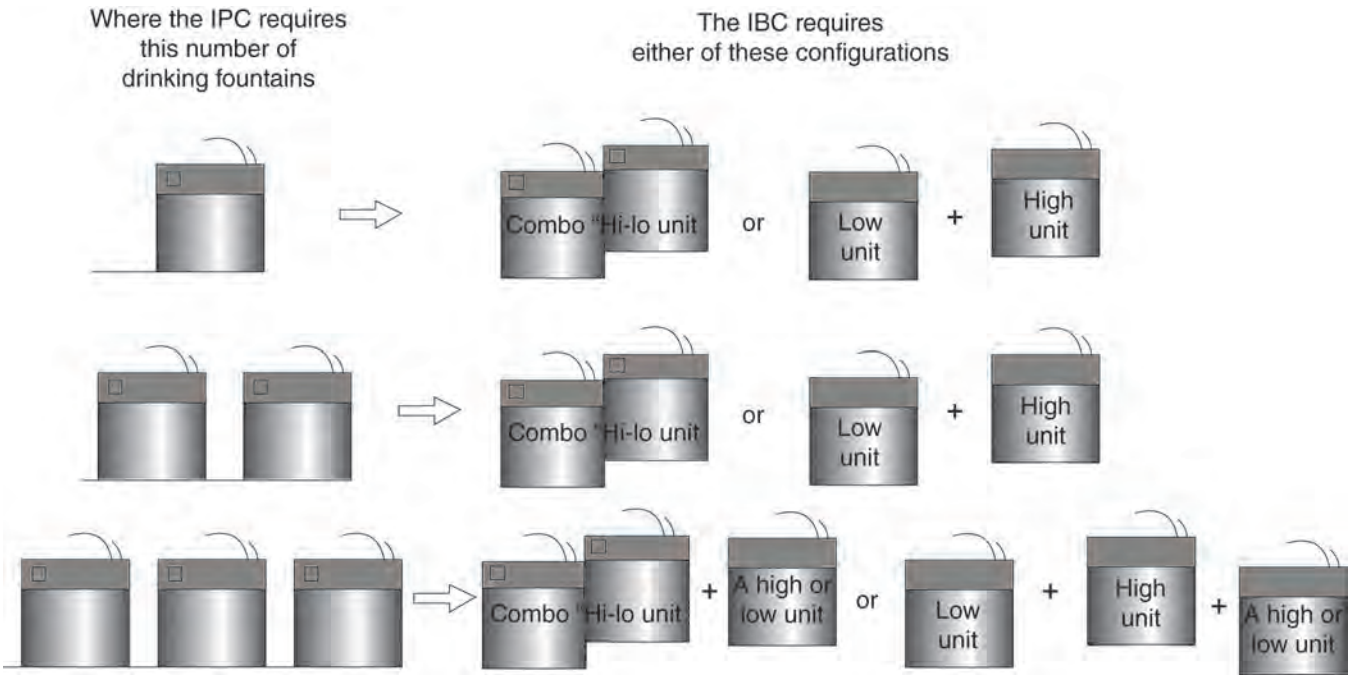
Quantities of Standing versus Wheelchair Drinking Fountains

CHANGE SUMMARY: Fifty percent of the required number of drinking fountains must be for standing persons and the other 50 percent for persons who use wheelchairs.

2021 CODE: **410.3.2 More than the minimum number.** Where more than the minimum number of drinking fountains specified in Section 410.3.1 is provided, 50 percent of the total number of drinking fountains provided shall comply with the requirements for persons who use a wheelchair and 50 percent of the total number of drinking fountains provided shall comply with the requirements for standing persons.

Exceptions:

1. Where 50 percent of the drinking fountains yields a fraction, 50 percent shall be permitted to be rounded up or down, provided that the total number of drinking fountains complying with this section equals 100 percent of the drinking fountains.
2. Where drinking fountains are primarily for children's use, drinking fountains for people using wheelchairs shall be permitted to comply with the children's provisions in ICC A117.1 and drinking fountains for standing children shall be permitted to provide the spout at 30 inches (762 mm) minimum above the floor.



Drinking fountains for accessible design

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CHANGE SIGNIFICANCE: This section has been in previous editions of the *International Building Code* and is now included in the IPC so the requirements are not overlooked. Exception 1 addresses when an odd number of drinking fountains is provided. The number can be rounded down (or up) before dividing by two. Where rounded down, the remaining required drinking fountains can be either for standing persons or persons using wheelchairs. Exception 2 applies to where children are the primary users of drinking fountains. In that case, the spout for standing children must be at least 30 inches above the floor and for children using wheelchairs, drinking fountains must comply with dimensional requirements for ICC A117.1.

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410.4

Drinking Fountain Substitution using Water Dispensers

CHANGE TYPE: Clarification

CHANGE SUMMARY: At least three required drinking fountains must be installed before 50 percent of the additional required drinking fountains can be substituted with water dispensers.

2021 CODE: **410.4 Substitution.** Where restaurants provide drinking water in a container free of charge, drinking fountains shall not be required in those restaurants. In other occupancies where three or more drinking fountains are required, water dispensers shall be permitted to be substituted for not more than 50 percent of the required number of drinking fountains.

CHANGE SIGNIFICANCE: Section 410.4 is clarified to coordinate with the requirement in Section 410.3 for the minimum number of drinking fountains (for accessibility) for a building. This is not a new requirement, as Chapter 11 of the IBC requires that, at a minimum, a "high" and a "low" drinking fountain be provided. The substitution of water dispensers for drinking fountains cannot be applied to the first two drinking fountains but only to the drinking fountains that are in excess of the first two.



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Drinking fountain substitution using water dispensers

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411.3

Water Heaters for Emergency Showers and Eye Wash Stations

CHANGE TYPE: Modification

CHANGE SUMMARY: A new type of water heater is available for emergency showers and eyewash stations that does not require a temperature-actuated mixing valve.

2021 CODE: **411.3 Water supply.** Where hot and cold water is supplied to an emergency shower or eyewash station, the temperature of the water supply shall only be controlled by a temperature-actuated mixing valve complying with ASSE 1071. Where water is supplied directly to an emergency shower or eyewash station from a water heater, the water heater shall comply with ASSE 1085.

CHANGE SIGNIFICANCE: Emergency shower stations and eyewash stations need precise limiting/control of the temperature of the water that is discharged to the user. The water discharge is also needed quickly. A water heater complying with ASSE 1085 has the necessary control technology to reliably provide water at the intended temperature for these applications.



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Emergency shower water heater

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CHANGE TYPE: Modification

CHANGE SUMMARY: Lower flow shower heads need to be compatible with the shower control (mixing valve).

2021 CODE: **412.3 Individual shower valves.** Individual shower and tub-shower combination valves shall be balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valves that conform to the requirements of ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1. Such valves shall be installed at the point of use. Shower control valves shall be rated for the flow rate of the installed shower head. Shower and tub-shower combination valves required by this section shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturer's instructions to provide water at a temperature not to exceed 120°F (49°C). In-line thermostatic valves shall not be utilized for compliance with this section.

412.4 Multiple (gang) showers. Multiple (gang) showers supplied with a single, tempered water supply pipe shall have the water supply for such showers controlled by an approved automatic temperature control mixing valve that conforms to ASSE 1069 or CSA B125.3, or each shower head shall be individually controlled by a balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valve that conforms to ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1 and is installed at the point of use. Where a showerhead is individually controlled, shower control valves shall be rated for the flow rate of the installed shower head. Such valves shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturer's instructions to provide water at a temperature not to exceed 120°F (49°C). Access shall be provided to an ASSE 1069 or CSA B125.3 valve.

CHANGE SIGNIFICANCE: The code requires a shower head flow rate be limited to 2.5 gpm. Shower controls (mixing valves) complying with the requirements of the product standards in the code are designed to safety operate at that flow. However, there are many different types of shower heads available in the market that have lower flow rates. These lower flows might not provide enough motive power within a mixing valve to allow for the valve to self-adjust to prevent temperature shock to the user when a supply pressure or temperature change occurs. Not all shower controls (mixing valves) are designed (and tested) to accommodate lower (less than 2.5 gpm) flows.

412.3

Shower Control Valves to be Rated for the Installed Shower Head



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Shower valve rated for lower flow shower head

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412.5

Methods for Limiting Water Temperature Discharged to Bathtubs

CHANGE TYPE: Modification

CHANGE SUMMARY: New types of water heaters and a new design for tub faucets are additional methods that can be used to control water temperature for bathtubs.

2021 CODE: **412.5 Bathtub and whirlpool bathtub valves.** ~~The hot water supplied to~~ Bathtubs and whirlpool bathtub valves shall ~~be limited to not greater than~~ have or be supplied by a water-temperature-limiting device that conforms to ASSE 1070/ASME A112.1070/CSA B125.70 or by a water heater complying with {ASSE 1082} or {ASSE 1084}, except where ~~such protection is otherwise provided by a~~ such valves are combination tub/shower valves in accordance with Section 412.3. The water-temperature-limiting device required by this section shall be equipped with a means to limit the maximum setting of the device to 120°F (49°C), and, where adjustable, shall be field adjusted in accordance with the manufacturer's instructions to provide hot water at a temperature not to exceed 120°F (49°C). Access shall be provided to water-temperature-limiting devices that conform to ASSE 1070/ASME A112.1070/CSA B125.70.

> **Exception:** Access shall not be required for nonadjustable water-temperature-limiting devices that conform to ASSE 1070/ASME A112.1070/CSA B125.70 and are integral with a fixture fitting, provided that the fixture fitting itself can be accessed for replacement.

CHANGE SIGNIFICANCE: Two new types of water heaters are available that have the necessary control technology to reliably provide water at the intended (maximum) temperature for this application. Freestanding bathtub faucets (floor mounted) have become available that have an integral temperature limiting device that complies with the test requirement of standard ASSE 1070/ASME A112.1070/CSA B125.70. Where one of these new methods is used, an external temperature limiting device is not needed.



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Temperature limiting for bathtubs

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412.10

Methods for Temperature Limitation at Head Shampoo Sinks and Footbaths

CHANGE TYPE: Modification

CHANGE SUMMARY: Two additional methods can be used to limit the water temperature discharged from a head shampoo sink.

2021 CODE: **412.10 Head shampoo sink faucets.** Head shampoo sink faucets shall be supplied with hot water that is limited to not more than 120°F (49°C)~~by a water-temperature-limiting device that conforms to ASSE 1070/ASME A112.1070/CSA B125.70~~. Each faucet shall have integral check valves to prevent crossover flow between the hot and cold water supply connections. The means for regulating the maximum temperature shall be one of the following:

1. A limiting device conforming to ASSE 1070/ASME A112.1070/CSA B125.70.
2. A water heater conforming to ASSE 1082.
3. A temperature-actuated, flow-reduction device conforming to ASSE 1062.

423.3 Footbaths and pedicure baths. The water supplied to specialty plumbing fixtures, such as pedicure chairs having an integral foot bathtub and footbaths, shall be limited to not greater than 120°F (49°C) by a water-temperature-limiting device that conforms to ASSE 1070/ASME A112.1070/CSA B125.70 or ~~CSA B125.3~~ by a water heater complying with ASSE 1082.

CHANGE SIGNIFICANCE: A water heater complying with ASSE 1082 has the necessary control technology to reliably provide water at the intended temperature for shampoo sinks, footbaths and pedicure baths. See also Section 419.5.



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Temperature limiting for head shampoo sinks

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419.5

Tempered Water for Public Hand-Washing Lavatories

CHANGE TYPE: Modification

CHANGE SUMMARY: A valve conforming to CSA B125.3 is no longer acceptable as a water-temperature limiting device for public hand-washing lavatories.

2021 CODE: **419.5 Tempered water for public hand-washing facilities.** Tempered water shall be delivered from lavatories and group wash fixtures located in public toilet facilities provided for customers, patrons and visitors. Tempered water shall be delivered through an approved water-temperature limiting device that conforms to ASSE 1070/ASME A112.1070/CSA B125.70 ~~or CSA B125.3~~.

CHANGE SIGNIFICANCE: In June of 2017, the CSA B125 Committee completed the project that removed the automatic compensating valve requirements from CSA B125.3. Therefore, valves made to the latest edition of the standard (2018) are not designed (or tested) for temperature limiting and are no longer suitable for this application.



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A CSA B125.3 device is no longer acceptable for temperature compensating.

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421.3.1

Standard for Shower Waste Fittings

CHANGE TYPE: Addition

CHANGE SUMMARY: Shower drains, including linear shower drains, are required to comply with the referenced standard.

2021 CODE: **421.3.1 Waste fittings.** Waste fittings shall conform to ASME A112.18.2/CSA B125.2.

CHANGE SIGNIFICANCE: The latest edition of ASME A112.18.2/CSA B125.2 contains specific requirements for typical shower drains and also linear type drains that are different from a trench type drain. This standard includes requirements for built-up shower drain systems that are normally used in field fabricated shower systems.



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Shower drain to comply with standard

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501.2

ASSE 1017 Temperature Actuated Mixing Valves

CHANGE TYPE: Clarification

CHANGE SUMMARY: The title of Standard ASSE 1017 is *Temperature-Actuated Mixing Valve*. Therefore, the code language is changed to align with the title of the standard.

2021 CODE: **501.2 Water heater as space heater.** Where a combination potable water heating and space heating system requires water for space heating at temperatures greater than 140°F (60°C), a ~~master thermostatic~~ temperature-actuated mixing valve complying with ASSE 1017 shall be provided to limit the water supplied to the potable hot water distribution system to a temperature of 140°F (60°C) or less. The potability of the water shall be maintained throughout the system. Requirements for combination potable water heating and space heating systems shall be in accordance with the *International Mechanical Code*.

CHANGE SIGNIFICANCE: The term "master" was confusing to some designers and installers as ASSE 1017 doesn't refer to that type of mixing valve. The standard indicates the acceptable location where such mixing valves are intended at the source of hot water and not at a point-of-use.



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"Master thermostatic" mixing valve does not exist.

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602.3.5

Potable Water Pumps to Comply with NSF 61

CHANGE TYPE: Modification

CHANGE SUMMARY: Pumps used to supply drinking water must conform to NSF 61.

2021 CODE: **602.3.5 Pumps.** Pumps shall be rated for the transport of potable water. Pumps in an individual water supply system shall be constructed and installed so as to prevent contamination from entering a potable water supply through the pump units. Pumps intended to supply drinking water shall conform to NSF 61. Pumps shall be sealed to the well casing or covered with a water-tight seal. Pumps shall be designed to maintain a prime and installed such that ready access is provided to the pump parts of the entire assembly for repairs.

CHANGE SIGNIFICANCE: A number of major manufacturers of potable water pumps have had their pumps third-party certified to NSF 61 for many years, even though the code did not require compliance. Now that the majority of manufacturers have pumps that comply with the standard, adding this requirement to the code provides additional safety for systems that supply drinking water.

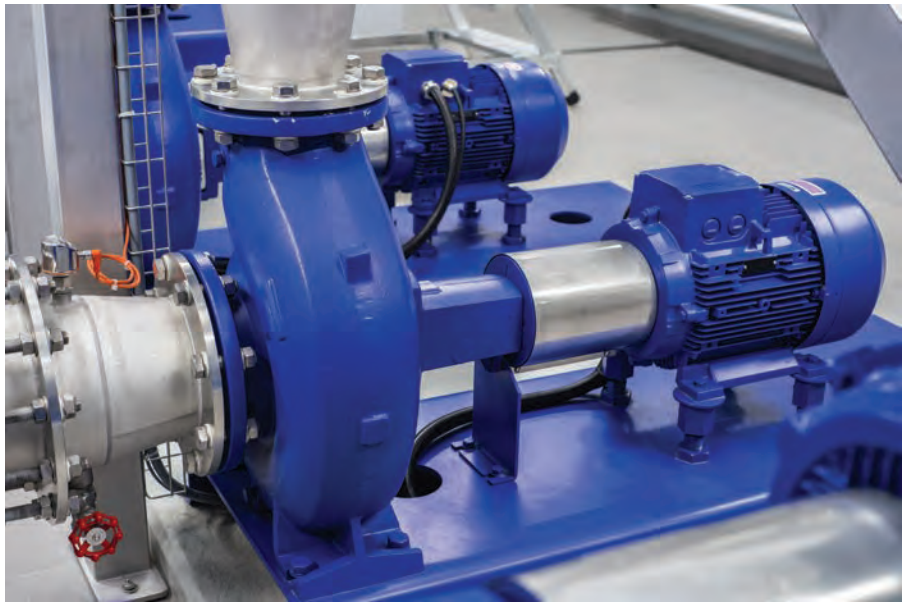


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NSF 61-compliant potable water pump

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605.12.3, 605.13.6

Solder and Flux to Conform to NSF 61

CHANGE TYPE: Modification

CHANGE SUMMARY: Solder and flux used in making joints in pipe and tubing for drinking water systems must conform to NSF 61.

2021 CODE: **605.12.3 Solder joints.** Solder joints shall be made in accordance with ASTM B828. Cut tube ends shall be reamed to the full inside diameter of the tube end. Joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32. The joining of water supply piping shall be made with lead-free solder and fluxes. "Lead free" shall mean a chemical composition equal to or less than 0.2-percent lead. Solder and flux joining pipe or fittings intended to supply drinking water shall conform to NSF 61.

CHANGE SIGNIFICANCE: A number of major manufacturers of solder and flux have had their products third-party certified to NSF 61 for many years, even though the code did not require compliance. Now that the majority of manufacturers have products that comply with the standard, adding this requirement to the code provides additional safety for systems that supply drinking water.



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NSF 61-Compliant solder and flux

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606.1 Individual Tenant Water Shut-off Valve

CHANGE TYPE: Modification

CHANGE SUMMARY: Multiple tenant buildings must have a main water shutoff valve for each tenant space.

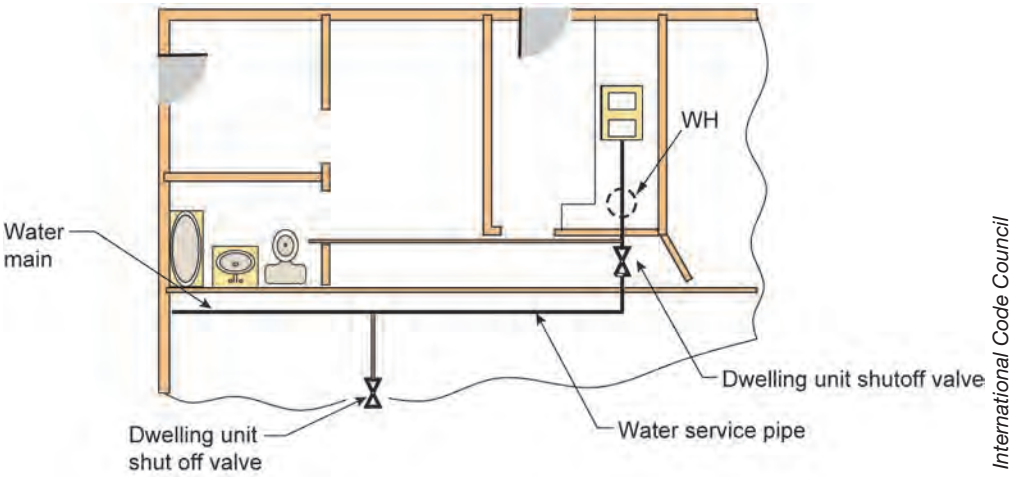
2021 CODE: **606.1 Location of full-open valves.** Full-open valves shall be installed in the following locations:

1. On the building water service pipe from the public water supply near the curb.
2. On the water distribution supply pipe at the entrance into the structure.

   2.1. In multiple-tenant buildings, where a common water supply piping system is installed to supply other than one- and two-family dwellings, a main shutoff valve shall be provided for each tenant.

(3. through 8. remain unchanged)

CHANGE SIGNIFICANCE: In multiple-tenant buildings, each tenant needs to have the capability to completely shut off all water coming into their space should the need arise, such as a leak in a pipe or a fixture supply valve, or where remodeling requires the modification of piping within the tenant space.



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Individual tenant shut-off valves

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607.1.1, 607.1.2

Water Heaters Providing Tempered Water to Fixtures

CHANGE TYPE: Modification

CHANGE SUMMARY: New designs of water heaters are available where the temperature control of the water heater can provide reliable and accurate control of the temperature of the heated water.

2021 CODE:

607.1.1 Temperature limiting means. A thermostat control for a water heater shall not only serve as the temperature limiting means for the purposes of complying with the requirements of this code for maximum allowable hot or tempered water delivery temperature at fixtures where the water heater complies with ASSE 1082 or ASSE 1085.

607.1.2 Tempered water temperature control. Tempered water shall be ~~supplied through a water temperature~~ controlled by one of the following:

1. A limiting device ~~that conforms~~ conforming to ASSE 1070/ASME A112.1070/CSA B125.70 ~~and shall limit the tempered water to not greater than~~ and set to a maximum of 110°F (43°C).
2. A thermostatic mixing valve conforming to ASSE 1017.
3. A water heater conforming to ASSE 1082.
4. A water heater conforming to ASSE 1084.

This provision shall not supersede the requirement for protective shower valves in accordance with Section 412.3.

CHANGE SIGNIFICANCE: Advances in control technologies for water heaters are recognized in the code to allow the controls of conforming water heaters to serve as the temperature limiting device rather than needing to provide an external mechanical water temperature limiting or control device.

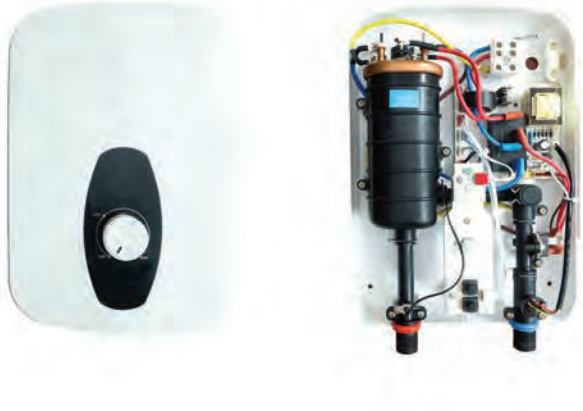


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Water heater for tempered water

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608.15.2.1

Discharge from Backflow Preventer Relief Opening

CHANGE TYPE: Modification

CHANGE SUMMARY: Where backflow preventers can relieve indoors, the relief discharge must be directed to an adequately sized waste receptor.

2021 CODE: **608.15.2.1 Relief port piping.** The termination of the piping from the relief port or air gap fitting of a backflow preventer shall discharge to an approved indirect waste receptor or to the outdoors where it will not cause damage or create a nuisance. The indirect waste receptor and drainage piping shall be sized to drain the maximum discharge flow rate from the relief port as published by the backflow preventer manufacturer.

CHANGE SIGNIFICANCE: The water discharge from a backflow preventer that discharges indoors must be directed to the drainage system of the building to prevent flood damage to the structure and building equipment. Alternatively, the relief discharge can be directed to the outdoors.



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Waste receptor for backflow preventer

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608.17.2

Backflow Device for Low Hazard Boiler Applications

CHANGE TYPE: Modification

CHANGE SUMMARY: The code adds a recognized standard, ASSE 1081, for a combination pressure regulator/backflow preventer product for boilers.

2021 CODE: **608.17.2 Connections to boilers.** The potable supply to the boiler shall be equipped with a backflow preventer with an intermediate atmospheric vent complying with ASSE 1012, ASSE 1081, or CSA B64.3. Where conditioning chemicals are introduced into the system, the potable water connection shall be protected by an air gap or a reduced pressure principle backflow preventer, complying with ASSE 1013, CSA B64.4 or AWWA C511.

CHANGE SIGNIFICANCE: Potable water connections to boilers require both a pressure reducing valve and a backflow prevention device. The added standard, ASSE 1081, *Performance Requirements for Backflow Preventers with Integral Pressure Reducing Boiler Feed Valve and Intermediate Atmospheric Vent Style for Domestic and Light Commercial Water Distribution Systems*, recognizes dual-purpose devices that satisfy both requirements. Products are now available that are "all-in-one" to simplify installations for low hazard boiler connections.



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Pressure reducing valve/backflow preventer for boiler

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609.2

Two Water Service Pipes for Group I-2, Condition 2 Healthcare Facilities

CHANGE TYPE: Modification

CHANGE SUMMARY: Buildings classified as Group I-2, Condition 2 facilities require two water service pipes. The previous requirement for hospitals to have two water service pipes was vague, resulting in enforcement difficulties.

2021 CODE: **609.2 Water service for Group I-2, Condition 2 facilities.** ~~Hospitals~~ Group I-2, Condition 2 facilities shall have not fewer than two water service pipes ~~installed in such a manner so as to minimize the potential for an interruption of the supply of water in the event of a water main or water service pipe failure.~~ sized such that with the loss of the largest service pipe, the remaining service pipes will meet the water demand for the entire facility. Each water service shall have a shutoff valve in the building and a shutoff valve at the utility-provided point of connection to the water main or other source of potable water.

CHANGE SIGNIFICANCE: Determining which hospitals actually needed redundant water service pipes could only be based on whether the facility was actually named a "hospital." Many facilities that do require water service redundancy may not be named "hospital." The use of the terminology "Group I-2, Condition 2 facilities," as detailed in Chapter 3 of the IBC provides clarity as to which buildings require the redundancy based on occupancy classification. The modification adds requirements for shutoff valves on those water lines and recognizes that not all such facilities will be served by a water utility (some could have ground water wells or other means.)



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Healthcare facility water service pipes

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609.2.1

Tracer Wire for Buried Nonmetallic Water Service Piping

CHANGE TYPE: Addition

CHANGE SUMMARY: The addition of a tracer wire on buried hospital water service piping allows for easier locating to avoid piping damage that would disrupt water service.

2021 CODE: **609.2.1 Tracer wire for nonmetallic piping.** An insulated tracer wire listed for the purpose or other approved conductor shall be installed adjacent to underground nonmetallic piping serving as a water service for a hospital. Access shall be provided to the tracer wire or the tracer wire shall terminate above ground at each end of the nonmetallic piping. The tracer wire size shall be not less than 18 AWG and the wire insulation type shall be suitable for direct burial.

CHANGE SIGNIFICANCE: A tracer wire is now required for underground nonmetallic water service piping serving Group I-2, Condition 2 facilities (hospitals). Although the installation of tracer products for buried nonmetallic piping and conduit is common in the utility industry, this section is specific as to the minimum size of the wire, access to the wire at each end of the piping and the insulation on the wire needing to be listed for direct burial service. Typical building wiring is not likely to be listed (by a third-party certification agency) for tracer wire service. Note that as AWG wire size number designations become larger, the wire diameters become smaller. Sizes less than 18 AWG are products having smaller wire diameters.



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Tracer required for underground nonmetallic water service pipe

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CHANGE TYPE: Modification

CHANGE SUMMARY: A standard is added to the building sewer pipe table for a composite wall ABS pipe.

2021 CODE:

Table 702.3
ABS Building Sewer Pipe Standard

TABLE 702.3 Building Sewer Pipe

Material	Standard
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D2661; ASTM D2680; ASTM F628; ASTM F1488; CSA B181.1

CHANGE SIGNIFICANCE: Another form of ABS pipe is added to the table of building sewer pipe standards. The standard covers nominal pipe sizes of 8, 10, 12 and 15 inches. This form of pipe is a composite wall construction where concentric inner and outer walls are braced by an integral truss-type structure. The resultant annular space between the walls is filled with a Portland cement/pearlite mixture. The product has a pipe stiffness of at least 200 psi to provide for very low deflection values for deep burial conditions as well as for AASHTO live loading conditions at less than one foot of cover.



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New standard for ABS sewer pipe

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705.2.4, 705.10.4

PVC and ABS Push-fit DWV Fittings

CHANGE TYPE: Addition

CHANGE SUMMARY: Push-fit fittings are a new type of DWV fitting for ABS and PVC piping that, when used, will reduce installation time.

2021 CODE: **705.2.4 Push-fit joints.** Push-fit DWV fittings shall be listed and labeled to ASME A112.4.4 and shall be installed in accordance with the manufacturer's instructions.

705.10.4 Push-fit joints. Push-fit joints shall conform to ASME A112.4.4 and shall be installed in accordance with the manufacturer's instructions.

CHANGE SIGNIFICANCE: Push-fit DWV fittings of either ABS or PVC are available for use. Such fittings eliminate the need for the solvent cementing of joints. The new standard has been added to Table 702.4, Pipe Fittings.



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Push-fit drainage fittings

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708.1.6

Removable Fixture Traps Serving as Cleanouts

CHANGE TYPE: Addition

CHANGE SUMMARY: Removable traps and removable fixtures with integral traps are acceptable as equivalent to cleanouts.

2021 CODE: **708.1.6 Cleanout equivalent.** A fixture trap or a fixture with integral trap, removable without altering concealed piping, shall be acceptable as a cleanout equivalent.

CHANGE SIGNIFICANCE: Removable traps and removable fixtures with integral traps such as urinals and water closets have long been considered as acceptable access to the drainage system for clearing stoppages. Note that the current code already has a few limitations on these cleanout means: 1) Section 708.1.3 prohibits the removal of water closets to serve as cleanout access to a building sewer. 2) Section 708.1.5 (Exception 1) only allows cleanout access through a removable P-trap for the same or one size larger pipe size.



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Removable trap as cleanout

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717, 718

Methods for Restoring Building Sewer Piping

CHANGE TYPE: Addition

CHANGE SUMMARY: The code recognizes two methods for restoring building sewer and building drain piping.

2021 CODE:

SECTION 717
RELINING BUILDING SEWERS AND BUILDING DRAINS

717.1 General. This section shall govern the relining of existing building sewers and building drainage piping.

717.2 Applicability. The relining of existing building sewers and building drainage piping shall be limited to gravity drainage piping 4 inches (102 mm) in diameter and larger. The relined piping shall be of the same nominal size as the existing piping.

717.3 Pre-installation requirements. Prior to commencement of the relining installation, the existing piping sections to be relined shall be descaled and cleaned. After the cleaning process has occurred and water has been flushed through the system, the piping shall be inspected internally by a recorded video camera survey.

717.3.1 Pre-installation recorded video camera survey. The video survey shall include verification of the project address location. The video shall include notations of the cleanout and fitting locations, and the approximate depth of the existing piping. The video shall also include notations of the length of piping at intervals not greater than 25 feet (7620 mm).

717.4 Permitting. Prior to permit issuance, the code official shall review and evaluate the preinstallation recorded video camera survey to determine if the piping system is able to be relined in accordance with the proposed lining system manufacturer's installation requirements and applicable referenced standards.

717.5 Prohibited applications. Where review of the preinstallation recorded video camera survey reveals that piping systems are not installed correctly or defects exist, relining shall not be permitted. The defective portions of piping shall be exposed and repaired with pipe and fittings in accordance with this code. Defects shall include, but are not limited to, backgrade or insufficient slope, complete pipe wall deterioration or complete separations such as from tree root invasion or improper support.

717.6 Relining materials. The relining materials shall be manufactured in compliance with applicable standards and certified as required in Section 303. Fold-and-form pipe reline materials shall be manufactured in compliance with ASTM F1504 or ASTM F1871.

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717.7 Installation. The installation of relining materials shall be performed in accordance with the manufacturer's installation instructions, applicable referenced standards and this code.

717.7.1 Material data report. The installer shall record the data as required by the relining material manufacture and applicable standards. The recorded data shall include but is not limited to the location of the project, relining material type, amount of product installed and conditions of the installation. A copy of the data report shall be provided to the code official prior to final approval.

717.8 Post-installation recorded video camera survey. The completed relined piping system shall be inspected internally by a recorded video camera survey after the system has been flushed and flow-tested with water. The video survey shall be submitted to the code official prior to finalization of the permit. The video survey shall be reviewed and evaluated to provide verification that no defects exist. Any defects identified shall be repaired and replaced in accordance with this code.

717.9 Certification. A certification shall be provided in writing to the code official, from the permit holder, that the relining materials have been installed in accordance with the manufacturer's installation instructions, the applicable standards and this code.

717.10 Approval. Upon verification of compliance with the requirements of Sections 717.1 through 717.9, the code official shall approve the installation.



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Building sewer restoration

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SECTION 718
REHABILITATION OF BUILDING SEWERS AND BUILDING DRAINS

718.1 Cure-in-place. Sectional cure-in-place rehabilitation of building sewer piping and sewer service lateral piping shall be in accordance with ASTM F2599. Main and lateral cure-in-place rehabilitation of building sewer and sewer service lateral pipe and their connections to the main sewer pipe shall be in accordance with ASTM F2561. Hydrophilic rings or gaskets in cure-in-place rehabilitation of building sewer piping and sewer service laterals shall be in accordance with ASTM F3240 to ensure water tightness and elimination of ground water penetration.

CHANGE SIGNIFICANCE: The methods covered in Sections 717 and 718 are considered as trenchless pipe restoration technologies. Section 717 covers a process referred to as the "fold and form pipe (FFP)" method of pipe restoration. A factory-made extruded thermoplastic folded liner is pulled into a cleaned existing pipe, expanded with air and steam (steam for softening the liner to allow unfolding) and then allowed to cool (using air pressure only) to form a new pipe within the existing pipe.

Section 718 covers a process referred to as the "cured-in-place pipe (CIPP)" method of pipe restoration. A felt tube is inserted into a flexible calibration tube (for ensuring the final cured pipe size.) The felt tube is impregnated in the field with polyester or epoxy resin. The tube assembly is inverted as it is inserted (or pulled) into the cleaned existing pipe so as to place the calibration tube on the inside of the felt liner. The calibration tube is expanded, and various methods are used to cure the resin in the felt liner. The calibration tube is removed after curing is complete.

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903.1.3

Protected Outdoor Vent Termination Method

CHANGE TYPE: Addition

CHANGE SUMMARY: New requirements for protected outdoor roof vent terminals accommodate solar panel and architectural roof feature installations.

2021 CODE: **903.1.3 Protected vent terminal.** Where an open vent pipe terminates above a sloped roof and is covered by either a roof-mounted panel (such as a solar collector or photovoltaic panel mounted over the vent opening) or a roof element (such as an architectural feature or a decorative shroud), the vent pipe shall terminate not less than 2 inches (51 mm) above the roof surface. Such roof elements shall be designed to prevent the adverse effects of snow accumulation and wind on the function of the vent. The placement of a panel over a vent pipe and the design of a roof element covering the vent pipe shall provide for an open area for the vent pipe to the outdoors that is not less than the area of the pipe, as calculated from the inside diameter of the pipe. Such vent terminals shall be protected by a method that prevents birds and rodents from entering or blocking the vent pipe opening.

CHANGE SIGNIFICANCE: There is an increasing trend towards buildings having rooftop-mounted solar panel arrays that is often at odds with the location of plumbing vent terminals on the roof. Also, the architectural community sometimes wishes to obscure vent piping terminations above the roof from view. Although vent piping systems could be designed to cause the vent terminals to be located elsewhere, doing so isn't necessarily cost-effective, especially where work on existing buildings is concerned. This new section provides details for having roof vent terminals covered (protected) by either solar panels or architectural shrouds.



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Architectural shroud

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915.1

Food Waste Disposers on Combination Waste and Vent Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: The prohibition of a food waste disposer discharging to a combination waste and vent system is removed.

2021 CODE: **915.1 Type of fixtures.** A combination waste and vent system shall not serve fixtures other than floor drains, sinks, lavatories and drinking fountains. Combination waste and vent systems shall not receive the discharge from a ~~food waste disposer or~~ clinical sink.

CHANGE SIGNIFICANCE: Laboratory investigations and years of recent field experience have proven that the prohibition on combination waste and vent systems receiving the discharge of food waste disposers is unwarranted. This change will allow for more applications of combination waste and vent systems in kitchen applications.



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Food waste disposer on CWV system

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1002.1

Direct Connection to Hydromechanical Grease Interceptor

CHANGE TYPE: Modification

CHANGE SUMMARY: A one, two or three-compartment pots and pans sink without a trap can be directly connected to a hydromechanical grease interceptor provided that the grease interceptor is in close proximity and connects to a drainage branch that has an emergency floor drain connected immediately downstream of the interceptor.

2021 CODE: **1002.1 Fixture traps.** Each plumbing fixture shall be separately trapped by a liquid-seal trap, except as otherwise permitted by this code. The vertical distance from the fixture outlet to the trap weir shall not exceed 24 inches (610 mm), and the horizontal distance shall not exceed 30 inches (610 mm) measured from the centerline of the fixture outlet to the centerline of the inlet of the trap. The height of a clothes washer standpipe above a trap shall conform to Section 802.3.3. A fixture shall not be double trapped.

Exceptions:

1. and **2.** *(remain unchanged)*

~~**3.** A grease interceptor intended to serve as a fixture trap in accordance with the manufacturer's installation instructions shall be permitted to serve as the trap for a single fixture or a combination sink of not more than three compartments where the vertical distance from the fixture outlet to the inlet of the interceptor does not exceed 30 inches (762 mm) and the developed length of the waste pipe from the most upstream fixture outlet to the inlet of the interceptor does not exceed 60 inches (1524 mm).~~



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Direct connection to hydromechanical interceptor permitted

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~~4.~~ 3. Floor drains in multilevel parking structures that discharge to a building storm sewer shall not be required to be individually trapped. Where floor drains in multilevel parking structures are required to discharge to a combined building sewer system, the floor drains shall not be required to be individually trapped provided that they are connected to a main trap in accordance with Section 1103.1.

4. Where a hydromechanical grease interceptor serves a food utensil, dishes, pots-and-pans sink, in accordance with the manufacturer's installation instructions. The branch drain serving the interceptor shall be provided with an emergency floor drain downstream of the interceptor connection, and the branch shall serve only the emergency floor drain and the interceptor. Where the interceptor serves a combination sink of not more than three compartments where the vertical distance from the fixture outlet to the inlet of the interceptor does not exceed 30 inches (762 mm) and the developed length of the waste pipe from the most upstream fixture outlet to the inlet of the interceptor does not exceed 60 inches (1524 mm). The food utensil, dishes, pots and pans sink shall be required to connect directly with the interceptor.

CHANGE SIGNIFICANCE: Section 802.1.7 requires pots and pans sinks to be indirectly connected to the drainage system to prevent drainage system backups from contaminating the sink wells. An indirect connection allows a fixture to not have a trap (i.e., the fixture falls under the "except as otherwise permitted by this code" of the first sentence of Section 1002.1). Exception 4, in effect, overrides the indirect connection requirement of Section 802.1.7 for pots and pans sinks but also allows that direct connection to not have a trap where a hydromechanical grease interceptor manufacturer's installation instructions indicate that a fixture trap is not required, and the hydromechanical grease interceptor is connected to the drainage system in a specific manner. In other words, the hydromechanical grease interceptor becomes an extension of the waste piping from the pots and pans sink provided that the interceptor is connected to the drainage system in a manner where if the drainage system did back up, the backup would only overflow at the emergency flow drain and not into the pots and pans sink.

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1002.4.1.5

Fixture Drains Serving as a Trap Priming Method

CHANGE TYPE: Addition

CHANGE SUMMARY: Waste from lavatories and hand sinks can be directed to floor drains, trench drains or floor sinks where such floor fixtures require a trap primer.

2021 CODE: **1002.4.1.5 Fixture drain connection for trap priming.** A fixture drain from a lavatory or hand sink shall serve as a method of providing trap seal protection for an emergency floor drain, a trench drain, or a floor sink where such fixtures are located in the same room. A fixture drain from a drinking fountain shall serve as a method of providing trap seal protection for an emergency floor drain, a trench drain, or a floor sink where such fixtures are in the same room or in a room adjacent to the room having the drinking fountain. The fixture drain shall not be routed on or above the surface of the floor and shall connect to the floor drain, trench drain, or floor sink at a point that is below the flood level rim and above the inlet to the trap of the receiving fixture.

CHANGE SIGNIFICANCE: This method is an extension of the concept in Section 1002.4.1.3 where a portion of the waste flow from a lavatory is directed to another fixture requiring its trap seal to be protected from evaporation. This method allows the entire flow to be directed to such traps.



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Fixture drain permitted to serve as trap priming method

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1102.6

Roof Drains to be Tested and Rated for Flow

CHANGE TYPE: Modification

CHANGE SUMMARY: Flow testing and rating of roof drains is required to be in accordance with the referenced standards.

2021 CODE: **1102.6 Roof drains.** Roof drains shall conform to ASME A112.3.1 or ASME A112.6.4. Roof drains, other than siphonic roof drains, shall be tested and rated in accordance with ASME A112.6.4 or ASPE/IAPMO Z1034.

CHANGE SIGNIFICANCE: For the 2021 IPC, Section 1106.2 requires that sizing of the chosen storm drain piping be checked against the published discharge flow rate of the specific roof drain model chosen for the storm drain pipe. Requiring testing and rating of roof drains to standards will result in third party certified flow rate information that the roof drain manufacturers can use for publishing flow rate data.



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Product testing and rating for flow required

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1106.2.1 Rainfall Rate Conversion Method

CHANGE TYPE: Addition

CHANGE SUMMARY: Although the conversion from inches-per-hour of rainfall to gallons per minute (gpm) is not complicated, including the conversion information in the code is helpful.

2021 CODE: **1106.2.1 Rainfall rate conversion method.** The rainfall rate falling on a roof surface shall be converted to a gallon per minute (L/m) flow rate in accordance with Equation 11-1.

$$GPM = R \times A \times 0.0104 \quad \text{(Equation 11-1)}$$

where:

R = Rainfall intensity in inches (mm) per hour.

A = Roof area in square feet (m^2).

CHANGE SIGNIFICANCE: Because the code requires sizing of the storm drainage piping using gallons per minute flow, having an equation to make the conversion of rainfall rate into gallons per minute clarifies the calculation process.



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A new equation converts inches per hour of rainfall to gallons per minute flow rate.

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1202.1

Nonflammable Medical Gas Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: NFPA 99 covers the installation, testing and labels for nonflammable medical gases.

2021 CODE: **1202.1 Nonflammable medical gases.** Nonflammable medical gas systems, inhalation anesthetic systems and vacuum piping systems shall be ~~designed~~ installed, tested and ~~installed~~ labeled in accordance with NFPA 99.

Exceptions:

1. This section shall not apply to portable systems or cylinder storage.
2. Vacuum system exhaust terminations shall comply with the *International Mechanical Code*.

CHANGE SIGNIFICANCE: System designers are responsible for the design of nonflammable medical gas systems, inhalation anesthetic systems and vacuum piping systems. The installation, testing and labels for these systems must be in accordance with the referenced NFPA standard.



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Nonflammable medical gas system installation

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1301.1

Nonpotable Rainwater Standard Alternative

CHANGE TYPE: Modification

CHANGE SUMMARY: Standard CSA B805/ICC 805 is added to the code to serve as an alternative method for providing a nonpotable water source.

2021 CODE: **1301.1 ~~Scope~~ General.** The provisions of Chapter 13 shall govern the materials, design, construction and installation of systems for the collection, storage, treatment and distribution of nonpotable water. For nonpotable rainwater systems, the provisions of CSA B805/ICC 805 shall be an alternative for regulating the materials, design, construction and installation of systems for rainwater collection, storage, treatment and distribution of nonpotable water. The use and application of nonpotable water shall comply with laws, rules and ordinances applicable in the jurisdiction.

CHANGE SIGNIFICANCE: Although Chapter 13 offers good overall coverage for using rainwater as a nonpotable water source, CSA B805/ICC 805, *Rainwater Harvesting Systems*, offers a more comprehensive approach for these systems.



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Rainwater storage system

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SIGNIFICANT CHANGES TO THE

INTERNATIONAL MECHANICAL CODE®

2021 EDITION

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PART 2

International Mechanical Code

Chapters 1 through 15

- **Chapter 1** Scope and Administration
  No changes addressed
- **Chapter 2** Definitions
  No changes addressed
- **Chapter 3** General Regulations
- **Chapter 4** Ventilation
- **Chapter 5** Exhaust Systems
- **Chapter 6** Duct Systems
- **Chapter 7** Combustion Air
  No changes addressed
- **Chapter 8** Chimneys and Vents
- **Chapter 9** Specific Appliances, Fireplaces and Solid Fuel-Burning Equipment
- **Chapter 10** Boilers, Water Heaters and Pressure Vessels
  No changes addressed
- **Chapter 11** Refrigeration
- **Chapter 12** Hydronic Piping
  No changes addressed
- **Chapter 13** Fuel Oil Piping and Storage
  No changes addressed
- **Chapter 14** Solar Thermal Systems
  No changes addressed
- **Chapter 15** Referenced Standards
  No changes addressed

The *International Mechanical Code*® (IMC®) contains provisions for the regulation of mechanical equipment design and installation. The code consists of fifteen chapters and two appendices. Appendix A deals with chimney connector pass-throughs, and Appendix B lists recommended permit fees.

The provisions of Chapter 1 address the scope, application, enforcement and administration of subsequent requirements of the code. Chapter 2 provides definitions for terms used throughout the IMC. Chapter 3 includes the general requirements for listed equipment, appliance location, protection for personnel servicing mechanical equipment, access requirements for appliances in various locations and condensate disposal. Chapter 4 addresses building ventilation. Chapter 5 addresses exhaust systems, including commercial kitchen exhaust systems. Chapter 6 covers all of the duct construction provisions for heating, ventilation and air conditioning systems. Chapter 7 addresses combustion air. Chapter 8 has requirements for vents and chimneys. Chapter 9 includes requirements for specific appliances, fireplaces and solid-fuel equipment. Chapter 10 deals with boilers, water heaters and pressure vessels. Chapter 11 addresses refrigeration systems. Chapter 12 has requirements for hydronic piping. Regulations governing fuel-oil piping and storage are located in Chapter 13. Chapter 14 deals with solar thermal systems. Chapter 15 contains standards, referenced in the 2018 IMC, listed by the promulgating agency of the standard. ■

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307.2.1.1
Condensate Discharge

401.2, 403.1
Mechanical Ventilation for Dwelling Units

401.4, 501.3.1
Intake Opening and Exhaust Outlet Locations

TABLE 403.3.1.1
Recirculation of Mechanical Exhaust Prohibited

403.3.1.3
Demand Controlled Ventilation

403.3.2.1
Outdoor Air for Dwelling Units

502.20
Manicure and Pedicure Station Exhaust System

504.4.1
Termination Location for Dryer Exhaust

506.3.7
Factory-Built Grease Duct Slope

507.1
Smoker Ovens with Integral Exhaust

514.2
Energy Recovery Ventilation Systems

602.2.1.8
Pipe and Duct Insulation Within Plenums

607.5.2
Duct Penetrations of Fire Barriers

607.5.5
Subducts Penetrating Shaft Enclosures

608.1, 403.3.1.5
Ventilation Air Distribution

801.21
Blocked Vent Switch for Oil-Fired Appliances

905.1
Wood-Burning Residential Hydronic Heaters

929
Unvented Alcohol Fuel-Burning Decorative Appliances

1101 THROUGH 1108
Ammonia Refrigeration Systems

1105.9
Machinery Room Means of Egress

1107 THROUGH 1110
Refrigerant Piping

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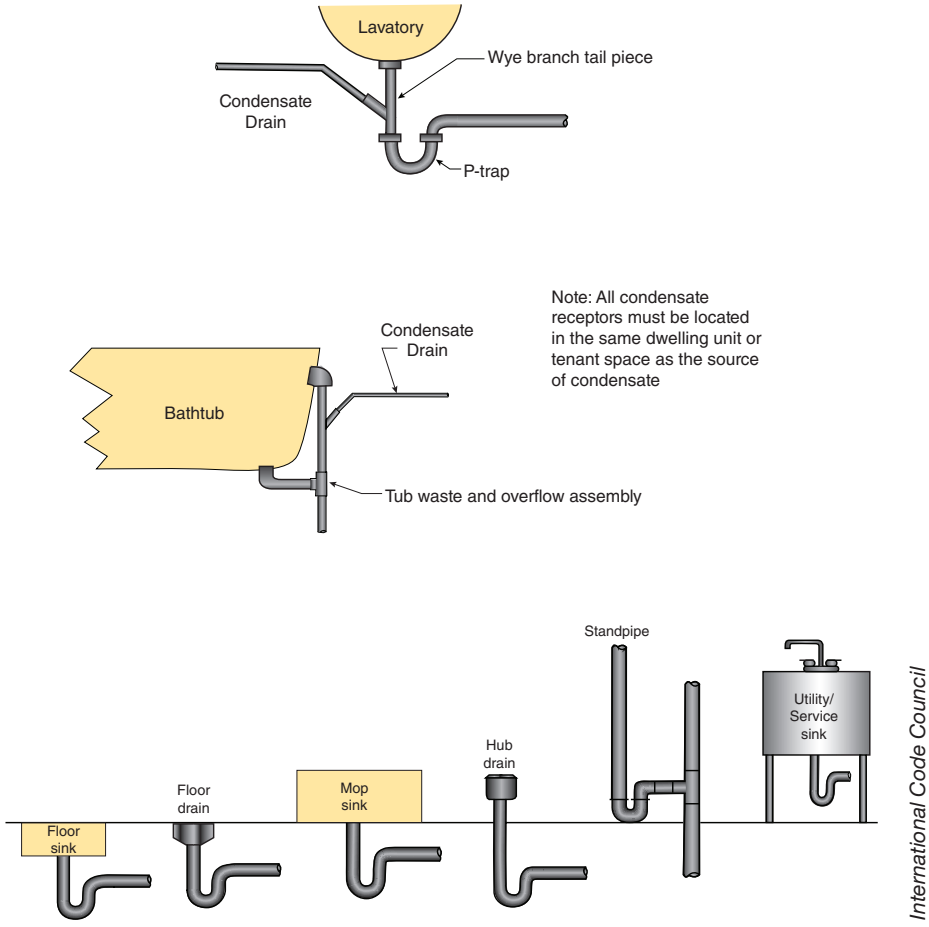
307.2.1.1

Condensate Discharge

CHANGE TYPE: Modification

CHANGE SUMMARY: Significant coverage is added to the code regarding the point of disposal of condensate. Such coverage addresses what has been common practice (acceptable and unacceptable) in most jurisdictions.

2021 CODE: **307.2.1.1 Condensate discharge.** Condensate drains shall not directly connect to any plumbing drain, waste or vent pipe. Condensate drains shall not discharge into a plumbing fixture other than a floor sink, floor drain, trench drain, mop sink, hub drain, standpipe, utility sink or laundry sink. Condensate drain connections to a lavatory wye branch tailpiece or to a bathtub overflow pipe shall not be considered as discharging to a plumbing fixture. Except where discharging to grade outdoors, the point of discharge of condensate drains shall be located within the same occupancy, tenant space or dwelling unit as the source of the condensate.



Allowable receptors for condensate

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CHANGE SIGNIFICANCE: This new section states prohibitions on what are bad practices and also states allowances for what are considered to be acceptable practices for condensate discharge. The code was silent on these practices until now. This text expressly prohibits the connection of condensate drains directly to DWV piping and prohibits condensate from discharging into plumbing fixtures other than those listed. The intent is to prevent insanitary conditions and potential health hazards.

Health hazards are created by drilling holes in plumbing vent piping in attics to connect a condensate drain from HVAC appliances installed in the attic. This is but one example of the hazards this new text intends to prevent. This text also clarifies that connections to lavatory tailpieces and bathtub overflow pipes are acceptable, as this has been a common practice in some localities.

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401.2, 403.1

Mechanical Ventilation for Dwelling Units

CHANGE TYPE: Clarification

CHANGE SUMMARY: This change clarifies where mechanical ventilation is required for dwelling units. The previous reference to the testing required by Section R402.4.1.2 of the *International Energy Conservation Code* (IECC) had caused varying interpretations as to whether the testing applied only to R-2 buildings of 3 stories or less or if it applied to all R-2 buildings. The revised text makes no distinction between R-2 buildings of 3 stories or less and R-2 buildings over 3 stories, thereby eliminating multiple interpretations.

2021 CODE: **401.2 Ventilation required.** Every occupied space shall be ventilated by natural means in accordance with Section 402 or by mechanical means in accordance with Section 403. ~~Where the air infiltration rate in a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2-inch water column (50 Pa) in accordance with Section R402.4.1.2 of the *International Energy Conservation Code*, the dwelling unit shall be ventilated by~~ Dwelling units complying with the air leakage requirements of the *International Energy Conservation Code* or *ASHRAE 90.1* shall be ventilated by mechanical means in accordance with Section 403. Ambulatory care facilities and Group I-2 occupancies shall be ventilated by mechanical means in accordance with Section 407.

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return or exhaust air except that mechanical ventilation air requirements for Group R-2, R-3 and R-4 occupancies ~~three stories and less in height above grade plane~~ shall be provided by an exhaust system, supply system or combination thereof. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey ventilation air shall be designed and installed in accordance with Chapter 6.



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Group R-2 apartment building

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CHANGE SIGNIFICANCE: The requirement for mechanical ventilation in R-2 dwelling units is no longer tied to a residential blower door testing requirement. This eliminates the distinction between commercial and residential R-2 buildings as defined in the IECC. The IMC does not regulate one- and two-family dwellings and townhouses, but does regulate R-2 multiple-family buildings, and the intent of this code section is now evident regarding R-2 buildings, that is, dwelling units under the scope of the IMC must be mechanically ventilated if such units comply with the air leakage requirements of the applicable energy code. In other words, if the building is constructed to significantly limit air leakage through the thermal envelope, then the building will have few air changes per hour and mechanical ventilation will be necessary to provide a healthy environment in the dwelling units. Section 403.1 was revised for consistency, as the number of stories above grade is no longer relevant.

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401.4, 501.3.1

Intake Opening and Exhaust Outlet Locations

CHANGE TYPE: Modification

CHANGE SUMMARY: A new type of factory-built combination exhaust and intake air fitting is introduced that does not require separation between the two openings.

2021 CODE: **401.4 Intake opening location.** Air intake openings shall comply with all of the following:

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air intake openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such locations. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening. Separation is not required between intake air openings and living space exhaust air openings of an individual dwelling unit or sleeping unit where an approved factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the manufacturer's instructions.
4. [No change to text]

501.3.1 Location of exhaust outlets. The termination point of exhaust outlets and ducts discharging to the outdoors shall be located with the following minimum distances:

1. For ducts conveying explosive or flammable vapors, fumes or dusts: 30 feet (9144 mm) from property lines; 10 feet (3048 mm) from operable openings into buildings; 6 feet (1829 mm) from exterior walls and roofs; 30 feet (9144 mm) from combustible walls and operable openings into buildings that are in the direction of the exhaust discharge; 10 feet (3048 mm) above adjoining grade.
2. For other product-conveying outlets: 10 feet (3048 mm) from the property lines; 3 feet (914 mm) from exterior walls and roofs; 10 feet (3048 mm) from operable openings into buildings; 10 feet (3048 mm) above adjoining grade.
3. For all environmental air exhaust: 3 feet (914 mm) from property lines; 3 feet (914 mm) from operable openings into buildings for all occupancies other than Group U; and 10 feet (3048 mm) from mechanical air intakes. Such exhaust shall not be considered hazardous or noxious. Separation is not required between intake air

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openings and living space exhaust air openings of an individual dwelling unit or sleeping unit where an approved factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the manufacturer's instructions.

4. Exhaust outlets serving structures in flood hazard areas shall be installed at or above the elevation required by Section 1612 of the *International Building Code* for utilities and attendant equipment.
5. For specific systems, see the following sections:
   - **5.1.** Clothes dryer exhaust, Section 504.4.
   - **5.2.** Kitchen hoods and other kitchen exhaust equipment, Sections 506.3.13, 506.4 and 506.5.
   - **5.3.** Dust, stock and refuse conveying systems, Section 511.2.
   - **5.4.** Subslab soil exhaust systems, Section 512.4.
   - **5.5.** Smoke control systems, Section 513.10.3.
   - **5.6.** Refrigerant discharge, Section 1105.7.
   - **5.7.** Machinery room discharge, Section 1105.6.1.

CHANGE SIGNIFICANCE: It is often difficult to maintain the code-prescribed clearances between exhaust openings and air intake openings for reasons such as window placements, proximity to neighboring buildings and dwelling units and lack of sufficient exterior wall area for locating intakes and outlets. The recognition of special factory-built and engineered dual-purpose fittings can solve many clearance problems in new construction and in existing construction where exhaust fans, air intake openings or energy recovery ventilator equipment is being installed. Such fittings are not intended to be "home-made" shop- or field-constructed fittings, rather they are intended to be engineered designs that are factory-built. The code official has approval discretion for such fittings. Such fittings are designed to severely limit the amount of exhaust air that can be entrained in the intake airflow. Also, combination termination fittings allow a single exterior wall penetration as opposed to two separate exhaust and intake penetrations. There are benefits to reducing wall penetrations including less labor, less envelope air infiltration, less potential for moisture penetration and improved aesthetics.



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Combination exhaust and intake air fitting

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Table 403.3.1.1

Recirculation of Mechanical Exhaust Prohibited

CHANGE TYPE: Clarification

CHANGE SUMMARY: Note g of Table 403.3.1.1 was rewritten to lessen the negative impact of recirculated exhaust air from spaces such as bath and toilet rooms, shower rooms, locker rooms and certain classrooms, shops and labs.

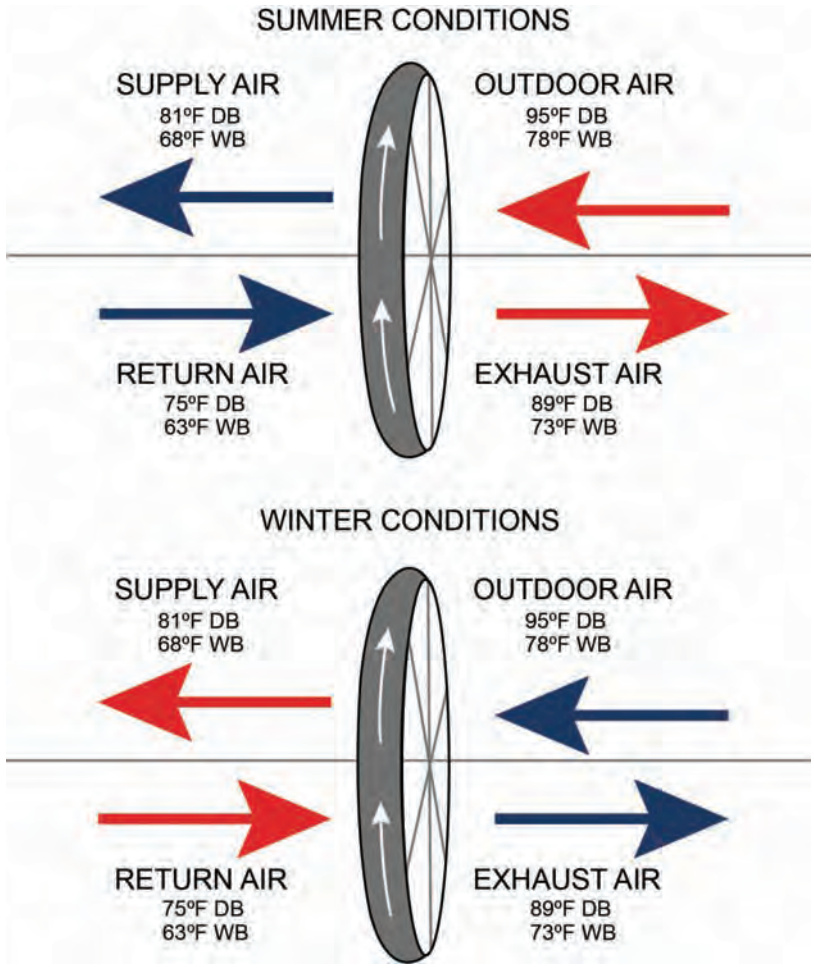
2021 CODE:

Table 403.3.1.1
Minimum Ventilation Rates
[No changes to table addressed]

[No changes to notes a through f]

g. Mechanical exhaust is required and recirculation from such spaces is ~~prohibited except that recirculation shall be permitted where the resulting supply airstream consists of not more than 10 percent air recirculated from these spaces.~~ prohibited. For occupancies other than science laboratories, where there is a wheel-type energy recovery ventilation (ERV) unit in the exhaust system design, the volume of air leaked from the exhaust airstream into the outdoor airstream within the ERV shall be less than 10 percent of the outdoor air volume. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Items 2 and 4).

[No change to note h]



Wheel-type energy recovery ventilation (ERV)

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CHANGE SIGNIFICANCE: The previous text of note g would have allowed 10 percent of the entire HVAC supply airflow to any space to be air that was taken from rooms designated by note g in Table 403.3.1.1. The intent of note g was to prevent air from those designated spaces from being circulated to other spaces, except for the small volume of air that leaks across the heat exchanger (cross-leakage) in an energy recovery ventilation (ERV) unit. The revised text clarifies the original intent, which was to allow only a small amount of air to leak from the exhaust airstream of a wheel type ERV into the outdoor airstream of that ERV. The intent of this section is now consistent with ASHRAE 62.1, which is the basis for Table 403.3.1.1.

Wheel type ERVs have a circular heat exchanger that rotates between two airstreams and some cross-leakage and carry-over from one airstream to the other is unavoidable. Sensible heat energy and moisture can be exchanged in an ERV in either direction between an exhaust air duct and an outdoor makeup air duct. Typically, ERVs handle only the outdoor air portion of the total supply air to a space.

Note that the new text intends to prohibit all cross-leakage in ERVs that serve science laboratories if the supply air is to be circulated to some other space. The phrase that begins the second sentence, "For occupancies other than science laboratories," means that the acceptability of limited cross-leakage for ERVs is not acceptable for ERVs that serve science labs. Although the text could be misread to mean that the limit on ERV cross-leakage does not apply to science lab occupancies, the actual intent is that zero cross-leakage is allowed and no amount of air from a science lab is allowed to be circulated to other spaces. This, of course, means that science labs could not be served by wheel-type ERVs if the supply air from the ERV is circulated to any space other than a science lab. Note the last sentence of Note g that clarifies that there is no restriction on recirculation of air from an air handler or an ERV if none of that air leaves the space served by the air handler or ERV.

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403.3.1.3

Demand Controlled Ventilation

CHANGE TYPE: Modification

CHANGE SUMMARY: The change clarifies that demand control ventilation schemes cannot eliminate all ventilation in a space while that space is expected to be occupied.

2021 CODE: **403.3.1.3 System operation.** The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3.1.1 and the actual number of occupants present. Where demand-controlled ventilation is employed to adjust the outdoor airflow rate based on the actual number of occupants present, the minimum quantity of outdoor air shall not fall below that determined from the area outdoor airflow rate column of Table 403.3.1.1 during periods when the building is expected to be occupied.

CHANGE SIGNIFICANCE: Section 403.3.1.3 allows for demand control ventilation, which means that the ventilation rate can be adjusted up or down as the number of occupants in a space increases or decreases. The section might be misinterpreted that the ventilation rate could reduce to zero if the number of occupants was zero. However, it was never intended that the outdoor airflow rate per square foot (R_a) prescribed by Table 403.3.1.1 could be overlooked when the occupant load in a space is zero. When the occupant load is zero, the minimum required ventilation rate is determined by the rate per square foot of floor area (R_a) in the next to last column of Table 403.3.1.1 times the net occupiable floor area of the space. Assuming the table has a prescribed airflow rate based on floor area (R_a) for the space in question in the table, there will always be some ventilation being provided, even when the space has no occupants.

Demand controlled ventilation example

1000 ft^2 high school science classroom/laboratory

Per Table 403.3.1.1, the rate per person (R_p) is 10 cfm;

The rate per square foot (R_a) is 0.18 cfm.

Based on the occupant density from the table, 25

Per 1000 ft^2, the total outdoor air flow rate for occupants would be 250 cfm.

The total outdoor air flow rate based on area would be 180 cfm.

When the science lab has fewer occupants or is unoccupied, the demand controlled ventilation of 250 cfm based on persons could be reduced, perhaps to zero; however, the 180 cfm rate based on area must not be reduced during periods when the building is expected to be occupied. during period when the building is closed to occupants, the minimum ventilation required by this new provision is not applicable.

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403.3.2.1 Outdoor Air for Dwelling Units

CHANGE TYPE: Modification

CHANGE SUMMARY: Because of the superior performance of balanced ventilation systems (see new definition), the code will grant a reduction in the ventilation rate, recognizing the higher efficiency of balanced ventilation systems.

2021 CODE: **403.3.2.1 Outdoor air for dwelling units.** An outdoor air ventilation system consisting of a mechanical exhaust system, supply system or combination thereof shall be installed for each dwelling unit. Local exhaust or supply systems, including outdoor air ducts connected to the return side of an air handler, are permitted to serve as such a system. The outdoor air ventilation system shall be designed to provide the required rate of outdoor air continuously during the period that the building is occupied. The minimum continuous outdoor airflow rate shall be determined in accordance with Equation 4-9.

$$Q_{OA} = 0.01A_{floor} + 7.5(N_{br} + 1) \quad \text{(Equation 4-9)}$$

where:

Q_{OA} = outdoor airflow rate, cfm

A_{floor} = floor area, ft^2

N_{br} = number of bedrooms; not to be less than one

Example calculation of ventilation rate and 30% reduction credit

Example: 1500 sq. foot, 3 bedroom home

$Q = 0.01A_{floor} = 705(N_{br} + 1)$.

Outdoor air cfm = $(0.01 \times 1500) = [7.5 \times (3 + 1)]$

O.A. cfm = 15 + 30 = 45

Balanced ventilation system means:

45 cfm O.A. supply with 45 cfm exhaust or

45 cfm O.A. supply with 40.5 to 49.5 cfm exhaust

(see definitions of "balanced ventilation")

New exception 2 allows a 30% reduction for systems:

1. That are balanced and
2. That supply outdoor air through ducts to each bedroom and at least one of the following rooms: living room, dining room, kitchen

Balanced ventilation system O.A. cfm = 45

$45 \times 0.3 = 13.5$ cfm

$45 - 13.5 = 31.5$ cfm

Or

$45 \times 0.7 = 31.5$ cfm

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Exceptions:

1. The outdoor air ventilation system is not required to operate continuously where the system has controls that enable operation for not less than 1 hour of each 4-hour period. The average outdoor airflow rate over the 4-hour period shall be not less than that prescribed by Equation 4-9.
2. The minimum mechanical ventilation rate determined in accordance with Equation 4-9 shall be reduced by 30 percent provided that both of the following apply:
   - 2.1. A ducted system supplies ventilation air directly to each bedroom and to one or more of the following rooms:
     - 2.1.1. Living room
     - 2.1.2. Dining room
     - 2.1.3. Kitchen
   - 2.2. The whole-house ventilation system is a balanced system.

SECTION 202
GENERAL DEFINITIONS

BALANCED VENTILATION. Any combination of concurrently operating mechanical exhaust and mechanical supply whereby the total mechanical exhaust airflow rate is within 10 percent of the total mechanical supply airflow rate.

CHANGE SIGNIFICANCE: The code will now give credit to dwelling unit ventilation systems that provide better distribution of outdoor air and provide for the mixing of indoor and outdoor air for better dilution of contaminants. The ventilation rate determined by equation 4-9 can be reduced by 30 percent where the ventilation system is balanced and outdoor air is ducted to each bedroom and also to the choice of the living room, dining room or kitchen. Balanced ventilation systems consist of both exhaust and supply systems that simultaneously operate to ensure the required through-flow of ventilation air in the dwelling. As defined, balanced systems have exhaust and supply rates that are nearly equal (i.e. the exhaust flow rate must be not more than 10 percent greater or less than the supply airflow rate) For example, if the supply airflow rate is 100 cfm, the exhaust airflow rate must be a maximum of 110 cfm and a minimum of 90 cfm. The intent is to ensure the required through-flow in the dwelling and to prevent positive and negative pressures with respect to the outdoors. Balanced systems can be more complex than supply-only and exhaust-only systems, but their performance is superior, hence, the 30 percent reduction credit. Commonly, energy recovery ventilators (ERVs) are utilized to supply balanced ventilation, as ERVs simultaneously supply and exhaust air and also employ a heat exchanger to precondition the incoming supply air, substantially reducing the energy penalty associated with ventilation.

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502.20

Manicure and Pedicure Station Exhaust System

CHANGE TYPE: Modification

CHANGE SUMMARY: The code now requires the continuous operation of nail salon exhaust systems during business hours.

2021 CODE: **502.20 Manicure and pedicure stations.** Manicure and pedicure stations shall be provided with an exhaust system in accordance with Table 403.3.1.1, Note h. Manicure tables and pedicure stations not provided with factory-installed exhaust inlets shall be provided with exhaust inlets located not more than 12 inches (305 mm) horizontally and vertically from the point of chemical application.

502.20.1 Operation. The exhaust system for manicure and pedicure stations shall have controls that operate the system continuously when the space is occupied.



Photo courtesy of SalonSafe LLC

Manicure and pedicure station exhaust system



Photo courtesy of SalonSafe LLC

Manicure and pedicure stations

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CHANGE SIGNIFICANCE: It has been observed that the required exhaust systems in nail salons are often not operated as intended, for reasons including fan noise, saving energy and neglecting to turn on the system. Unhealthy levels of contaminants can result in the space if the required exhaust system (source capture system) is not operating when customers are being served. The new code section will require the exhaust system to operate continuously while the space is occupied, which presumably means during the hours the salon is open for business.

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504.4.1

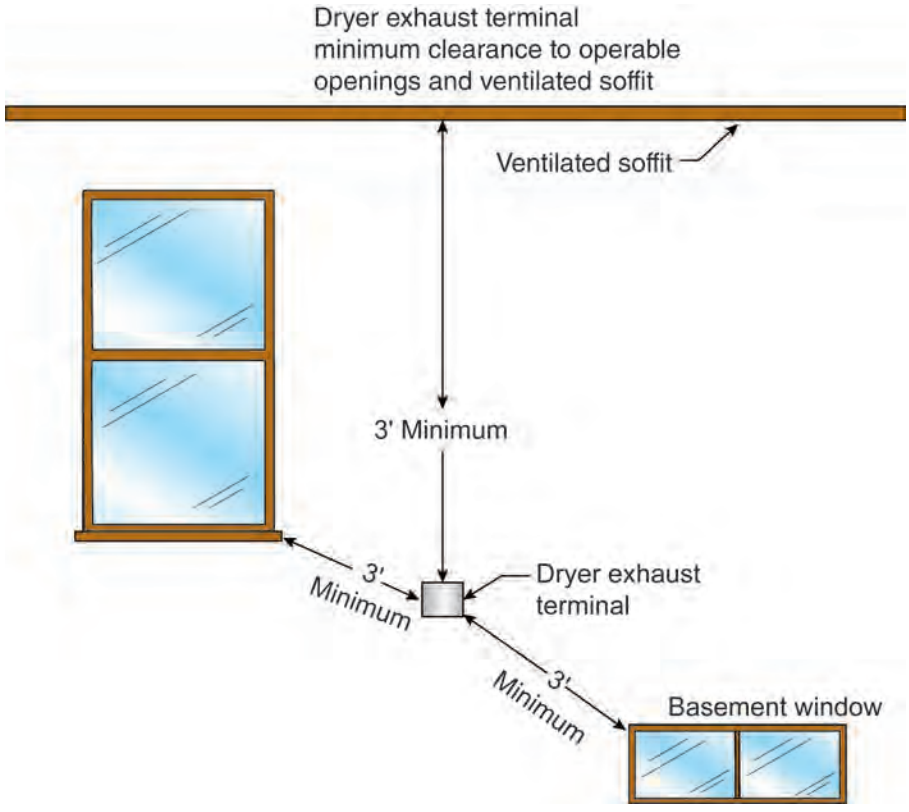
Termination Location for Dryer Exhaust

CHANGE TYPE: Modification

CHANGE SUMMARY: New text was added to address the possibility of dryer exhaust air being reintroduced into a building interior.

2021 CODE: **504.4.1 Termination location.** Exhaust duct terminations shall be in accordance with the dryer manufacturer's installation instructions. Where the manufacturer's instructions do not specify a termination location, the exhaust duct shall terminate not less than 3 feet (914 mm) in any direction from openings into buildings including openings in ventilated soffits.

CHANGE SIGNIFICANCE: Previously, the code did not address the required separation between building openings and clothes dryer exhaust terminations. The appliance installation instructions may or may not specify such separation distances. This new section defers to the appliance installation instructions, and if the instructions are silent on the matter, a 3-foot minimum separation distance is specified. Building openings include doors, windows, ventilation and makeup air intake louvers and ventilated soffit intake openings.



Dryer exhaust terminal minimum clearance to operable openings and soffit vents

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506.3.7

Factory-Built Grease Duct Slope

CHANGE TYPE: Modification

CHANGE SUMMARY: The new exception exempts factory-built grease ducts from the duct slope prescriptions of the code, relying instead on the slope requirements stated in the product listing and manufacturer's installation instructions.

2021 CODE: **506.3.7 Prevention of grease accumulation in grease ducts.** Duct systems serving a Type I hood shall be constructed and installed so that grease cannot collect in any portion thereof, and the system shall slope not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) toward the hood or toward a grease reservoir designed and installed in accordance with Section 506.3.7.1. Where horizontal ducts exceed 75 feet (22 860 mm) in length, the slope shall be not less than one unit vertical in 12 units horizontal (8.3-percent slope).

> **Exception:** Factory-built grease ducts shall be installed at a slope that is in accordance with the listing and manufacturer's installation instructions.



International Code Council

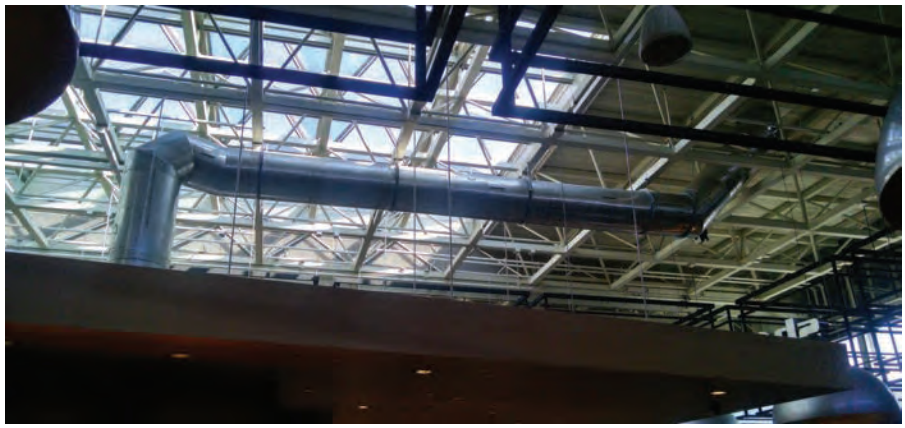
Grease duct

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CHANGE SIGNIFICANCE: Factory-built grease ducts are tested to UL 1978. and the required minimum slope is determined by testing. Unlike rectangular and square grease ducts, factory-built grease ducts are round and the invert of such horizontal ducts is a curved channel with a much smaller surface area over which grease would flow. It is logical for round ducts to have less slope than flat bottom horizontal ducts. Having less slope will ease installation restraints for long horizontal duct runs.



International Code Council

Grease duct

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507.1

Smoker Ovens with Integral Exhaust

CHANGE TYPE: Modification

CHANGE SUMMARY: The new exception exempts smoker ovens from the requirement for a Type I hood where such ovens have an integral exhaust system and are listed for installation without a Type I hood.

2021 CODE: **507.1 General.** Commercial kitchen exhaust hoods shall comply with the requirements of this section. Hoods shall be Type I or II and shall be designed to capture and confine cooking vapors and residues. A Type I or Type II hood shall be installed at or above appliances in accordance with Sections 507.2 and 507.3. Where any cooking appliance under a single hood requires a Type I hood, a Type I hood shall be installed. Where a Type II hood is required, a Type I or Type II hood shall be installed. Where a Type I hood is installed, the installation of the entire system, including the hood, ducts, exhaust equipment and makeup air system shall comply with the requirements of Sections 506, 507, 508 and 509.



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Smoker oven with integral exhaust

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Exceptions:

1. Factory-built commercial exhaust hoods that are listed and labeled in accordance with UL 710, and installed in accordance with Section 304.1, shall not be required to comply with Sections 507.1.5, 507.2.3, 507.2.5, 507.2.8, 507.3.1, 507.3.3, 507.4 and 507.5.
2. Factory-built commercial cooking recirculating systems that are listed and labeled in accordance with UL 710B, and installed in accordance with Section 304.1, shall not be required to comply with Sections 507.1.5, 507.2.3, 507.2.5, 507.2.8, 507.3.1, 507.3.3, 507.4 and 507.5. Spaces in which such systems are located shall be considered to be kitchens and shall be ventilated in accordance with Table 403.3.1.1. For the purpose of determining the floor area required to be ventilated, each individual appliance shall be considered as occupying not less than 100 square feet (9.3 m^2).
3. Where cooking appliances are equipped with integral downdraft exhaust systems and such appliances and exhaust systems are listed and labeled for the application in accordance with NFPA 96, a hood shall not be required at or above them.



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Smoker oven with integral exhaust

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4. Smoker ovens with integral exhaust systems, provided that the appliance is installed in accordance with the manufacturer's installation instructions, is listed and tested for the application and complies with Chapter 5.

CHANGE SIGNIFICANCE: Cooking appliances that burn solid fuel with an open flame occurring at any time are defined as extra-heavy-duty appliances and Section 507.2 requires a Type I exhaust hood for such appliances. The new exception allows smoker ovens to be exhausted by means of an integral exhaust system that discharges to a factory-built chimney or duct system in accordance with the listing of the appliance. Note that some appliances offer alternatives to a Type I hood, but others specify that a Type I hood must be used over the appliance. This new Exception 4 is specific to smoker ovens that have integral (built-in) exhaust systems that vent the cooking effluent to the outdoors, that assist with draft or that evacuate smoke from the appliance interior before the doors are opened. The appliances that fall under the new exception must be listed and labeled as suitable for venting by means other than a Type I hood.

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514.2

Energy Recovery Ventilation Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: The prohibition of some types of energy recovery ventilation (EVR) equipment for use with Type II kitchen exhaust hoods has been lifted.

2021 CODE: **514.2 Prohibited applications.** Energy recovery ventilation systems shall not be used in the following systems:

1. Hazardous exhaust systems covered in Section 510.
2. Dust, stock and refuse systems that convey explosive or flammable vapors, fumes or dust.
3. Smoke control systems covered in Section 513.
4. Commercial kitchen exhaust systems serving Type I ~~or Type II~~ hoods.
5. Clothes dryer exhaust systems covered in Section 504.

Exception: The application of ERV equipment that recovers sensible heat only utilizing coil-type heat exchangers shall not be limited by this section.

CHANGE SIGNIFICANCE: Commercial kitchen exhaust systems are a rich source of energy that could be captured and put to good use rather than wasted to the atmosphere. The concern for the use of ERVs with kitchen exhaust is that the exhaust could foul the ERV heat exchanger and could increase the risk of grease fires. The reference to Type II hoods in Item 4 was deleted; therefore, the sensible and latent heat in the exhaust from Type II hoods serving dishwashers and appliances that do not



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Commercial kitchen ovens

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produce grease or smoke can now be recovered by any appropriate type of ERV (i.e. not limited to just simple coil-type sensible heat exchangers). The exhaust effluent from Type II hoods consists of waste heat and water vapor and is not expected to be harmful to ERV equipment. Conversely, the exhaust effluent from Type I hoods typically bears grease, smoke, creosote, particulate matter and other cooking byproducts that would be detrimental to ERV equipment and that could create a fuel load for potential fires.



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Commercial kitchen ovens

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CHANGE TYPE: Modification

CHANGE SUMMARY: The revision addresses the practice of using pipe insulation materials to protect piping that does not meet the required fire performance requirements.

602.2.1.8

Pipe and Duct Insulation Within Plenums

2021 CODE: **602.2.1.8 Pipe and duct insulation within plenums.** Pipe and duct insulation contained within plenums, including insulation adhesives, shall have a flame spread index of not more than 25 and a smoke developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723, using the specimen preparation and mounting procedures of ASTM E2231. Pipe and duct insulation shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C). Pipe and duct insulation shall be listed and labeled. Pipe and duct insulation shall not be used to reduce the maximum flame spread and smoke-developed indices except where the pipe or duct and its related insulation, coatings and adhesives are tested as a composite assembly in accordance with Section 602.2.1.7.



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Pipe insulation

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CHANGE SIGNIFICANCE: It is common for plastic piping to be installed in plenum spaces, such as above-ceiling return air plenums. Section 602.2.1 requires that materials installed within plenums be noncombustible or have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723. Some plastic piping materials cannot meet the requirements of Section 602.2.1; therefore, if they are installed within a plenum, they must be protected by some material that does meet the fire performance requirements and that is listed for that application. Section 602.2.1 allows combustible piping to be "fully enclosed within materials listed and labeled for installation within a plenum and listed for the application." The revised code text states that if pipe insulation is used as the enclosing material, the entire assembly of the pipe, the insulation and any coverings and adhesives must be tested as a composite assembly. Although there are insulation materials available that meet the fire performance requirements themselves, it is an unknown how the entire assembly will perform unless the entire assembly is tested. Without being tested as a composite assembly, it is possible that the protected piping could break down and degrade when exposed to heat, despite being protected by a pipe insulation material.



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Duct insulation

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607.5.2

Duct Penetrations of Fire Barriers

CHANGE TYPE: Modification

CHANGE SUMMARY: The revision describes how flexible air connectors can be installed in a duct system that is otherwise required to be constructed entirely of sheet steel.

2021 CODE: **607.5.2 Fire barriers.** Ducts and air transfer openings that penetrate fire barriers shall be protected with listed fire dampers installed in accordance with their listing. Ducts and air transfer openings shall not penetrate enclosures for interior exit stairways and ramps and exit passageways except as permitted by Sections 1023.5 and 1024.6, respectively, of the *International Building Code*.

Exception: Fire dampers are not required at penetrations of fire barriers where any of the following apply:

1. Penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.
2. Ducts are used as part of an approved smoke control system in accordance with Section 513 and where the fire damper would interfere with the operation of the smoke control system.
3. Such walls are penetrated by fully ducted HVAC systems, have a required fire-resistance rating of 1 hour or less, are in areas of other than Group H and are in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 of the *International Building Code*. For the purposes of this exception, a fully ducted HVAC system shall be a duct system for the structure's HVAC system. Such a duct system shall be constructed of sheet steel not less than 26 gage [0.0217 inch (0.55 mm)] thickness and shall be continuous from the air-handling appliance or equipment to the air outlet and inlet terminals. Flexible air connectors shall be permitted in a fully ducted system, limited to the following installations.
   - **3.1.** Nonmetallic flexible connections that connect a duct to an air handling unit or equipment located within a mechanical room in accordance with Section 603.9.
   - **3.2.** Nonmetallic flexible air connectors in accordance with Section 603.6.2 that connect an overhead metal duct to a ceiling diffuser where the metal duct and ceiling diffuser are located within the same room.

CHANGE SIGNIFICANCE: Exception 3 allows fire barrier walls to be penetrated by ducts without fire damper protection under the conditions stated in the exception. One of the conditions is that the HVAC system must be a fully ducted system constructed entirely of 26 gage or heavier sheet steel from the air handlers to all outlet and inlet terminals. This condition precludes the use of flexible duct and flexible air connectors as they are not constructed of sheet steel and are typically of nonmetallic construction.

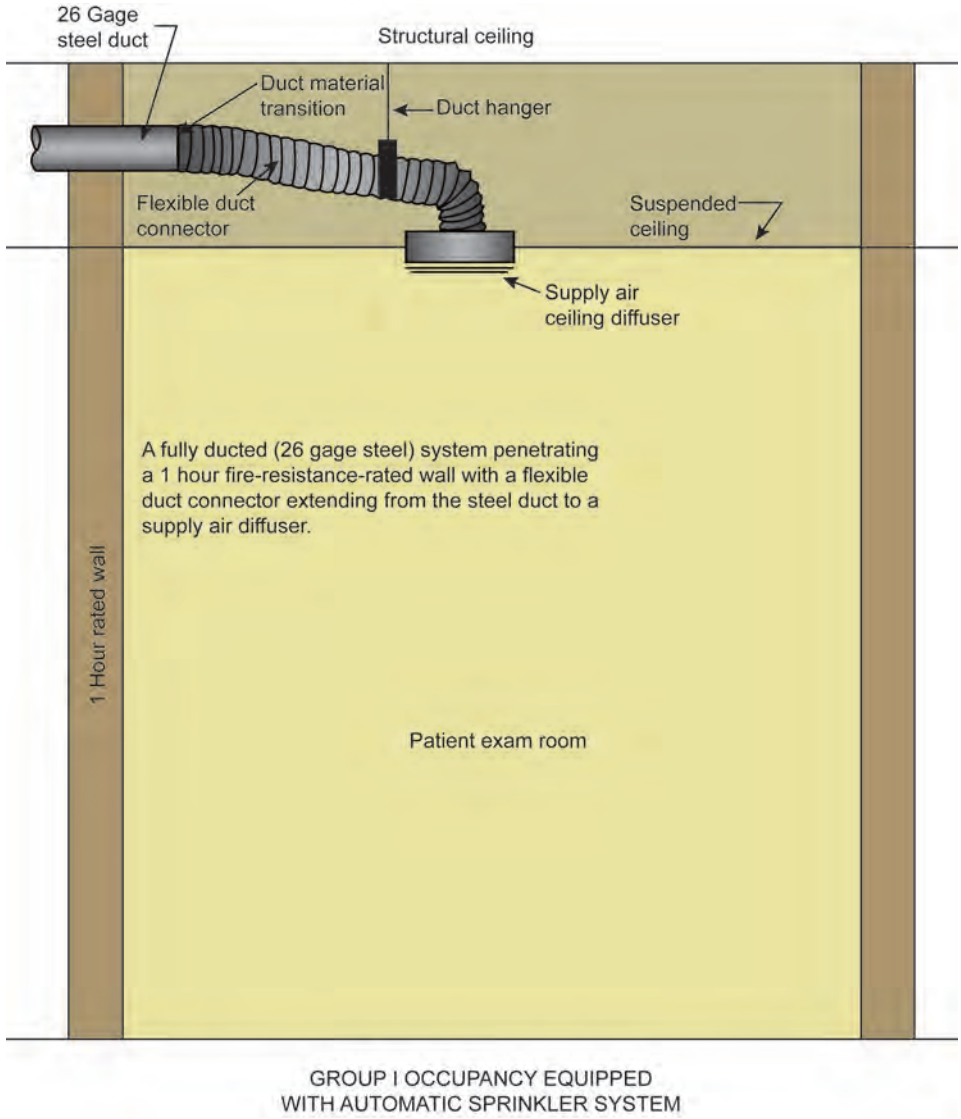
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The new text states the conditions under which flexible air connectors (defined in the IMC) can be installed in a fully ducted HVAC system. Flexible air connectors are limited to 14 feet in length and are intended for connecting metal ducts to ceiling air terminals for both supply and return air. Such connectors are practically a necessity because the exact location of ceiling air terminals in a suspended ceiling grid is an unknown at the time when the steel ducts are installed above the ceiling. Item 3.2 of Exception 3 sets three conditions that must be met for the allowance of flexible air connectors in a fully ducted HVAC system.

1. The flexible air connectors are subject to Sections 603.6.2 through 603.6.2.2 which require listing and labeling to UL 181; limit the length to 14 feet and prohibit the connectors from passing through any wall, floor or ceiling.
2. The flexible air connectors are installed only above the ceiling to connect metal ducts to ceiling diffusers.
3. The metal duct, the ceiling diffuser and the flexible air connector are all located in the same room.



Duct penetration of fire barrier

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The logic behind this allowance is that if a metal duct is allowed to serve an intake or supply opening in a room, there is no consequence in having a section of flexible air connector between that metal duct and that opening in the ceiling. With or without the flexible air connector, the metal duct is still connected to an opening in the ceiling; therefore, the presence of a flexible component changes nothing.

For example, consider a 26-gage sheet steel duct that passes through a fire barrier without a fire damper and terminates at a ceiling register three feet inside a room. The intent of Section 607.5.2, Exception 3 has been met because the wall penetration is made by a sheet steel duct. Installing a flexible air connector to allow that same ceiling register to be relocated elsewhere in that same room has no effect on the integrity of the fully ducted HVAC system.

Note that Item 3.1 of Exception 3 does not appear to be related to flexible air connectors, but rather, appears to be referring to the flexible material vibration isolators commonly used to connect ductwork to air handlers. Flexible air connectors were not intended for such applications.

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607.5.5

Subducts Penetrating Shaft Enclosures

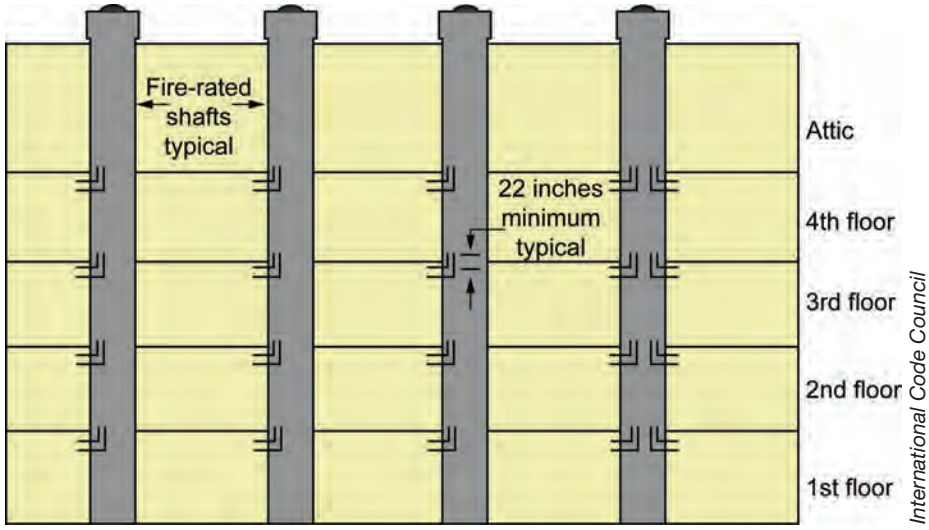
CHANGE TYPE: Modification

CHANGE SUMMARY: The revision makes Exception 1 consistent with Exception 2 because the requirements for a subduct option for fire dampers should be the same for the subduct option for smoke dampers.

2021 CODE: **607.5.5 Shaft enclosures.** Shaft enclosures that are permitted to be penetrated by ducts and air transfer openings shall be protected with listed fire and smoke dampers installed in accordance with their listing.

Exceptions:

1. Fire dampers are not required at penetrations of shafts where any of the following apply:
   - **1.1.** Steel exhaust subducts having a wall thickness of not less than 0.0187 inch (0.4712 mm) extend not less than 22 inches (559 mm) vertically in exhaust shafts and an exhaust fan is installed at the upper terminus of the shaft that is powered continuously, in accordance with Section 909.11 of the *International Building Code*, so as to maintain a continuous airflow upward to the outdoors. ~~provided that there is a continuous airflow upward to the outdoors.~~
   - **1.2.** Penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.
   - **1.3.** Ducts are used as part of an approved smoke control system in accordance with Section 909 of the *International Building Code*, and where the fire damper will interfere with the operation of the smoke control system.
   - **1.4.** The penetrations are in parking garage exhaust or supply shafts that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.



Subducts penetrating shaft enclosures

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2. In Group B and R occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 of the *International Building Code*, smoke dampers are not required at penetrations of shafts where kitchen, clothes dryer, bathroom and toilet room exhaust openings with steel exhaust subducts, having a ~~minimum~~ wall thickness of not less than 0.0187 inch (0.4712 mm) ~~(No. 26 gage),~~ extend not less than 22 inches (559 mm) vertically and the exhaust fan at the upper terminus is powered continuously in accordance with the provisions of Section 909.11 of the *International Building Code*, and maintains airflow upward to the outdoors.
3. Smoke dampers are not required at penetrations of exhaust or supply shafts in parking garages that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.
4. Smoke dampers are not required at penetrations of shafts where ducts are used as part of an approved mechanical smoke control system designed in accordance with Section 909 of the *International Building Code* and where the smoke damper will interfere with the operation of the smoke control system.
5. Fire dampers and combination fire/smoke dampers are not required in kitchen and clothes dryer exhaust systems where dampers are prohibited by this code.

CHANGE SIGNIFICANCE: Exception 1 provides an option for subducts instead of fire dampers; however, the requirements for the subduct option were incomplete compared to the same option for smoke dampers in Exception 2. Namely, Exception 1 did not state a minimum wall thickness for the subduct steel, it did not refer to a continuously operating exhaust fan at the shaft terminus as the means for creating the upward airflow in the shaft, and it did not require the exhaust fan to be provided with standby power. Exception 1 lacked some of the important requirements for subducts that were in Exception 2, even though the subduct options for fire dampers and smoke dampers both rely on the exact same principles. This revision corrects an oversight in the code.

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608.1, 403.3.1.5

Ventilation Air Distribution

CHANGE TYPE: Modification

CHANGE SUMMARY: This revision relocates text that requires verification of the required ventilation airflow rates by means of balancing the system and adds a requirement for airflow adjustment means for air distribution and exhaust systems, in addition to the previous requirement for ventilation air systems.

2021 CODE: ~~**403.3.1.5 Balancing.** The ventilation air distribution system shall be provided with means to adjust the system to achieve not less than the minimum ventilation airflow rate as required by Sections 403.3 and 403.3.1.2. Ventilation systems shall be balanced by an approved method. Such balancing shall verify that the ventilation system is capable of supplying and exhausting the airflow rates required by Sections 403.3 and 403.3.1.2.~~

608.1 Balancing. Air distribution, ventilation and exhaust systems shall be provided with means to adjust the system to achieve the design airflow rates and shall be balanced by an approved method. Ventilation air distribution shall be balanced by an approved method and such balancing shall verify that the air distribution system is capable of supplying and exhausting the airflow rates required by Chapter 4.

CHANGE SIGNIFICANCE: Chapter 6 is the more logical place for balancing requirements. The requirement for an adjustment means should have been broadly applicable to all air conveyance systems, not just ventilation air systems. However, the code was silent on balancing for systems other than ventilation air systems. The new section will now require the balancing of all air conveyance systems as opposed to only ventilation air systems. The requirement for verifying the required ventilation airflow rates of Chapter 4 is relocated to the new balancing section to consolidate all balancing requirements in Chapter 6.



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Means to adjust airflow to balance ventilation air distribution

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801.21

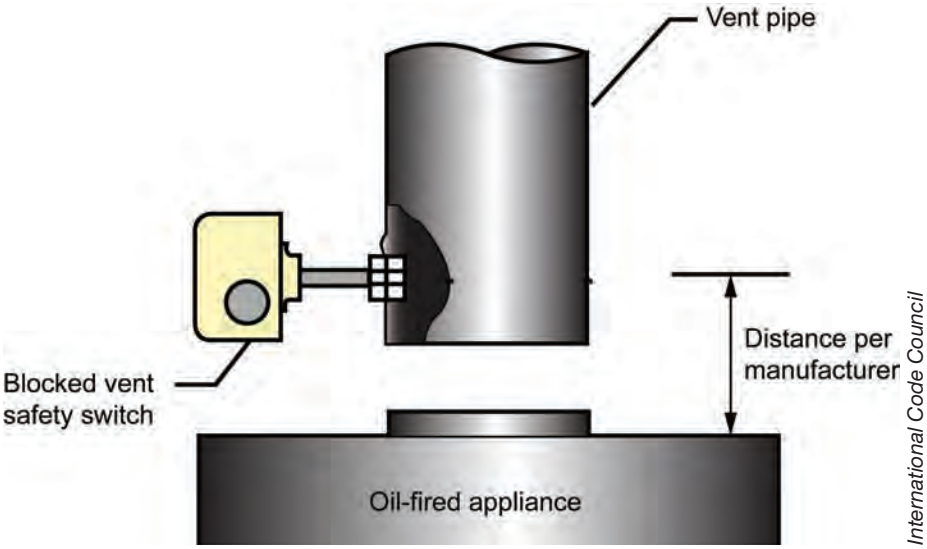
Blocked Vent Switch for Oil-Fired Appliances

CHANGE TYPE: Addition

CHANGE SUMMARY: A requirement was added for an additional safety device for oil-fired appliances to be consistent with what is required for some gas-fired appliances.

2021 CODE: **801.21 Blocked vent switch.** Oil-fired appliances shall be equipped with a device that will stop burner operation in the event that the venting system is obstructed. Such device shall have a manual reset, and shall be installed in accordance with the manufacturer's instructions.

CHANGE SIGNIFICANCE: Blocked (obstructed) vent switches are not new, but the code has not required them until now. Oil-fired appliances such as furnaces vent to masonry chimneys, factory-built chimneys or Type L vents. These venting systems, especially masonry chimneys, are subject to blockage by items including plant debris, animal nesting materials, bird and raccoon carcasses and deteriorated masonry. The required blocked vent switch detects spillage from the venting system, typically from a draft regulator installed between the appliance and the vent or chimney, and shuts off the appliance. This function can prevent carbon monoxide poisoning in the event of an obstructed vent or chimney. The manual reset feature prevents the appliance from operating without the intentional action by an occupant or an HVAC service person. If the blocked vent switch activates, the cause must be determined and remedied before the appliance is allowed to resume operation.



Blocked vent switch for oil-fired appliances

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905.1

Wood-Burning Residential Hydronic Heaters

CHANGE TYPE: Modification

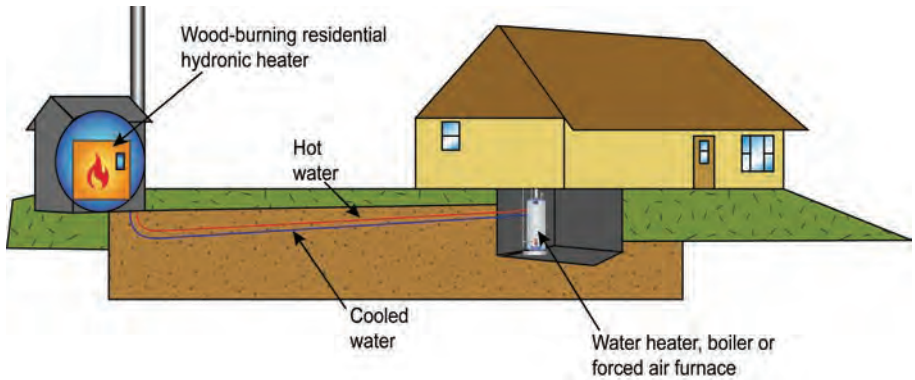
CHANGE SUMMARY: The revision makes the code consistent with EPA rules for heater emissions.

2021 CODE: **905.1 General.** Fireplace stoves and solid-fuel-type room heaters shall be listed and labeled and shall be installed in accordance with the conditions of the listing. Fireplace stoves shall be tested in accordance with UL 737. Solid-fuel-type room heaters shall be tested in accordance with UL 1482. Fireplace inserts intended for installation in fireplaces shall be listed and labeled in accordance with the requirements of UL 1482 and shall be installed in accordance with the manufacturer's instructions. New wood-burning residential hydronic heaters shall be EPA certified.

CHANGE SIGNIFICANCE: Hydronic heaters are solid fuel-burning hot water boilers. They are popular in rural areas and are also known as outdoor wood furnaces, among other names. They can burn wood, coal, pellets and biomass fuel. Typically, these units are located outdoors, vent through short chimneys attached directly to the unit and operate as unpressurized vessels, at or very near atmospheric pressure. The typical installation involves a hydronic heater installed outdoors on a pad with insulated plastic tubing run underground to a water coil in an air handler located in the building to be heated. These heaters have evolved to become much more efficient and cleaner burning than older technology. Older technology heaters produced much higher particulate emissions, and because the heaters vented through short chimneys, the smoke could stay close to the ground and seriously affect the air quality in the vicinity of such heaters.

The EPA was concerned with improving the air quality in areas where solid fuel was used to heat homes and other buildings and requires that these heaters be tested and certified as complying with the EPA limits on emissions (combustion byproducts). The emission limits will become more stringent in the future. The revised code text requires what the EPA requires to prevent higher polluting appliances from being installed.

The following link addresses the EPA rules for hydronic heaters: https://www.epa.gov/sites/production/files/2015-02/documents/20150204fs-hydronic-heaters.pdf.



Wood-burning residential hydronic heater

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CHANGE TYPE: Addition

CHANGE SUMMARY: Coverage was added for a new type of decorative fuel-burning appliance about which the code was previously silent.

2021 CODE:

SECTION 929
UNVENTED ALCOHOL FUEL-BURNING DECORATIVE APPLIANCES

929.1 General. Unvented alcohol fuel-burning decorative appliances shall be listed and labeled in accordance with UL 1370 and shall be installed in accordance with the conditions of the listing, manufacturer's instructions and Chapter 3.

SECTION 202
GENERAL DEFINITIONS

UNVENTED ALCOHOL FUEL-BURNING DECORATIVE APPLIANCE. A stationary, self-contained appliance intended to be directly or indirectly secured to a wall or floor and not intended for duct connection. Such appliance burns alcohol and is made in a manufacturing facility for subsequent delivery to the installation site.

CHANGE SIGNIFICANCE: The code did not address unvented alcohol fuel-burning decorative appliances in previous editions, but now they are within the scope of the code. The referenced UL standard 1370 is titled: *Unvented Alcohol Fuel Burning Decorative Appliances*. These appliances are not heaters and perform a strictly decorative function. As stated in the definition, they are stationary (not portable) and must be secured to a wall or floor. The applicable provisions of Chapter 3 apply to these appliances, such as Sections 303 and 304. As with all appliances regulated by the IMC, these decorative appliances must be installed in strict accordance with the manufacturer's instructions and the conditions of the product listing. Installation considerations include, among others, clearances to combustibles, the minimum required room volume and access. The energy input is limited to 0.25 gallon of denatured alcohol fuel per hour.

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Unvented Alcohol Fuel-Burning Decorative Appliances



Photo courtesy of EcoSmart Fire

Unvented alcohol fuel-burning decorative appliance

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1101 through 1108

Ammonia Refrigeration Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: These revisions remove all regulations for ammonia refrigeration systems from the IMC and instead simply defer all regulation to the suite of IIAR standards already referenced in the IMC.

2021 CODE: **1101.1 Scope.** This chapter shall govern the design, installation, construction and repair of refrigeration systems that vaporize and liquefy a fluid during the refrigerating cycle. ~~Refrigerant piping design and installation, including pressure vessels and pressure relief devices, shall conform to this code.~~ Permanently installed refrigerant storage systems and other components shall be considered as part of the refrigeration system to which they are attached.

1101.1.1 Refrigerants other than ammonia. Refrigerant piping design and installation for systems containing a refrigerant other than ammonia, including pressure vessels and pressure relief devices, shall comply with this chapter and ASHRAE 15.

1101.1.2 Ammonia refrigerant. Refrigeration systems using ammonia as the refrigerant shall comply with IIAR 2, IIAR 3, IIAR 4 and IIAR 5 and shall not be required to comply with this chapter.

~~**1101.6 General.** Refrigeration systems shall comply with the requirements of this code and, except as modified by this code, ASHRAE 15. Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, ASHRAE 15, IIAR 2, IIAR 3, IIAR 4 and IIAR 5.~~



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Ammonia refrigeration systems

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TABLE 1103.1 Refrigerant Classification, Amount and OEL (only the applicable rows are shown for brevity)

R-32	CH_2F_2	difluoromethane (methylene fluoride)	A2[f][c]	4.8	36,000	77	1,000	1-4-0
R-143A	CH_3CF_3	1,1,1-trifluoroethane	A2[f][c]	4.5	21,000	70	1,000	2-0-0[b]
R-444A	zeotrope	R-32/152a/1234ze(E) (12.0/5.0/83.0)	A2[f][c]	5.1	21,000	81	850	—
R-444B	zeotrope	R-32/152a/1234ze(E) (41.5/10.0/48.5)	A2[f][c]	4.3	23,000	69	890	—
R-445A	zeotrope	R-744/134a/1234ze(E) (6.0/9.0/85.0)	A2[f][c]	4.2	16,000	67	930	—
R-446A	zeotrope	R-32/1234ze(E)/600 (68.0/29.0/3.0)	A2[f][c]	2.5	16,000	39	960	—
R-447A	zeotrope	R-32/125/1234ze(E) (68.0/3.5/28.5)	A2[f][c]	2.6	16,000	42	900	—
R-451A	zeotrope	R-1234yf/134a (89.8/10.2)	A2[f][c]	5.3	18,000	81	520	—
R-451B	zeotrope	R-1234yf/134a (88.8/11.2)	A2[f][c]	5.3	18,000	81	530	—
~~R-717~~	~~NH_3~~	~~ammonia~~	~~B2[f]~~	~~0.014~~	~~320~~	~~0.22~~	~~25~~	~~3-3-0[c]~~
R-1234yf	$CF_3CF=CH_2$	2,3,3,3-tetrafluoro-1 propene	A2[f][c]	4.7	16,000	75	500	—
R-1234ze(E)	$CF_3CH=CHF$	trans-1,3,3,3-tetrafluoro-1-propene	A2[f][c]	4.7	16,000	75	800	—

a. Degrees of hazard are for health, fire, and reactivity, respectively, in accordance with NFPA 704.

b. Reduction to 1-0-0 is allowed if analysis satisfactory to the code official shows that the maximum concentration for a rupture or full loss of refrigerant charge would not exceed the IDLH, considering both the refrigerant quantity and room volume.

c. ~~For installations that are entirely outdoors, use 3-1-0.~~ The ASHRAE Standard 34 flammability classification for this refrigerant is 2L, which is a subclass of Class 2.

d. Class I ozone depleting substance; prohibited for new installations.

e. Occupational Exposure Limit based on the OSHA PEL, ACGIH TLV-TWA, the TERA WEEL or consistent value on a time-weighted average (TWA) basis (unless noted C for ceiling) for an 8 hr/d and 40 hr/wk.

~~f. The ASHRAE Standard 34 flammability classification for this refrigerant is 2L, which is a subclass of Class 2.~~

1105.6.3 Ventilation rate. ~~For other than ammonia systems, the~~ Mechanical ventilation systems shall be capable of exhausting the minimum quantity of air both at normal operating and emergency conditions, as required by Sections 1105.6.3.1 and 1105.6.3.2. ~~The minimum required emergency ventilation rate for ammonia shall be 30 air changes per hour in accordance with IIAR2.~~ Multiple fans or multispeed fans shall be allowed to produce the emergency ventilation rate and to obtain a reduced airflow for normal ventilation.

~~**1105.8 Ammonia discharge.** Pressure relief valves for ammonia systems shall discharge in accordance with ASHRAE 15.~~

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1105.8 Emergency pressure control system. ~~Permanently installed refrigeration systems containing more than 6.6 pounds (3 kg) of flammable, toxic or highly toxic refrigerant or ammonia~~ Emergency pressure control systems shall be provided ~~with an emergency pressure control system~~ in accordance with Section 605.10 of the *International Fire Code*.

~~**1106.3 Ammonia room ventilation.** Ventilation systems in ammonia machinery rooms shall be operated continuously at the ventilation rate specified in Section 1105.6.3.~~

~~**Exceptions:**~~

1. ~~Machinery rooms equipped with a vapor detector that will automatically start the ventilation system at the ventilation rate specified in Section 1105.6.3, and that will actuate an alarm at a detection level not to exceed 1,000 ppm.~~
2. ~~Machinery rooms conforming to the Class 1, Division 2, hazardous location classification requirements of NFPA 70.~~

1106.3 Flammable refrigerants. Where refrigerants of Groups A2, A3, B2 and B3 are used, the machinery room shall conform to the Class 1, Division 2, hazardous location classification requirements of NFPA 70.

Exceptions:

1. ~~Ammonia machinery rooms that are provided with ventilation in accordance with Section 1106.3.~~
2. Machinery rooms for systems containing Group A2L refrigerants that are provided with ventilation in accordance with Section 1106.4.

~~**1108.2 Test gases.** Tests shall be performed with an inert dried gas including, but not limited to, nitrogen and carbon dioxide. Oxygen, air, combustible gases and mixtures containing such gases shall not be used.~~

~~**Exception:** The use of air is allowed to test R-717, ammonia, systems provided that they are subsequently evacuated before charging with refrigerant.~~

[Note: Not all changes to Sections 1101 through 1108 are shown. Please refer to the 2021 IMC for the complete text and associated tables.]

CHANGE SIGNIFICANCE: The IIAR standards already referenced in the IMC comprehensively cover all aspects of refrigeration systems that use ammonia as the refrigerant. Therefore, there is no longer the need to have duplicate/overlapping coverage in the IMC that could create confusion and future correlation issues. The IIAR standards referenced in the IMC are stand-alone documents that do not need to rely on the IMC for coverage of ammonia systems. These revisions to the IMC are intended to parallel revisions to ASHRAE 15.

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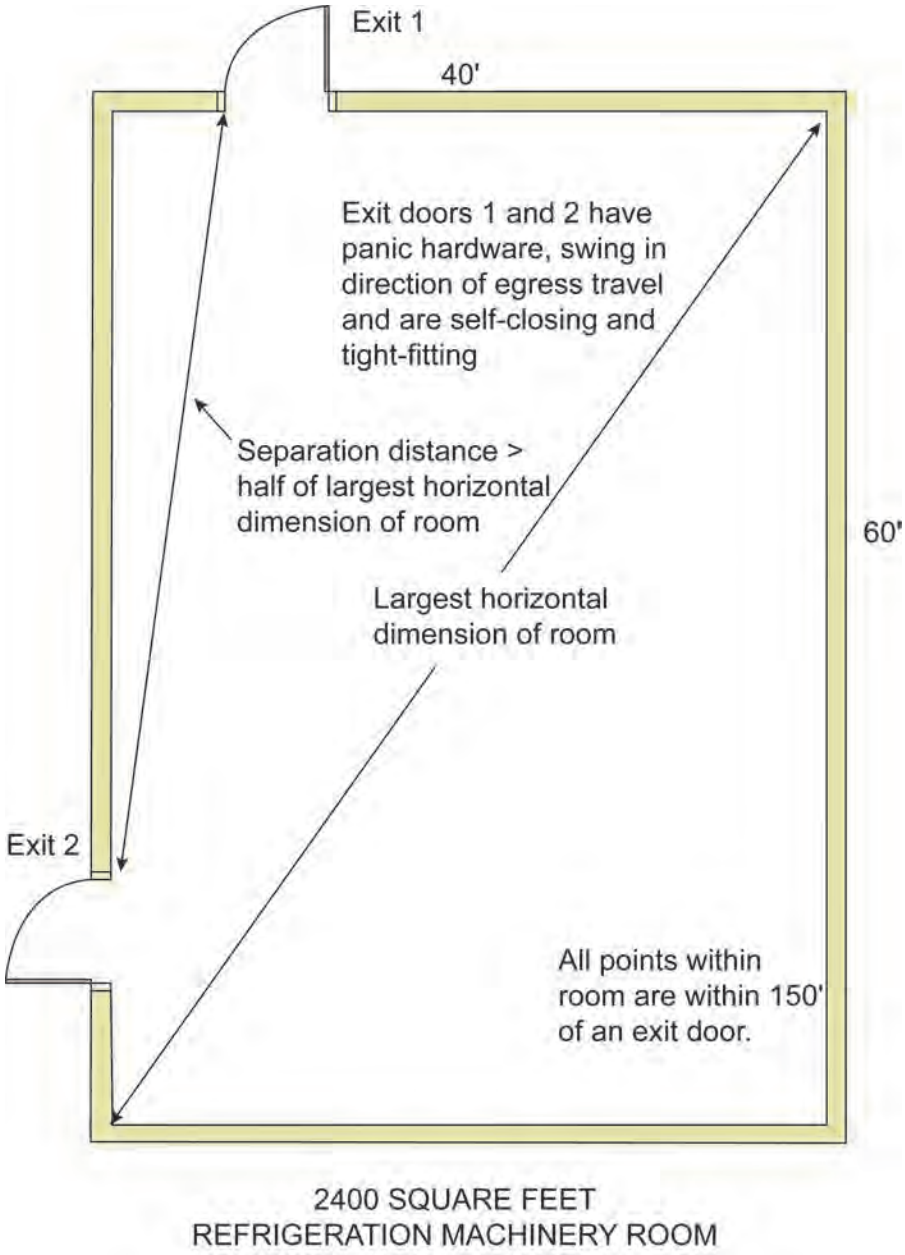
CHANGE TYPE: Addition

CHANGE SUMMARY: Revised egress requirements for machinery rooms from the IBC were added to the IMC to prevent such requirements from being overlooked.

1105.9

Machinery Room Means of Egress

2021 CODE: **1105.9 Means of egress.** Machinery rooms larger than 1,000 square feet (93 m^2) in area shall have not less than two exits or exit access doorways. Where two exit access doorways are required, one such doorway is permitted to be served by a fixed ladder or an alternating tread device. Exit access doorways shall be separated by a horizontal



Machinery room means of egress

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distance equal to or greater than one-half of the largest horizontal dimension of the room. All portions of machinery rooms shall be within 150 feet (45 720 mm) of an exit or exit access doorway. An increase in exit access travel distance is permitted where in accordance with Section 1017.1 of the *International Building Code*. Exit and exit access doorways shall swing in the direction of egress travel and shall be equipped with panic hardware, regardless of the occupant load served. Exit and exit access doorways shall be tight-fitting and self-closing.

CHANGE SIGNIFICANCE: Egress requirements for machinery rooms are contained in the IBC but were not previously duplicated in the IMC. Machinery room requirements are in the IMC; therefore, egress requirements for such spaces logically belong in the IMC as well. The lack of egress coverage in the IMC could result in the requirements being overlooked by users of the IMC. The IBC egress coverage is added to the IMC and is also revised relative to panic hardware.

It is appropriate for refrigeration machinery rooms to have panic hardware on means of egress doors to protect occupants from the risk of a rapid release of hazardous or asphyxiant gases. The need for rapid escape from refrigeration machinery rooms is not unlike what is needed for Group H occupancies, which are required by the IBC to have panic hardware on all swinging doors. Likewise, IIAR 2 includes this requirement for ammonia refrigeration machinery rooms. The requirement in the IBC is not readily found as a refrigeration machinery room requirement since it is isolated in the means of egress chapter.



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Machinery room egress door

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1107 through 1110

Refrigerant Piping

CHANGE TYPE: Addition

CHANGE SUMMARY: Section 1107, Refrigerant Piping, of the 2018 IMC was deleted entirely and replaced with all new text in Sections 1107 through 1110.

2021 CODE:

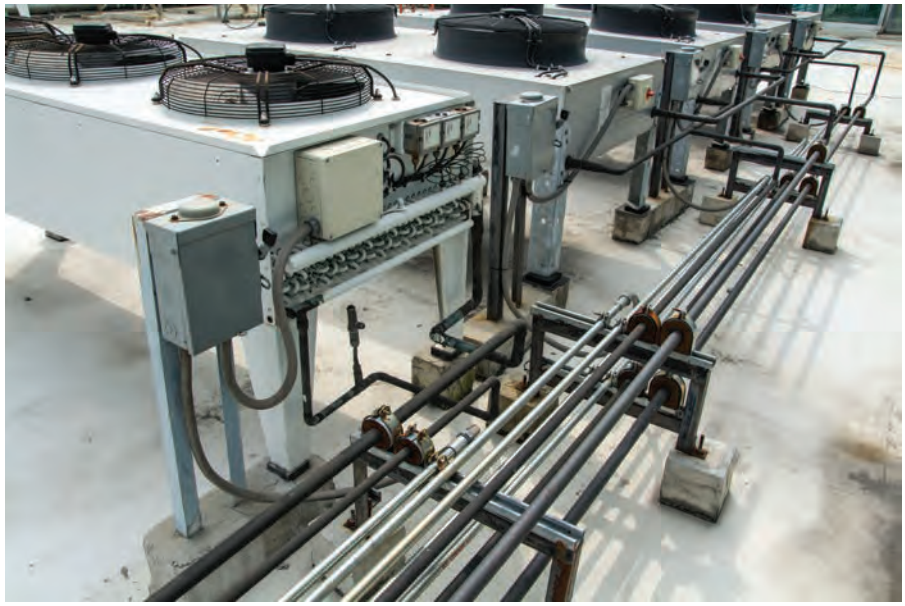
[Due to space constraints, only portions of Sections 1107 through 1110 are shown. Please refer to the 2021 IMC for the complete text and associated tables.]

SECTION 1107
PIPING MATERIAL

1107.1 Piping. Refrigerant piping material for other than R-717 (ammonia) systems shall conform to the requirements in this section. Piping material and installations for R-717 (ammonia) refrigeration systems shall comply with IIAR 2.

1107.2 Used materials. Used pipe, fittings, valves and other materials that are to be reused shall be clean and free of foreign materials and shall be approved for reuse.

1107.3 Material rating. Materials, joints and connections shall be rated for the operating temperature and pressure of the refrigerant system. Materials shall be suitable for the type of refrigerant and type of lubricant in the refrigerant system. Magnesium alloys shall not be used in contact with any halogenated refrigerants. Aluminum, zinc, magnesium and their alloys shall not be used in contact with R-40 (methyl chloride).



International Code Council

Refrigeration piping

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TABLE 1107.4 Refrigerant Pipe

Piping Material	Standard (See Chapter 15)

TABLE 1107.5 Refrigerant Pipe Fittings

Fitting Material	Standard (See Chapter 15)

TABLE 1107.5.1 Copper Brazed Swaged Cup Depths

Fitting Size (Inch)	Minimum Depth (Inch)	Maximum Depth (Inch)

SECTION 1108
JOINTS AND CONNECTIONS

1108.1 Approval. Joints and connections shall be of an approved type. Joints and connections shall be tight for the pressure of the refrigerant system when tested in accordance with Section 1110.

1108.1.1 Joints between different piping materials. Joints between different piping materials shall be made with approved adapter fittings. Joints between dissimilar metallic piping materials shall be made with a dielectric fitting or a dielectric union conforming to dielectric tests of ASSE 1079. Adapter fittings with threaded ends between different materials shall be joined with thread lubricant in accordance with Section 1108.3.4.

1108.2 Preparation of pipe ends. Pipe shall be cut square, reamed and chamfered, and shall be free of burrs and obstructions. Pipe ends shall have full-bore openings and shall not be undercut.

1108.3 Joint preparation and installation. Where required by Sections 1108.4 through 1108.9, the preparation and installation of brazed, flared, mechanical, press-connect, soldered, threaded and welded joints shall comply with Sections 1108.3.1 through 1108.3.5.

SECTION 1109
REFRIGERANT PIPE INSTALLATION

1109.1 General. Refrigerant piping installations, other than R-717 (ammonia) refrigeration systems, shall comply with the requirements of this section. The design of refrigerant piping shall be in accordance with ASME B31.5.

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1109.2 Piping location. Refrigerant piping shall comply with the installation location requirements of Sections 1109.2.1 through 1109.2.7. Refrigerant piping for Groups A2L and B2L shall also comply with the requirements of Section 1109.3. Refrigerant piping for group A2, A3, B2 and B3 shall also comply with the requirements of Section 1109.4.

1109.2.1 Minimum height. Exposed refrigerant piping installed in open spaces that afford passage shall be not less than 7 feet 3 inches (2210 mm) above the finished floor.

1109.2.2 Refrigerant pipe enclosure. Refrigerant piping shall be protected by locating it within the building elements or within protective enclosures.

Exception: Piping protection within the building elements or protective enclosure shall not be required in any of the following locations:

1. Where installed without ready access or located more than 7 feet 3 inches (2210 mm) above the finished floor.
2. Where located within 6 feet (1829 mm) of the refrigerant unit or appliance.
3. Where located in a machinery room complying with Section 1105.

1109.2.3 Prohibited locations. Refrigerant piping shall not be installed in any of the following locations:

1. Exposed within a fire-resistance-rated exit access corridor.
2. Within an interior exit stairway.
3. Within an interior exit ramp.
4. Within an exit passageway.
5. Within an elevator, dumbwaiter or other shaft containing a moving object.

TABLE 1109.3.2 Shaft Ventilation Velocity

Cross-Sectional Area of Shaft (sq. in.)	Minimum Ventilation Velocity (feet per minute)

SECTION 1110
REFRIGERANT PIPING SYSTEM TEST

1110.1 General. Refrigerant piping systems, other than R-717 (ammonia) refrigeration systems, that are erected in the field, shall be pressure tested for strength and leak tested for tightness, in accordance with the requirements of this section, after installation and before being placed in operation. Tests shall include both the high- and low-pressure sides of each system.

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Exception: Listed and labeled equipment, including compressors, condensers, vessels, evaporators, gas bulk storage tanks, safety devices, pressure gauges and control mechanisms, shall not be required to be tested.

1110.2 Exposure of refrigerant piping system. Refrigerant pipe and joints installed in the field shall be exposed for visual inspection and testing prior to being covered or enclosed.

1110.3 Test gases. The medium used for pressure testing the refrigerant system shall be one of the following inert gases: oxygen-free nitrogen, helium or argon. For R-744 refrigerant systems, carbon dioxide shall be allowed as the test medium. For R-718 refrigerant systems, water shall be allowed as the test medium. Oxygen, air, combustible gases and mixtures containing such gases shall not be used as test medium. Systems erected on the premises with tubing not exceeding ⅝ inch (15.9 mm) outside diameter shall be allowed to use the refrigerant identified on the nameplate label or marking as the test medium.

1110.4 Test apparatus. The means used to pressurize the refrigerant piping system shall have on its outlet side a test pressure measuring device and either a pressure-limiting device or a pressure-reducing device. The test pressure measuring device shall have an accuracy of ±3 percent or less of the test pressure and shall have a resolution of 5 percent or less of the test pressure.

[Due to space constraints, only portions of Sections 1107 through 1110 are shown. Please refer to the 2021 IMC for the complete text and associated tables.]



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Copper refrigeration piping

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CHANGE SIGNIFICANCE: The rewrite of Section 1107 reorganizes existing text and updates provisions that have not been changed in many years. The rewrite is more comprehensive than previous code coverage and also includes expanded coverage of some topics and includes several new topics that were not previously covered at all. The new Sections 1107 through 1110 are the culmination of efforts by several experts in the field of refrigerant piping design and installation. The new sections address piping for all refrigerants except ammonia.

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SIGNIFICANT CHANGES TO THE

INTERNATIONAL FUEL GAS CODE®

2021 EDITION

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PART 3

International Fuel Gas Code

Chapters 1 through 8

- **Chapter 1** Scope and Administration
  No changes addressed
- **Chapter 2** Definitions
- **Chapter 3** General Regulations
- **Chapter 4** Gas Piping Installations
- **Chapter 5** Chimneys and Vents
- **Chapter 6** Specific Appliances
- **Chapter 7** Gaseous Hydrogen Systems
  No changes addressed
- **Chapter 8** Referenced Standards
  No changes addressed

The *International Fuel Gas Code*® (IFGC®) applies to the installation of fuel gas piping systems, fuel gas utilization equipment, gaseous hydrogen systems and related accessories. Chapter 1 provides for the administration and enforcement of the code, assigning responsibility and authority to the code official. Chapter 2 contains definitions of terms specific to their use throughout the code. The general requirement provisions of Chapter 3 govern the approval and installation of all equipment and appliances regulated by the code. Requirements for the design and installation of gas piping systems are set out in Chapter 4 and include provisions for materials, components, fabrication, testing, inspection, operation and maintenance of such systems. The scope of Chapter 5 includes factory-built chimneys, liners, vents, connectors and masonry chimneys serving gas-fired appliances. Reference is made to the *International Mechanical Code*® (IMC®) for chimneys serving appliances using other fuels and to the *International Building Code*® (IBC®) for the construction requirements of masonry chimneys. Approval, design and installation of specific appliances such as furnaces, boilers, water heaters, fireplaces, decorative appliances, room heaters and clothes dryers are covered in Chapter 6. Chapter 7 covers the developing technology of gaseous hydrogen systems, including hydrogen generation and refueling operations, and provides reference to the applicable provisions of the *International Fire Code*® (IFC®). Chapter 8 provides a complete list of standards referenced in various sections of the code. ■

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202
Definition of Point of Delivery

307.2
Concealed Condensate Piping

402.7, 202
Press-Connect Joint

403.8.3
Threaded Joint Sealing

404.5
Fittings in Concealed Locations

503.5.6.1
Chimney Lining

503.8
Venting System Terminal Clearances

503.10.7
Vent Connector Junctions

614.7
Clothes Dryer Makeup Air

618.6
Return Air from Mechanical Room

623.2
Commercial Cooking Appliances

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202

Definition of Point of Delivery

CHANGE TYPE: Modification

CHANGE SUMMARY: New definitions clarify terms that are used in the definition of "point of delivery" and a change to the definition of "service shutoff" coordinates with all of the relative definitions.

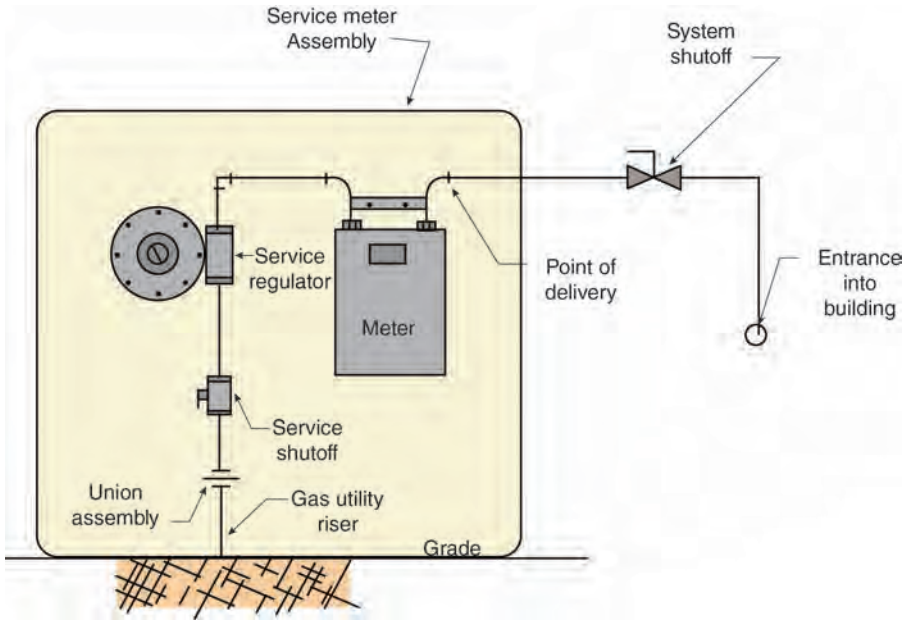
2021 CODE: **202 POINT OF DELIVERY.** For natural gas systems, the point of delivery is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a system shutoff valve is provided ~~at~~ after the outlet of the service meter assembly, such valve shall be considered to be downstream of the point of delivery. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the service pressure regulator, exclusive of line gas regulators, in the system.

SERVICE METER ASSEMBLY. The meter, valve, regulator, piping, fittings and equipment installed by the service gas supplier before the point of delivery.

SYSTEM SHUTOFF. A valve installed after the point of delivery to shut off the entire piping system.

VALVE. A device used in piping to control the gas supply to any section of a system of piping or to an appliance.

> **Service shutoff.** A valve, installed by the serving gas supplier between the ~~service meter or~~ source of supply and the point of delivery ~~customer piping system~~, to shut off the entire piping system.



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Service meter assembly and point of delivery

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CHANGE SIGNIFICANCE: The point of delivery (POD) is the point where the IFGC code applicability begins. Everything downstream of the POD is governed by the IFGC, and everything upstream of the POD is governed by the Department of Transportation (DOT) and the gas utility company. The definition of POD refers to the service meter assembly, but this term was not defined until now. The new definition clarifies which components are under the control of the gas utility company and are, therefore, before (upstream of) the POD and not controlled by the IFGC. The definition of service shutoff (valve) was revised to refer to the POD instead of the vague reference to customer piping system and the term service meter was deleted, recognizing that the new definition of service meter assembly includes the meter as one of several components that are upstream of the POD.

The definition of POD was also revised to include the newly defined term "system shutoff," which is an optional valve installed after (downstream of) the service meter assembly. A system shutoff valve is a valve that is installed by choice to allow the customer or building owner to shut off the gas to the entire building. This valve also allows the gas to be turned on by a party other than the gas utility after the gas utility has set the service meter assembly, thus avoiding the operation of the gas utility owned service shutoff valve. The distinction between a service shutoff valve and a system shutoff valve is that the system shutoff valve is owned and operated by the customer and the service shutoff valve is owned by the gas utility and can be operated only by qualified personnel working for the gas utility. The service shutoff valve is commonly operated by contractors performing work on the building's gas piping system, but, by federal law, this practice is not legal. The service shutoff valve is for use only by gas utility personnel or perhaps emergency personnel. Having a system shutoff valve downstream of the POD will allow contractors to shut off the gas to the building within the law.

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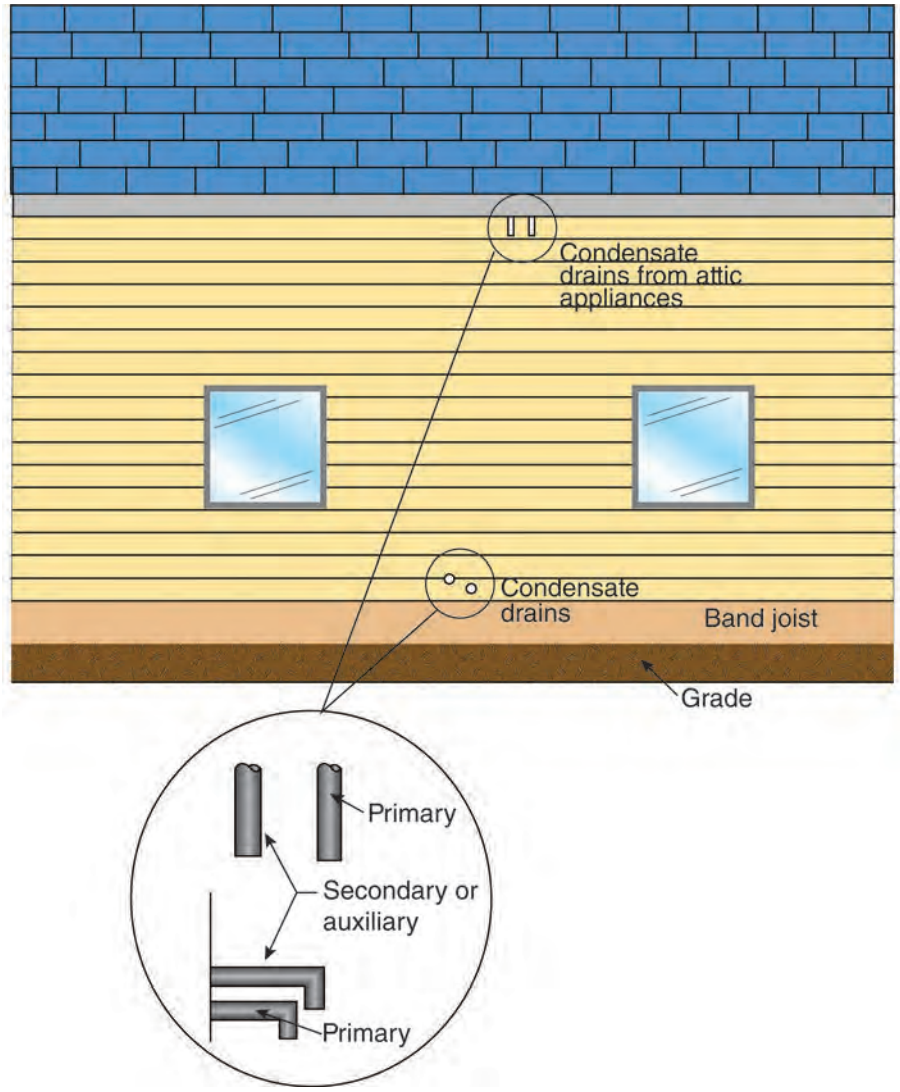
307.2

Concealed Condensate Piping

CHANGE TYPE: Modification

CHANGE SUMMARY: The code was revised to address the concern over the terminations of concealed condensate drain lines where it will not be apparent which drain is the normal condensate drain and which drain is the secondary (backup) drain.

2021 CODE: **307.2 Fuel-burning appliances.** Liquid combustion byproducts of condensing appliances shall be collected and discharged to an approved plumbing fixture or disposal area in accordance with the manufacturer's instructions. Condensate piping shall be of approved corrosion-resistant material and shall be not smaller than the drain connection on the appliance. Such piping shall maintain a minimum slope in the direction of discharge of not less than ⅛ unit vertical in 12 units horizontal (1-percent slope). The termination of concealed condensate piping shall be marked to indicate whether the piping is connected to the primary drain or to the secondary drain.



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Labeling of concealed condensate piping termination

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CHANGE SIGNIFICANCE: Section 307.2 requires a primary condensate drainage system, and Section 307.5 requires an auxiliary drain pan and drain where overflow of the primary drain would cause damage to the building. Where the two drain lines serving the same remote appliance are not readily observable, one would not know which drain line was which. For example, if the two drain lines came from an attic space and terminated through an outside wall, one could not discern which was the primary drain. If condensate is flowing from the auxiliary drain, that is an indication of a failed primary drain line and immediate attention would be needed to correct the problem. If the two drain lines were not labeled as to their purpose, it would not be possible to distinguish between normal primary drain line flow and abnormal auxiliary drain line flow. The required marking is intended to be permanent; therefore, it must be suitable for the location so as to remain visible for the life of the system. Duct tape and a felt tip pen marking would not survive long exposed to the weather.

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402.7, 202

Press-Connect Joint

CHANGE TYPE: Modification

CHANGE SUMMARY: The code now recognizes press-connect joints as suitable for high pressure (over 5 psig) applications indoors.

2021 CODE: **402.7 Maximum operating pressure.** The maximum operating pressure for piping systems located inside buildings shall not exceed 5 pounds per square inch gauge (psig) (34 kPa gauge) except where one or more of the following conditions are met:

1. The piping joints are welded or brazed.
2. The piping is joined by fittings listed to ANSI LC-4/CSA 6.32 and installed in accordance with the manufacturer's instructions.

(Items 3 through 8 are unchanged)

SECTION 202
GENERAL DEFINITIONS

PRESS-CONNECT JOINT. A permanent mechanical joint incorporating an elastomeric seal or an elastomeric seal and corrosion-resistant grip or bite ring. The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer.

CHANGE SIGNIFICANCE: A new type of piping system joint is now allowed for gas piping systems inside buildings that operate at pressures greater than 5 psig. As described in the definition of "press-connect joint" and as can be seen in the photos, the fittings for steel pipe have a "bite ring" with teeth that indent in the steel pipe wall so the fitting is impossible to remove or displace. Press-connect fittings for gas piping systems were already allowed under Sections 403.10.1 and 403.10.2, but were not allowed if the gas pressure in the system exceeded 5 psig. Press-connect fittings form a seal by means of a compressed O-ring that is specially formulated to tolerate high temperatures and extreme conditions dictated by the product standard ANSI LC-4/CSA 6.32. Press-connect joints are common for copper plumbing piping and are gaining popularity for steel piping.



Photo courtesy of Viega LLC

Press-connect fitting with bite ring used with Sch 40 and Sch 10 steel pipe

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403.8.3

Threaded Joint Sealing

CHANGE TYPE: Modification

CHANGE SUMMARY: The text was revised to require the use of thread joint sealants (aka, joint compounds, pipe dope, pipe tape).

2021 CODE: **403.8.3 Threaded joint ~~compounds~~ sealing.** Threaded joints shall be made using a thread joint sealing material. Thread joint sealing materials ~~compounds~~ shall be nonhardening and shall be resistant to the ~~action of liquefied petroleum gas or to any other~~ chemical constituents of the gases to be conducted through the piping. Thread joint sealing materials shall be compatible with the pipe and fitting materials on which the sealing materials are used.

CHANGE SIGNIFICANCE: The code addressed pipe thread sealants but never required them to be used. Thread sealants act primarily as a lubricant to allow the threads to make up tight to form a metal-to-metal seal, and any imperfections or voids in the threads are filled in by the thread sealant material. The most common thread sealants used today are pastes made with PTFE (Teflon) and Teflon tapes. Sealing compounds must not be hardening so that pipe joints can be disassembled when necessary, shrinkage of the sealant is minimized and the material can be resilient to vibration and movement.

LP-gas can react with some pipe sealants, and this might also be the case for other gases; therefore, the text simply requires that the sealant be compatible with whatever is conveyed in the piping. The thread sealant used must be suitable for the pipe and fitting materials used. Some thread sealants can attack some pipe and fitting materials. This is more of an issue with plumbing piping, which often has plastic threads, while gas piping always involves metallic threads. Thread sealant container labels will state what pipe and fitting materials are suitable or not suitable for use with the sealant.



Photo courtesy of gettyimages.com/Vudhikul Ocharoen

Threaded joint pipe tape

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404.5

Fittings in Concealed Locations

CHANGE TYPE: Modification

CHANGE SUMMARY: This change addresses an omission of threaded fittings that were intended to be allowed in concealed locations, yet not specifically mentioned in the text.

2021 CODE: **404.5 Fittings in concealed locations.** Fittings installed in concealed locations shall be limited to the following types:

1. Threaded elbows, tees, couplings, plugs and caps.
2. Brazed fittings.
3. Welded fittings.
4. Fittings listed to ANSI LC-1/CSA 6.26 or ANSI LC-4/CSA 6.32.

CHANGE SIGNIFICANCE: Threaded (screwed) fittings, such as those used with steel piping, are allowed to be concealed, except for unions. Item 1 of this section lists the threaded fittings that are allowed to be concealed. Unions are not in the list and are, therefore, prohibited in concealed locations. There was no reason to exclude threaded plugs and threaded caps, so that omission was corrected. Left/right couplings can be viewed as a type of union; however, they are nonetheless threaded couplings and are not prohibited.



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Threaded fittings permitted in concealed spaces

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503.5.6.1
Chimney Lining

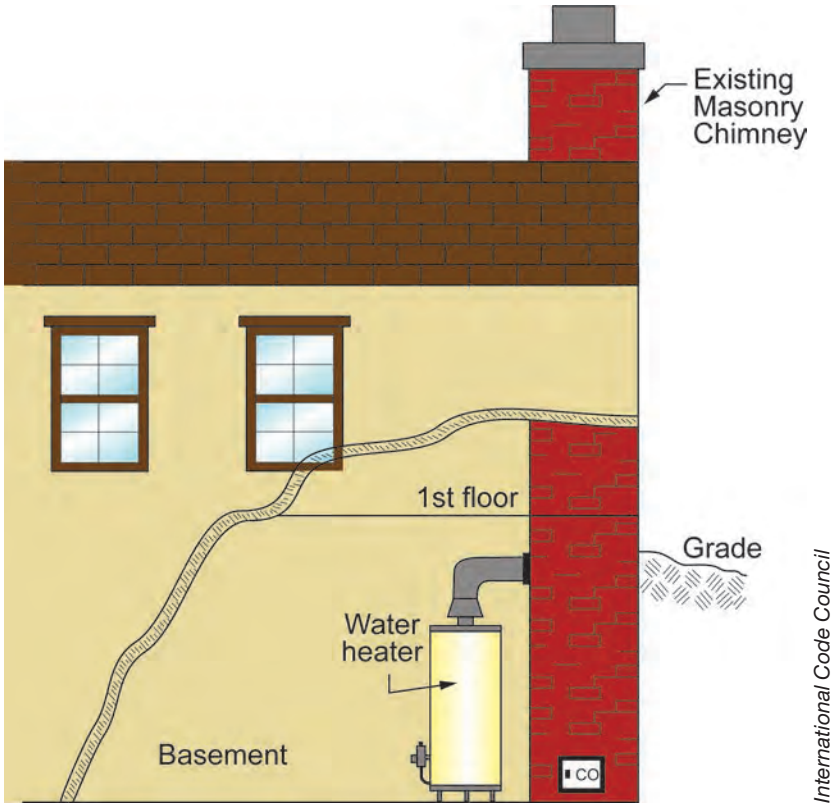
CHANGE TYPE: Modification

CHANGE SUMMARY: The exception for existing chimneys, previously intended to avoid a hardship, is considered to be outdated and has been deleted.

2021 CODE: **503.5.6.1 Chimney lining.** Chimneys shall be lined in accordance with NFPA 211.

> ~~**Exception:** Where an existing chimney complies with Sections 503.5.6 through 503.5.6.3 and its sizing is in accordance with Section 503.5.5, its continued use shall be allowed where the appliance vented by such chimney is replaced by an appliance of similar type, input rating and efficiency.~~

CHANGE SIGNIFICANCE: The exception allowed an existing unlined chimney to vent replacement appliances, where such replacement appliances were similar in type, Btu/h input rating and thermal efficiency. A replacement appliance installation is treated the same as the initial appliance installation, meaning that it is new work that must comply with the code that is currently in effect for new work. The exception applied to all appliances, but for this discussion, let's consider water heaters. For



Code-compliant chimney lining required for replacement appliance

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example, a replacement water heater installation is required to be served by a code-compliant venting system, just as the initial water heater was. However, this exception allowed a non-code-compliant chimney to serve a new water heater installation, in conflict with a basic principle of the code, the appliance installation instructions and the appliance listing. The reason for this was that many existing buildings, typically homes, had old unlined existing chimneys and it would be a financial hardship to require the chimney to be lined if the water heater had to be replaced, especially if the previous water heater was apparently being vented properly. The exception was based on the assumption that the previous water heater was venting properly. If it was not, the replacement appliance would not be venting properly either. Because newer appliances change design, input ratings and efficiency, it is unlikely that the replacement appliance will be "similar" to the previous appliance. Serviceable unlined chimneys have become quite rare in an era where high-efficiency appliances dominate. Also, consider that the exception would rarely if ever be applicable because it required the existing unlined chimney to be correctly sized and in good condition, which would be exceedingly rare. For all of the reasons above, the time had come for the hardship exception to be deleted.

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CHANGE TYPE: Modification

CHANGE SUMMARY: Though-the-wall vent terminal clearance distances have been placed in a new table with a corresponding figure for ease of use.

503.8
Venting System Terminal Clearances

2021 CODE: **503.8 Venting system ~~termination location~~ terminal clearances.** The clearances for through-the-wall direct-vent and non-direct-vent terminals shall be in accordance with Table 503.8 and Figure 503.8.

Exception: The clearances in Table 503.8 shall not apply to the combustion air intake of a direct-vent appliance

~~The location of venting system terminations shall comply with the following (see Appendix C):~~

~~1. A mechanical draft venting system shall terminate not less than 3 feet (914 mm) above any forced-air inlet located within 10 feet (3048 mm).~~

~~**Exceptions:**~~

~~1. This 83provision shall not apply to the combustion air intake of a direct-vent appliance.~~

~~2. This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of listed outdoor appliances.~~

~~2. A mechanical draft venting system, excluding direct-vent appliances, shall terminate not less than 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window or gravity air inlet into any building. The bottom of the vent terminal shall be located not less than 12 inches (305 mm) above finished ground level.~~

~~3. The clearances for through-the-wall, direct-vent terminals shall be in accordance with Table 503.8. The bottom of the vent terminal and the air intake shall be located not less than 12 inches (305 mm) above finished ground level.~~

~~4. Through-the-wall vents for Category II and IV appliances and non-categorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves or other equipment. Where local experience indicates that condensate is a problem with Category I and III appliances, this provision shall also apply. Drains for condensate shall be installed in accordance with the appliance and vent manufacturers' instructions.~~

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~~5. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building. This requirement shall not apply to vent terminals that are 2 feet (607 mm) or more above or 25 feet (7620 mm) or more below operable openings.~~

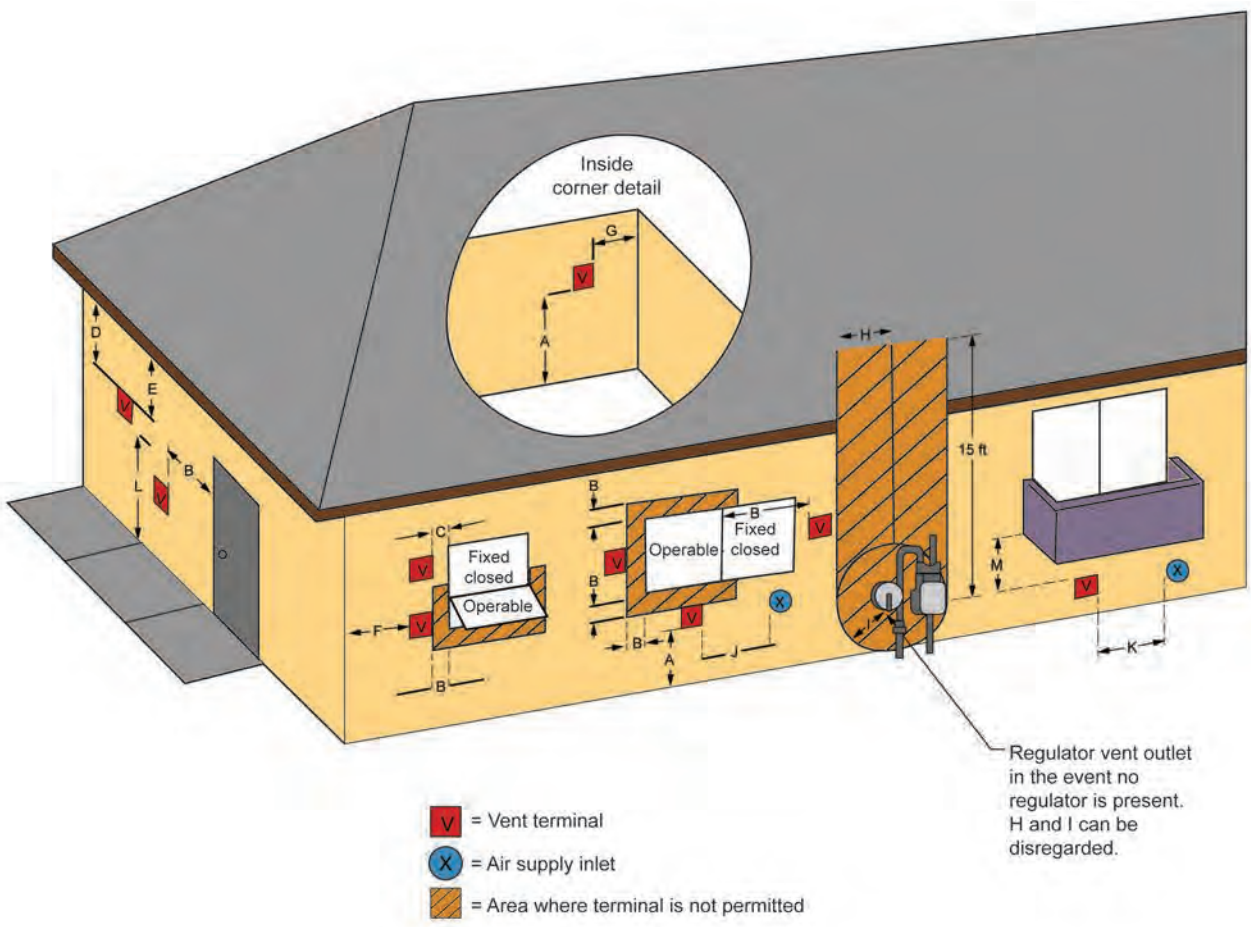


Figure 503.8 Through the wall vent terminal clearances

~~TABLE 503.8 Through-The-Wall Direct-Vent Termination Clearances~~

~~Direct-Vent Appliance Input Rating (Btu/hr)~~	~~Through-The-Wall Vent Terminal Clearance From Any Air Opening Into The Building (Inches)~~
~~< 10,000~~	~~6~~
~~≥ 10,000 ≤ 50,000~~	~~9~~
~~> 50,000 ≤ 150,000~~	~~12~~
~~> 150,000~~	~~In accordance with the appliance manufacturer's instructions and not less than the clearances specified in Section 503.8, Item 2~~

~~For SI: 1 inch = 25.4 mm, 1 Btu/h = 0.2931 W.~~

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TABLE 503.8 Through-the-Wall Vent Terminal Clearances

Figure Clearance	Clearance Location	Minimum Clearances for Direct-Vent Terminals	Minimum Clearances for Nondirect-vent Terminals
A	Clearance above finished grade level, veranda, porch, deck, or balcony	12 in.	
B	Clearance to window or door that is openable	6 in.: Appliances ≤ 10,000 Btu/hr 9 in.: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr 12 in.: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for nondirect-vent terminals in Row B	4 ft. below or to side of opening or 1 foot above opening
C	Clearance to nonopenable window	None unless otherwise specified by the appliance manufacturer	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	None unless otherwise specified by the appliance manufacturer	
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
H	Clearance to each side of center line extended above regulator vent outlet	3 ft. up to a height of 15 ft. above the regulator vent outlet	
I	Clearance to service regulator vent outlet in all directions	3 ft. for gas pressures up to 2 psi; 10 ft. for gas pressures above 2 psi	
J	Clearance to nonmechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for Row B	
K	Clearance to a mechanical air supply inlet	10 ft. horizontally from inlet or 3 ft. above inlet	
L	Clearance above paved sidewalk or paved driveway located on public property	7 ft. and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard	
M	Clearance to underside of veranda, porch, deck, or balcony	12 in. where the area beneath the veranda, porch, deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.	

For SI units, 1 in. = 25.4 mm, 1 ft. = 304.8 mm, 1 Btu/hr = 0.293 W

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CHANGE SIGNIFICANCE: The reformatting of Section 503.8 is not meant to make any technical changes to the though-the-wall vent terminal clearance provisions. Reorganizing the content and placing all of the clearance requirements into a single table makes the information easier to locate and understand than the previous layout of the material. In addition, Figure 503.8 illustrates the location and clearances for the vent terminations. The identifying letter in the table corresponds to the lettered locations in the figure. The figure is similar to the figure that has appeared in Appendix C. The new figure captures all of the terminal locations with the corresponding identifying letters from the table.

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503.10.7 Vent Connector Junctions

CHANGE TYPE: Addition

CHANGE SUMMARY: New text addresses the juncture of appliance vent connectors and the required method.

2021 CODE: **503.10.7 Connector junctions.** Where vent connectors are joined together, the connection shall be made with a tee or wye fitting.

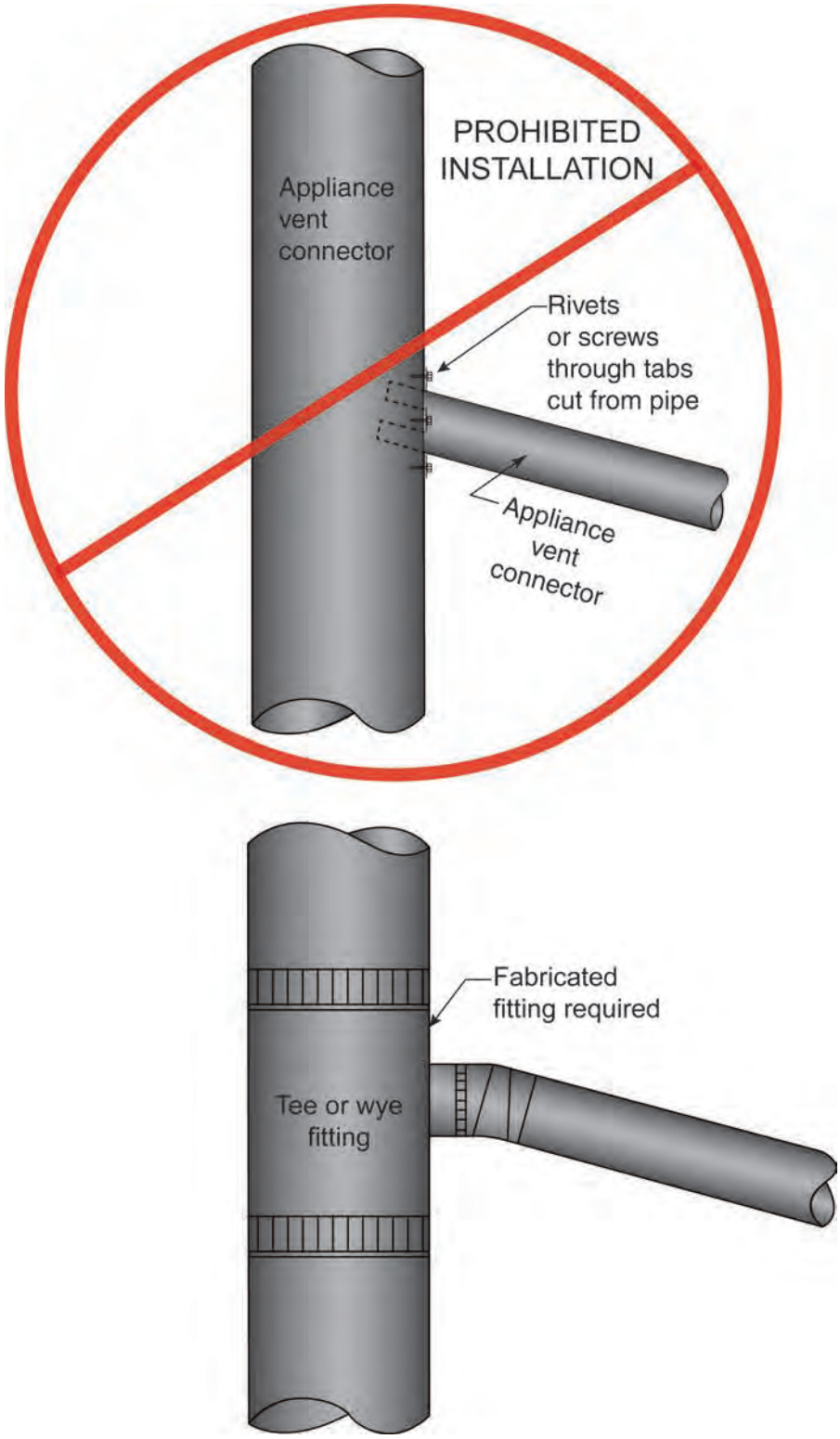
CHANGE SIGNIFICANCE: This new requirement was added to address, primarily, single-wall vent connectors that are joined together before connecting to a chimney, B-vent or Type L vent. An age-old practice was to cut a hole in the side or bottom of a single-wall metal pipe vent connector to join a smaller vent connector pipe to it. For example, a 6-inch vertical single-wall pipe vent connector serving a boiler or furnace has a hole cut in the side of it and a 3-inch single-wall pipe vent connector serving a water heater is inserted into the hole and fastened in place by bent tabs that are screwed or riveted to the larger vent connector pipe.

Such connection is not substantial or secure, allows considerable leakage that can affect draft, creates an obstruction inside the larger vent connector, typically ignores connector sizing criteria and is, at best, poor practice. This new section requires the use of manufactured tee or wye fittings. This has not been an issue with double-wall connectors because they are necessarily joined with tee and wye fittings designed for the purpose.

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Vent connectors joined by tee or wye fittings

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614.7 Clothes Dryer Makeup Air

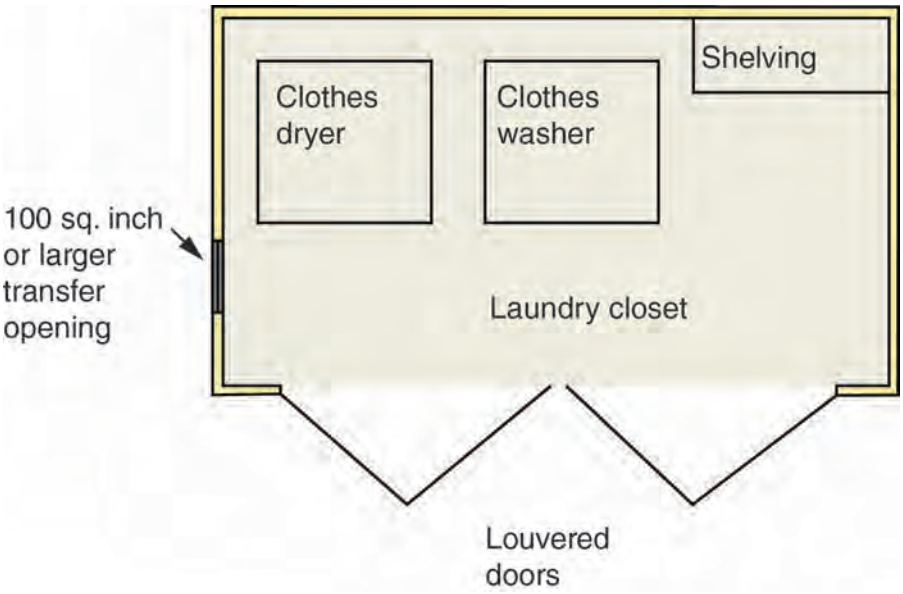
CHANGE TYPE: Clarification

CHANGE SUMMARY: This revision separated two unrelated requirements for clothes dryer makeup air into separate sections to clarify the applicability of each.

2021 CODE: **614.7 Makeup air.** Installations exhausting more than 200 cfm (0.09 m^3/s) shall be provided with makeup air. ~~Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (645 mm^2) for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.~~

614.7.1 Closet Installation. Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (645 mm^2) for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.

CHANGE SIGNIFICANCE: Section 614.7 requires all dryers exhausting greater than 200 cfm to be provided with a makeup air supply because of the concern for creating negative pressure in the space and starving the dryer for airflow. This requirement is distinct from the requirement for providing an opening in closet enclosures that contain dryers. Section 614.7 now addresses only the requirement to provide makeup air for dryers that exceed the 200 cfm threshold, and Section 614.7.1 addresses the requirement to have an opening in the closet enclosure to allow the makeup air into the closet. Without the opening into the closet, the dryer would be isolated from its source of makeup air and the closet would experience significant negative pressure. The requirement of Section 614.7.1 must necessarily apply to all dryers, regardless of the cfm exhaust rate, while Section 614.7 of the 2018 code appeared to require the closet opening only for dryers that exhaust over 200 cfm.



Makeup air for a closet installation of a dryer

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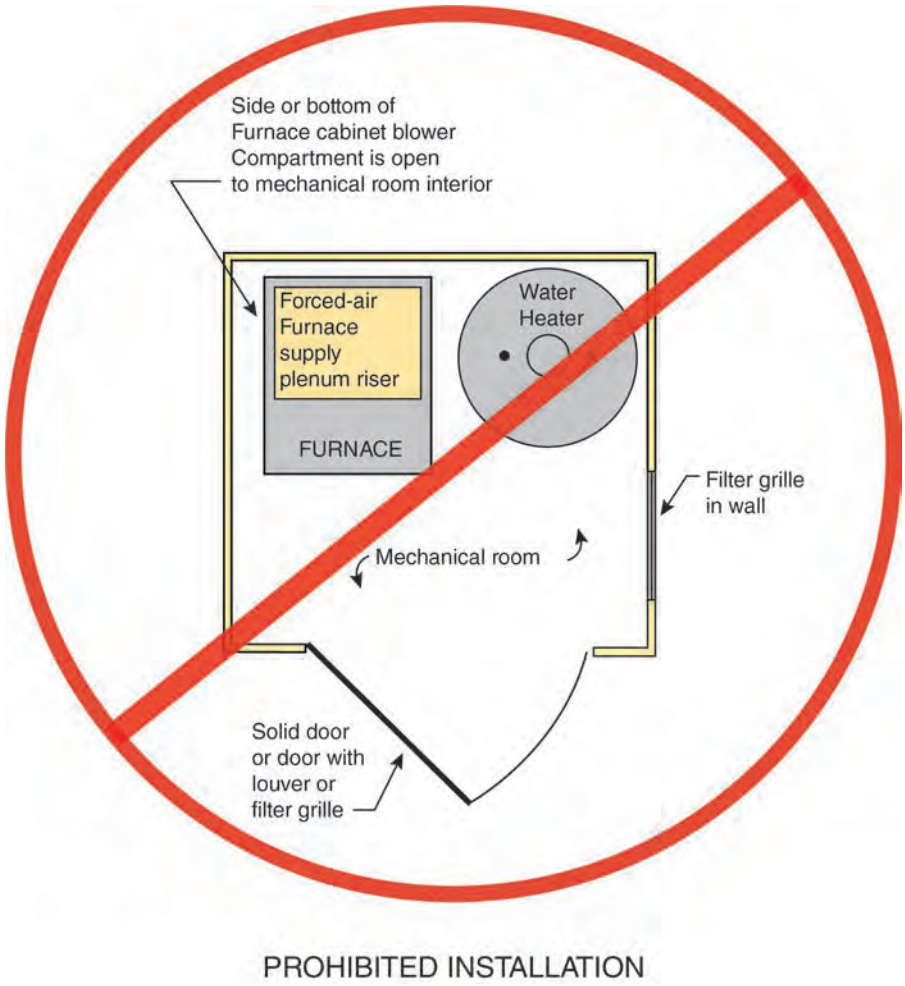
618.6

Return Air from Mechanical Room

CHANGE TYPE: Modification

CHANGE SUMMARY: New text clarifies the intent to prohibit pulling return air from the mechanical room.

2021 CODE: **618.6 Furnace plenums and air ducts.** Where a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside of the space containing the furnace, the return air shall be handled by a duct(s) sealed to the furnace casing and terminating outside of the space containing the furnace. Return air shall not be taken from the mechanical room containing the furnace.



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Prohibited installation of return air taken from the mechanical room containing the furnace

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CHANGE SIGNIFICANCE: The wording of this section was not sufficiently clear to all readers and furnace installations have often been in violation of this section. This section intends to prevent a significant hazard. The added text explicitly states the intent that the furnace must not draw air from the closet or mechanical room that contains the furnace. Many dwelling units have been constructed with furnaces installed in closets, commonly with a water heater, and the furnace return air inlet opening is open to the closet interior. Return air from the dwelling is drawn through a louvered door or grille in the closet enclosure and passes through the closet interior and into the furnace return air opening. Of course, this creates a strong negative pressure within the closet space as the return airflow overcomes the resistance of the louvered door or wall grille and any filters in such. Negative pressures in the closet space can interfere with the furnace and water heater vents, causing flue gas spillage, appliance malfunction and entrainment of flue gases in the return airflow. This section addresses furnaces; however, the same hazard can exist if an electric furnace or heat pump or cooling system air handler is installed in a closet with a gas-fired water heater or boiler.

The added text makes it clear that return air for the furnace must be ducted to the furnace from outside the furnace closet to prevent the creation of negative pressure within the closet. It is important to note that this section grants no relief or exception for direct-vent or power-vented appliances. Direct-vent and power-vented appliances are less affected by negative pressures than open combustion chamber natural draft appliances, but, direct-vent and power-vented appliances are not immune to negative pressures.

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623.2

Commercial Cooking Appliances

CHANGE TYPE: Modification

CHANGE SUMMARY: An unnecessary exception for commercial cooking appliances within dwelling units has been deleted.

2021 CODE: **623.2 Prohibited location.** Cooking appliances designed, tested, listed and labeled for use in commercial occupancies shall not be installed within dwelling units or within any area where domestic cooking operations occur.

~~Exceptions~~ Exception:

~~1.~~ Appliances that are also listed as domestic cooking appliances.

~~2. Where the installation is designed by a licensed Professional Engineer, in compliance with the manufacturer's installation instructions.~~

CHANGE SIGNIFICANCE: The exception was created because some consumers were demanding commercial cooking appliances in their homes as this has become a popular trend. Also, at least one state government modified the adopted IFGC to permit commercial cooking appliances to be installed in dwellings if an engineer designed the job. The marketplace has taken care of this demand, because appliance manufacturers currently offer many commercial-style appliances that are duel listed as both commercial and household appliances. This dual listing is already addressed in Exception 1. There is no reason to risk occupant safety by installing commercial-only appliances in dwellings when there are many appliances listed for dwelling (household) installation and have the commercial features and capacities that consumers want.

Exception 2 permitted cooking appliances listed only for commercial applications to be installed in a dwelling if a licensed professional engineer designed the kitchen installation and followed the manufacturer's installation instructions. This is a contradictory statement, because the manufacturer's instructions generally prohibit the installation of commercial appliances in dwellings; thus, the engineer could not design an installation that complied with the appliance manufacturer's instructions. This is also contrary to Section 301.3, which requires appliances to be listed and labeled for the application in which they are used. Commercial



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Commercial-type domestic range

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ranges that are not listed for domestic (household) use are not listed and labeled for use in a dwelling; therefore, it is a code violation whether or not it has the blessing of the design engineer. The typical appliance nameplates state that a commercial appliance is not intended for domestic use, so installation in a dwelling would be a violation of the manufacturer's instructions as well as Section 301.3. Commercial cooking appliances are not suitable or even safe within dwellings for multiple reasons, including, for example, that they require large clearances to combustibles, they might have much higher input ratings and surface temperatures, they might require non-combustible floors, they might lack some safety features required for domestic appliances and they might require exhaust systems similar to what is required in restaurants. This conflicted exception is not necessary because of the allowance of Exception 1 and the allowance in Chapter 1 for the code official to grant alternative approval for installations that meet the spirit and intent of the code and that are deemed equivalent to what the code specifies. For example, there have likely been cases where the code official has approved the installation of commercial-only appliances in extraordinary homes where the kitchen was built and operated like a restaurant and children were not present.

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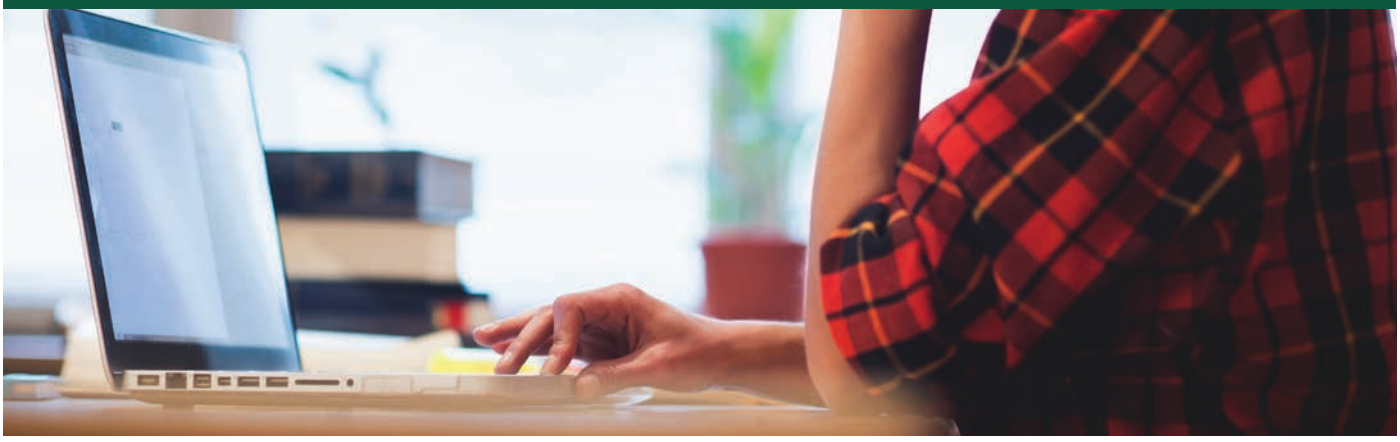
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Preface

The purpose of *Significant Changes to the International Fire Code®,* 2021 Edition, is to familiarize fire officials, building officials, plans examiners, fire inspectors, design professionals and others with many of the important changes in the 2021 *International Fire Code®* (IFC®). This publication is designed to assist code users in identifying the specific code changes that have occurred and, more important, in understanding the reasons behind the changes. It is also a valuable resource for jurisdictions in order to help them explain the significance and impact of the changes as they go through their code adoption process.

Only a portion of the total number of code changes to the IFC are discussed in this book. The changes selected were identified for a number of reasons, including their frequency of application, special significance or change in application. However, the importance of the changes not included is not to be diminished. Further information on all code changes can be found in the Complete Revision History, available from the International Code Council® (ICC®), through the online store at http://shop.iccsafe.org. This resource collection provides the published documentation for each successful code change contained in the 2021 IFC since the 2018 edition.

Significant Changes to the International Fire Code, 2021 Edition, is arranged to follow the general layout of the IFC, including code sections and section number format. The table of contents, in addition to providing guidance in the use of this publication, allows for a quick identification of those significant code changes that occur in the 2021 IFC.

Throughout the book, code changes are accompanied by a photograph or an illustration to assist in and enhance the reader's understanding of the specific change. A summary and a discussion of the significance of the change are also provided. Each code change is identified by type, be it an addition, modification, clarification or deletion.

The code change itself is presented in a legislative format similar to the style utilized for code change proposals. Deleted code language is shown with a strikethrough, and new code text is indicated by underlining. As a result, the actual 2021 code language is provided as well as

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a comparison with the 2018 language, so the user can easily determine changes to the specific code text.

As with any code change text, *Significant Changes to the International Fire Code,* 2021 Edition, is best used as a companion to the 2021 IFC. Because only a limited discussion of each change is provided, the reader should reference the code itself in order to gain a more comprehensive understanding of the code change and its application.

The commentary and opinions set forth in this text are those of the author and do not necessarily represent the official position of ICC. In addition, they may not represent the views of any enforcing agency because such agencies have the sole authority to render interpretations of the IFC. In many cases, the explanatory material is derived from the reasoning expressed by code change proponents.

Comments concerning this publication are encouraged and may be directed to ICC at significantchanges@iccsafe.org.

About the *International Fire Code*

Fire code officials, fire inspectors, building officials, design professionals, contractors and others involved in the field of fire safety recognize the need for a modern, up-to-date fire code. The *International Fire Code* (IFC), 2021 Edition, is intended to meet these needs through model code regulations that safeguard the public health and safety in all communities, large and small. The IFC is kept up to date through ICC's open code development process. The provisions of the 2018 edition, along with those code changes approved through 2019, make up the 2021 edition.

One in a family of International Codes® published by ICC, the IFC is a model code that establishes minimum fire safety requirements for new and existing buildings, facilities, storage and processes. It addresses fire prevention, fire protection, life safety and safe storage and use of hazardous materials. The IFC provides a total approach of controlling hazards in all buildings and sites, regardless of the hazard being indoors or outdoors.

The IFC is a design document. For example, before a building is constructed, the site must be provided with an adequate water supply for fire-fighting operations and a means of building access for emergency responders in the event of a medical emergency, fire or natural or technological disaster. Depending on the building's occupancy and uses, the IFC regulates the various hazards that may be housed within the building, including refrigeration systems, application of flammable finishes, fueling of motor vehicles, high-piled combustible storage and the storage and use of hazardous materials. The IFC sets forth minimum requirements for these and other hazards and contains requirements for maintaining the life safety of building occupants, the protection of emergency responders, and to limit the damage to a building and its contents as the result of a fire, explosion or unauthorized hazardous material discharge and electrical systems. The IFC is available for adoption and use by jurisdictions internationally. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference, in accordance with proceedings establishing the jurisdiction's laws.

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Kevin Scott is President of KH Scott & Associates LLC. Kevin has extensive experience in the development of fire safety, building safety and hazardous materials regulations. Kevin has actively worked for over 30 years in the development of fire code, building code and fire safety regulations at the local, state, national and international levels. Kevin previously worked as a Senior Regional Manager with the International Code Council, and before that, he was Deputy Chief for the Kern County Fire Department, California, where he worked for 30 years. He has developed and presented many seminars on a variety of technical subjects including means of egress, high-piled combustible storage, hazardous materials and plan review and inspection practices.

Kevin was a member of the original IFC Drafting Committee that worked to create the first edition of the IFC. He served for 7 years on the IFC Code Development Committee and was chairperson for the committee from 2001 to 2004. Kevin has actively participated in numerous technical committees to evaluate specific hazards and technologies, and to create regulations specific to those hazards.

Some of the more significant committees are:

- High-piled Combustible Storage Committee
- Hydrogen Gas Ad Hoc Committee
- Task Group 400
- Technical Advisory Committee on Retail Storage of Group 'A' Plastic Commodities
- Underwriters Laboratories Fire Council.

Kevin's constant work to improve fire and life safety has been recognized on many levels. His contributions have been acknowledged by various organizations when they presented him with the following awards:

- Mary Eriksen-Rattan Award in 2013—presented by the Southern California State Fire Prevention Officers' Association

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- William Goss Award in 2009—presented by the California State Firefighters Association
- Fire Official of the Year Award in 2005—presented by the California Building Officials
- Robert W. Gain Award in 2003—presented by the International Fire Code Institute.

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The International Code Council is the leading global source of model codes and standards and building safety solutions that include product evaluation, accreditation, technology, codification, training and certification. The Code Council's codes, standards and solutions are used to ensure safe, affordable and sustainable communities and buildings worldwide. The International Code Council family of solutions includes the ICC Evaluation Service, the International Accreditation Service, General Code, S. K. Ghosh Associates, NTA Inc., ICC Community Development Solutions and the Alliance for National & Community Resilience. The Code Council is the largest international association of building safety professionals and is the trusted source of model codes and standards, establishing the baseline for building safety globally and creating a level playing field for designers, builders and manufacturers.

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PART 1

Administrative

Chapters 1 and 2



- **Chapter 1** Scope and Administration No changes addressed
- **Chapter 2** Definitions No changes addressed

The provisions of Chapter 1 set forth requirements for the adoption, application, enforcement and administration of the *International Fire Code* (IFC). In addition to establishing the general scope and intent of the IFC, this chapter addresses construction, operational and maintenance inspection authority, the responsibilities and authority of the fire code official and the adoption of referenced standards. Upon adoption by a governmental jurisdiction, Chapter 1 establishes requirements for the issuance of construction and operational permits, inspection of facilities and processes, collection of fees, issuance of stop work orders and other legal notices and formation of a board of appeals.

Chapter 2 provides definitions for terms used throughout the IFC and the *International Building Code*® (IBC®). Codes are technical documents, and every word and term can add to or change the meaning of a provision and its application. ■

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PART 2

General Safety Provisions

Chapters 3 and 4



- **Chapter 3** General Requirements
- **Chapter 4** Emergency Planning and Preparedness

A basic concept of the *International Fire Code* (IFC) is to prevent the ignition of materials inside and outside buildings. Controlling fuels and ignition sources limits the potential for fire. Chapter 3 contains requirements for combustible waste materials, control or elimination of ignition sources, open flames, recreational fires and the use of smoking materials. Certain equipment can also be a source of ignition, and Chapter 3 addresses the proper operation of asphalt kettles, powered industrial trucks, mobile food preparation vehicles and 3D printing. In occupancies such as assembly uses or covered malls, controls are specified for certain hazardous materials or displays of vehicles. Chapter 3 also contains requirements for the protection from vehicle impact to prevent the release of compressed gas, flammable liquid or hazardous materials.

Chapter 4 requires that evacuation plans be prepared, that a hazardous materials communication program be established and that employees be trained to identify fire hazards and safely evacuate building occupants. ■

320, 202

Additive Manufacturing (3D Printing)

321, 321.1

Exterior Artificial Combustible Vegetation

405.1, 405.2 (NEW), TABLE 405.3, 405.5

Emergency Drills

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320, 202

Additive Manufacturing (3D Printing)

CHANGE TYPE: Addition

CHANGE SUMMARY: Requirements for 3D printing operations are added to the code.

2021 CODE TEXT: **NOTE:** Due to the extent of the code text, an outline of Section 320 is shown below. For the full text, see the *2021 International Fire Code*.

320 ADDITIVE MANUFACTURING (3D PRINTING)

320.1 General.

320.1.1 Scope.

320.1.2 Installation, operation and maintenance.

320.1.3 Production materials.

320.2 Non-industrial additive manufacturing.

320.2.1 Listing.

320.2.2 Occupancies.

320.3 Industrial additive manufacturing.

320.3.1 Permits required.



Photo courtesy of Getty Images

This 3D printer is producing a steel part utilizing the additive manufacturing process.

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320.3.2 Listing.

320.3.3 Combustible dusts and metals.

320.3.4 Powder evaluation.

320.3.5 Combustible (non-metallic) dusts.

320.3.6 Combustible metals.

320.3.7 Ancillary equipment.

320.3.8 Hazardous materials.

320.3.9 Inert Gas.

320.3.10 Technical assistance.

320.3.11 Performance-based design alternative.

320.3.12 Occupancies.

202 Definitions

3D PRINTER. A machine used in the additive manufacturing process for fabricating objects through the deposition of a material using a print head, nozzle or another printer technology.

ADDITIVE MANUFACTURING. A process of joining materials to make objects from 3D model data, usually layer upon layer, sometimes referred to as 3D printing. The code recognizes two types of additive manufacturing:

> **Industrial additive manufacturing.** 3D printing operations that typically utilize combustible powders or metals, an inert gas supply, a combustible dust collection system, or that create a hazardous (classified) location area or zone outside of the equipment.
>
> **Non-industrial additive manufacturing.** 3D printing operations that do not create a hazardous (classified) location area outside of the equipment, and do not utilize an inert gas supply or a combustible dust collection system.

CHANGE SIGNIFICANCE: The use of additive manufacturing, also referred to as 3D printing, is becoming more prevalent in industrial, business and personal (nonindustrial) applications. Definitions are added to the code to differentiate between industrial and nonindustrial equipment. This differentiation is critical because the requirements differ between the applications.

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Generally, for business and personal (nonindustrial) additive manufacturing processes, relatively inexpensive 3D printers are available for use in residences, classrooms, offices and businesses for producing customized products and prototypes. Four criteria, found in the definition and Section 320.2.1, are critical for these systems:

1. They do not create a hazardous (classified) location with regard to electrical equipment design or ignition source restrictions.
2. They do not utilize inert gases for operation of the printer.
3. They do not utilize a dust collection system.
4. The prepackaged production materials do not exceed a capacity of 30 liters.

These criteria are typically covered by the equipment listing. If the 3D printing equipment does not qualify as a nonindustrial additive manufacturing process, then it must comply with industrial additive manufacturing process requirements.

Section 320.2 establishes basic safety requirements for this nonindustrial additive manufacturing equipment. The 3D printing process occurs in equipment that is entirely self-contained and includes prepackaged production materials with a maximum size of 30 liters. The equipment listing required in Section 320.2.1 is relied upon to verify that the equipment operates safely and does not create a hazardous (classified) area outside of the unit. Three new UL standards have been added as applicable to nonindustrial additive manufacturing equipment. Since the equipment is listed as a stand-alone piece of equipment similar to an ink jet or laser printer, these 3D printers are allowed in any occupancy.

All 3D printing equipment not covered by Section 320.2 is considered industrial additive manufacturing equipment and is regulated in Section 320.3. These 3D printing processes are typically larger operations using external powder feed supplies and dust collection systems with or without an inert gas supply. In short, the industrial additive manufacturing process presents a greater safety hazard. These hazards include potential explosions due to the use of combustible nonmetallic and metallic powders during both use and storage. There are also a number of hazards related to worker safety that are not specifically covered by the code. These include ingestion hazards of nano-size particulates by equipment operators, asphyxiation hazards with argon and other gases used to inert the environment within the equipment and static electricity control considerations.

Some of the requirements for industrial operations are as follows:

- Industrial additive manufacturing process is required to obtain an operational permit. A permit is not required for the nonindustrial additive manufacturing equipment.
- Industrial 3D printers must be listed to UL 2011, but non-listed equipment can be approved based on a field evaluation.
- Section 320.3.10 authorizes the code official to obtain technical assistance and require a report from an approved source evaluating the industrial additive manufacturing operation.

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- Several NFPA standards are referenced to address the hazards associated with powders utilized in the 3D printing process.
- Use of inert gases must comply with IFC Chapter 53.
- Industrial 3D printing is only allowed in manufacturing facilities.
- If the quantities of hazardous materials exceed the maximum allowable quantity per control area, the room or building will become a Group H occupancy.

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321, 321.1

Exterior Artificial Combustible Vegetation

CHANGE TYPE: Addition

CHANGE SUMMARY: Artificial combustible vegetation is regulated when it is located on a roof or within close proximity to a building.

2021 CODE TEXT:

321 ARTIFICIAL COMBUSTIBLE VEGETATION

321.1 Artificial combustible vegetation on roofs and near buildings. Artificial combustible vegetation exceeding 6 feet (1829 mm) in height and permanently installed outdoors, within 5 feet (1524 mm) of a building or on the roof of a building, shall comply with Section 807.4.1. The placement of artificial combustible vegetation shall also comply with Sections 806.3 and 807.4.2.

Exception: Artificial decorative vegetation located more than 30 feet (9144 mm) from the exterior wall of a building.

CHANGE SIGNIFICANCE: The new trend to occupy rooftops areas has resulted in an increased use of decorative artificial vegetation on roofs. Artificial combustible vegetation is placed on occupied roofs, adjacent to building entrances and in courtyards or break areas. When placed in close proximity to a building they can spread fire to a building if ignited. Outdoor use poses weathering problems due to moisture, UV exposure or cleaning chemicals necessary to freshen up the vegetation.

Decorative artificial vegetation is largely composed of plastic materials. When the decorative vegetation ignites, the fire spreads rapidly and produces large volumes of thick, black smoke.



In July 2015, combustible artificial vegetation ignited on the pool deck at the Las Vegas Cosmopolitan Hotel, Las Vegas, NV. The vegetation was artificial palm trees.

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These vegetation fires can spread to surrounding buildings and the smoke can quickly obscure the egress path. This was very evident when the artificial vegetation burned on the rooftop pool deck of the Las Vegas Cosmopolitan Hotel. The *International Building Code* (IBC) and *International Fire Code* (IFC) regulate decorative artificial vegetation inside buildings in Chapter 8. Requirements in Chapter 8 address artificial decorative vegetation in buildings. This new section covers use outdoors and refers back to some of the requirements in Chapter 8, such as the restriction on electrical wiring in Section 807.4.2.

Not all outdoor vegetation is regulated. These requirements are limited to vegetation that is over 6 feet in height and either within 5 feet of a building or on the roof. The height limit of 6 feet allows for the use of some artificial vegetation without it being tested to NFPA 701.

The section also stipulates that the artificial vegetation is permanently installed outdoors. This is not intended to mean that the vegetation is anchored down, but it is designed to limit application to permanent fixtures, such as large potted plants and bushes. It is not intended to apply to transient items such table top ornaments.

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405.1, 405.2 (New), Table 405.3, 405.5

Emergency Drills

CHANGE TYPE: Modification

CHANGE SUMMARY: The frequency of training and participation in fire drills and evacuation drills are revised. The use of defend-in-place or staged evacuation strategies are included with specific criteria for each. Lockdown drills are not a substitute for required fire and evacuation drills.

2021 CODE TEXT: **405.1 General.** Emergency fire and evacuation drills complying with Sections 405.2 through 405.10 shall be conducted not less than annually where fire safety and evacuation plans are required by Section 403 or where required by the fire code official. Lockdown plan drills shall be conducted in accordance with the approved plan. Such drills shall not be substituted for fire and evacuation drills required by Section 405.3. Drills shall be designed in cooperation with the local authorities.

405.2 Occupant participation. Emergency fire and evacuation drills shall involve the actual evacuation of occupants to a selected assembly point and shall provide occupants with experience in exiting through required exits.

Exceptions:

1. In ambulatory care facilities and Group I-2 the movement of care recipients to a safe area or to the exterior of the building is not required.
2. In Group I-1, Condition 2 the assembly point for residents is permitted to be within an adjacent smoke compartment.
3. In Group R-4, actual exiting from emergency escape and rescue openings shall not be required. Opening the emergency escape and rescue opening and signaling for help shall be an acceptable alternative.



Photo courtesy of Pixsooz/iStock / Getty Images Plus/ Getty Images

Emergency evacuation drills are required in certain occupancies.

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4. In Group I-3, Conditions 2 through 5 where a defend-in-place response is permitted, the assembly point for detainees is permitted to be within an adjacent smoke compartment.
5. In Group I-3, Conditions 2 through 5, movement of detainees is not required to an assembly point where there are security concerns.

TABLE ~~405.2~~ 405.3 Fire and Evacuation Drill Frequency and Participation

GROUP or OCCUPANCY	FREQUENCY	PARTICIPATION
Group A	Quarterly	~~Employees~~ Staff
Group B[b a]	Annually	All occupants
Group B[c] (Ambulatory care facilities)	Quarterly on each shift[a]	~~Employees~~ Staff
Group B[b a] (Clinic, outpatient)	Annually	~~Employees~~ Staff
Group E	Monthly[a]	All occupants
Group F	Annually	Employees
Group I-1[e]	Semiannually on each shift[a]	All occupants
Group I-2	Quarterly on each shift[a]	~~Employees~~ Staff
Group I-3	Quarterly on each shift[a]	~~Employees~~ Staff
Group I-4	Monthly on each shift[a]	All occupants
Group R-1	Quarterly on each shift	Employees
Group R-2[d b]	Four annually	All occupants
Group R-4[e]	Semiannually on each shift[a]	All occupants

~~a. In severe climates, the fire code official shall have the authority to modify the emergency evacuation drill frequency.~~
~~b.~~ a. Emergency evacuation drills are required in Group B buildings having an occupant load of 500 or more persons or more than 100 persons above or below the lowest level of exit discharge.
~~c. Emergency evacuation drills are required in ambulatory care facilities in accordance with Section 403.3.~~
~~d.~~ b. Emergency evacuation drills in Group R-2 college and university buildings shall be in accordance with Section 403.9.2.1. Other Group R-2 occupancies shall be in accordance with Section 403.9.2.2.
c. In Groups I-1 and R-4, see Sections 403.7.1.5 and 403.9.3.5 for additional drills for staff.

~~405.4~~ 405.5 Time. Drills shall be held at unexpected times and under varying conditions to simulate the unusual conditions that occur in case of fire.

Exceptions:

1. In severe climates, the fire code official shall have the authority to modify the emergency evacuation drill termination points and frequency.
2. In Groups I-1, I-2, I-3 and R-4, where staff only emergency evacuation drills are conducted after visiting hours or where care recipients are expected to be asleep, a coded announcement shall be an acceptable alternative to audible alarms.

CHANGE SIGNIFICANCE: Chapter 4 has undergone a series of code changes resulting in reorganization of requirements in addition to modifications. The intent of the revisions is to coordinate the fire safety, evacuation and lock down plans between the various occupancies, and provide for defend-in-place and staged evacuation strategies for Groups I-1, I-2, I-3, R-4 and ambulatory care facilities. See Chapter 4 in the 2021 *International Fire Code* (IFC) for the full text.

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Section 405.1 is revised to recognize that lockdown drills occur at facilities that have developed a lockdown plan. Section 404.2.3.2 states that if a lockdown plan is provided, then lockdown drills shall occur. However, that section also states that lockdown drills cannot substitute for the required fire and evacuations drills required in Section 405. Section 405.1 now restates that provision so it is not missed when evaluating the required fire and evacuation drill frequency. Lockdown drills, if they occur, cannot be considered a substitute for the evacuation drills.

Section 405.2 is added stating that all occupants actually need to evacuate when conducting fire and evacuation drills. This statement is followed by five exceptions. Some of these exceptions were found in the 2018 IFC, but were located throughout Section 403. Those provisions have been relocated to Section 405.2 and allowances for defend-in-place are now included. Several Group I occupancies do not anticipate evacuation of the building as the initial plan. For example, Group I-2 hospitals and Group I-3 jails move occupants to adjacent smoke compartments. For these occupancies, evacuation to the exterior should be considered in the fire safety and evacuation plan, but it is typically the last of various stages of evacuation.

Table 405.3 is revised to address several separate items.

1. Certain entries in the right-hand column are revised to specify that all staff must participate rather than requiring employees to participate. In healthcare facilities, often doctors, interns or nurses are under contract, so they are not all employees. However, they must be trained and respond during emergencies. Therefore, the term staff is more relevant than employees in these occupancies.
2. Footnote a in the 2018 IFC is deleted. The provisions from Footnote a are now found in Section 405.5, Exception 1. The allowance to adjust the evacuation drills based on weather conditions is applicable to all occupancies. Relocating it into this section expands its application to all occupancies.
3. Footnote c in the 2018 IFC is deleted. This footnote was redundant in requiring compliance with the provisions for ambulatory care facilities. Note that the provisions for ambulatory care facilities have been relocated to now be found under the general Group B requirements in Section 403.3.1. Along with the relocation, the requirements are modified to specify instruction in evacuation drills at least every 3 months and training for new staff upon assignment at the facility.
4. Footnote e is added for Group I-1 and R-4 occupancies to provide a pointer for additional drills required for staff only.

Section 405.5 is revised by adding Exception 1, as discussed above, and Exception 2. Exception 2 was located as Exception 2 to Section 403.8.2.3 in the 2018 IFC. That section has been deleted and the exception is now located in Section 405.5.

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PART 3

Building and Equipment Design Features

Chapters 5 through 12



- **Chapter 5** Fire Service Features
- **Chapter 6** Building Services and Systems
- **Chapter 7** Fire and Smoke Protection Features
- **Chapter 8** Interior Finish, Decorative Materials and Furnishings
- **Chapter 9** Fire Protection and Life Safety Systems
- **Chapter 10** Means of Egress
- **Chapter 11** Construction Requirements for Existing Buildings
- **Chapter 12** Energy Systems
- **Chapters 13 through 19** (Reserved)

International Fire Code (IFC) Part III contains requirements that provide fire fighters with a means of accessing a building and establishing a fire protection water supply for that building. Chapter 5 contains requirements for address numbers on buildings and provisions for fire department access roadways. Chapter 6 contains requirements for building systems, such as elevators, commercial cooking operations, commercial clothes dryers and refrigeration systems. When specified by the *International Building Code* (IBC), buildings constructed using fire-resistant materials must be properly maintained to ensure the specified fire-resistance ratings are maintained. Chapter 7 specifies the requirements for maintenance of fire-resistance-rated construction.

Interior finish and decorative materials or furnishings offer fuel contribution and surfaces through which a fire can spread and transport heat and smoke to other parts of a room or to other rooms. Chapter 8 contains requirements for regulating wall and ceiling finishes, decorative materials and furnishings.

Fire protection systems and life safety systems are required in accordance with Chapter 9. Chapter 9 specifies the requirements for automatic sprinkler systems, alternative fire-extinguishing systems, fire alarm and detection systems, standpipes, portable fire extinguishers and other fire appliances, emergency alarm systems, mass notification, smoke and heat vents, smoke control systems, carbon monoxide alarms, and gas detection systems. For materials that can have a detonation or deflagration hazard, Chapter 9 specifies the requirements for explosion control systems.

Merriam-Webster's *New Collegiate Dictionary* defines egress as "a place or means of going out." In the event of a fire or an emergency that requires the occupants to safely exit a building, Chapter 10 establishes the minimum requirements for means of egress from buildings.

Chapter 11 sets forth retroactive construction requirements for existing buildings. These provisions establish minimum fire-resistance rating requirements for shafts as well as minimum means of egress requirements in existing buildings. It also establishes retroactive requirements for the installation of automatic sprinkler systems and fire alarm systems in existing buildings or occupancies.

Chapter 12 addresses energy storage and energy generation systems. This chapter includes emergency and standby power, portable generators, solar photovoltaic power, fuel cells and energy storage systems. This chapter includes other battery technologies, fuel cell power systems and energy storage systems, such as capacitor energy storage. ■

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508.1, 508.1.1, 508.1.3, 508.1.7 (NEW)

Fire Command Center

510.4.1, 510.4.1.1, 202

Emergency Responder Communication Coverage – Signals

510.4, 510.4.2.4, 510.4.2.5, 510.4.2.8, 510.5.1 (NEW), 510.5.4

Emergency Responder Communication Coverage – Interference

603.4

Electrical Working Space

604.5.4 (NEW), 604.5.5 (NEW), 315.3.3

Storage in Elevator Machine Rooms and Lobbies

605.1, 605.4, 605.4.1.1 (NEW), 605.4.2.1 (NEW), 605.4.2.2

Fuel Oil Storage Tanks

610

Clothes Dryer Exhaust Ducts

701.6

Maintenance of Fire-Resistance-Rated Construction

703.2, 704.2

Repair of Penetrations and Voids

708, 708.1

Maintenance of Spray Fire-Resistant Materials

808.5 (NEW)

Play Structures

202 (NEW), 901.1, 901.2, 901.2.1, 901.4, 901.4.1, 901.4.2, 901.4.3 (NEW), 901.4.5, 901.6

Life Safety Systems

903.2.4.2 (NEW), 903.2.9.3 (NEW)

Distilled Spirits

903.2.4, 903.2.4.3 (NEW), 903.2.7, 903.2.7.2 (NEW), 903.2.9, 903.2.9.4 (NEW)

Upholstered Furniture and Mattresses

903.2.10, 903.2.11.3

Group S-2 Parking Garages

903.2.10.2, IBC 202

Mechanical-Access Parking Garages

903.3.1.2

NFPA 13R Sprinkler Systems

903.3.1.2.2

Sprinklers on Means of Egress Balconies

905.3.1

Standpipes in Parking Garages

906.1

Portable Fire Extinguishers

907.2.10 (NEW)

Manual Fire Alarm in Public-Storage and Self-Storage Facilities

907.4, 907.5, 907.5.1 (NEW), 907.5.2.1.3 (NEW), 907.5.2.1.3.1 (NEW), 907.5.2.1.3.2 (NEW)

Low-frequency Alarms in Sleeping Rooms

907.5.2.1.2

Sound Pressure Level for Audible Alarms

907.5.2.2.5, 1203.2.4

Standby Power for Emergency Voice/Alarm Communications Systems

907.5.2.3.3, 907.5.2.3.3.1 (NEW)

Expansion Capability for Fire Alarms in Group R-2

907.6.6.1, 907.6.6.2 (NEW)

Fire Alarm System Monitoring

908.3

Emergency Alarm and Fire Alarm Interface

909.17

Smoke Control System Response Time

910.3.4 (NEW), 910.3.5 (NEW)

Smoke and Heat Vent Operation

913.1

Fire Pumps

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913.2.2

Protection of Circuits for Electric Fire Pumps

914.3.1.2

Water Supply to Fire Pumps

914.7, 914.7.1, 914.7.2, 202

Puzzle Rooms

1006.3, 1006.3.1, 1006.3.2, 1017.3.2.3

Exit Access Stairways in Atriums

1006.3.2, EXCEPTION 7; 1006.3, 1006.3.1

Egress from Occupied Roofs

1006.3.4, TABLE 1006.3.4(1), TABLE 1006.3.4(2)

Single Exit – Exit Access vs. Common Path

1009.2.1

Elevator Serving Occupied Roof

1010.1.1

Size of Doors

1010.2.4

Locks and Latches

1010.2.8, 1010.2.8.1, 1031.2.2

Locking Arrangements in Educational Occupancies

1010.2.9, 1010.2.9.1, 1010.2.9.2

Panic Hardware and Fire Exit Hardware

1020.5

Dead-End Corridors in Group I-2

1030.16, 1030.16.1

Handrails at Social Stairs

1103.5.4

Sprinklers in High-Rise Buildings

1103.7.5.1

Group R-1 Hotel and Motel Fire Alarm System

1103.9

Carbon Monoxide Detection in Existing Buildings

1203.1.2

Fuel Line Piping Protection

1204

Portable Generators

1205.3.3

Smoke Ventilation with Solar PV

1207

Electrical Energy Storage Systems

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508.1, 508.1.1, 508.1.3, 508.1.7 (New)

Fire Command Center

CHANGE TYPE: Modification

CHANGE SUMMARY: A fire command center is required in large buildings classified as Group F-1 and S-1 occupancies.

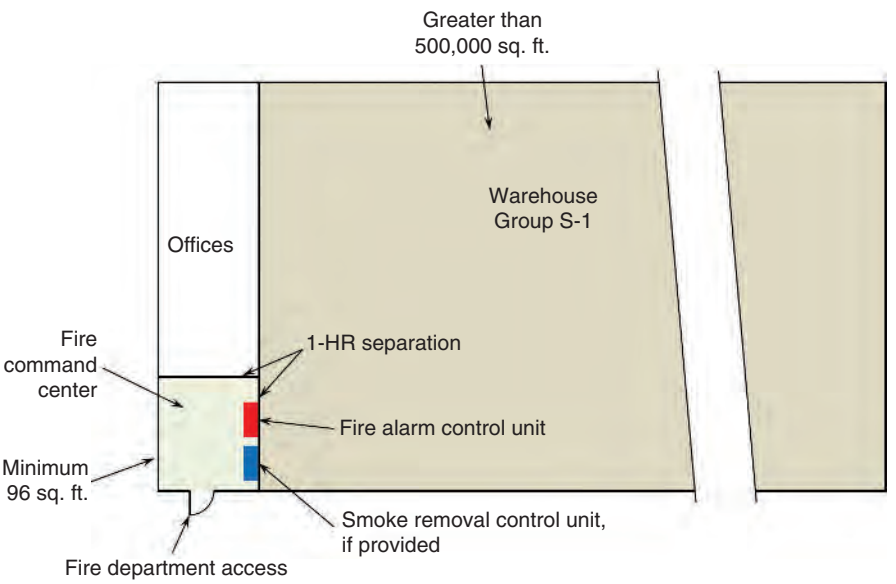
2021 CODE TEXT: **508.1 General.** Where required by other sections of this code and in all buildings classified as high-rise buildings by the *International Building Code* and in all F-1 and S-1 Occupancies with a building footprint of over 500,000 square feet, a fire command center for fire department operations shall be provided and shall comply with Sections 508.1.1 through ~~508.1.6~~ 508.1.7.

508.1.1 Location and access. The location and ~~accessibility of~~ access to the fire command center shall be approved by the fire code official.

508.1.3 Size. The fire command center shall be not less than 0.015 percent of the total building area of the facility served or 200 square feet (19 m²) in area, whichever is greater, with a minimum dimension of 0.7 times the square root of the room area or 10 feet (3048 mm), whichever is greater.

Where a fire command center is required for Group F-1 and S-1 occupancies with a building footprint greater than 500,000 square feet (46 452 m²) in area the fire command center shall have a minimum size of 96 square feet (9 m²) with a minimum dimension of 8 feet (2348 mm) where approved by the fire code official.

508.1.7 Fire command center identification. The fire command center shall be identified by a permanent easily visible sign stating "FIRE COMMAND CENTER" located on the door to the fire command center.



The fire command center is separated from the remainder of the building by 1-hour construction.

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CHANGE SIGNIFICANCE: Fire-fighting operations at large warehouse buildings in excess of 500,000 square feet can be as challenging for fire fighters as operating in high-rise buildings. Adding a fire command center to these types of buildings will allow the incident commander to see at a glance where the fire is, the building layout and any active fire protection systems. The ability to access this information in one location that is protected from the remainder of the building allows the incident commander to provide the best strategy possible to combat the fire and protect the lives of fire fighters.

Large structures of this size pose numerous challenges to emergency responders due to the large amount of fuel loading from the storage, manufacturing or processing of high-hazard commodities and plastics within the building. Fire-fighting challenges include the wide distribution of smoke throughout the structure, difficulty for firefighters to locate and reach the fire and difficulty in search and evacuation of the public, employees and fire fighters. These structures typically require numerous fire protection and detection systems that may include fire pumps, multiple fire sprinkler systems, advanced fire alarm systems, smoke control systems and refrigeration gas detection systems. During a fire, the incident commander must have the ability to readily identify the status of the various fire protection and detection systems and have access to other building information details that may include building floor plans, high-pile storage details, smoke control systems, fire sprinkler zone details, mechanical refrigeration equipment, information on hazardous materials and safety data.

A fire command center provides a centralized location for the incident commander to review details about the building and the incident and to effectively coordinate emergency responders and suppression activities with increased efficiency and speed. Section 508.1.2 would require that the fire command center is separated by 1-hour construction from the remainder of the building.

Fire-fighting experience based on multiple incidents in buildings with and without a fire command center has demonstrated that having detailed information on built-in fire protection systems and controls, building schematics and hazardous materials storage plans are vital towards mitigating the event.

The location of the room must be approved by the fire code official and the entry door to the room must be identified as the fire command center.

The items required in the fire command center listed in Section 508.1.6 would be limited to those components already in the building. This section would not require additional items that were otherwise not required for the construction of the building.

Note that the size of a fire command center in Group F-1 and S-1 occupancies is different from that in a high-rise building. This is appropriate since the number of systems required in these occupancies is less than in a high-rise. The minimum size of a fire command center is 96 square feet.

There was discussion at the code hearing to utilize the fire pump room as the fire command center. This would not be advisable because the noise level in a pump room while the pump is running will most likely prohibit any type of communication within the room. It is intended that the fire pump room and the fire command center be separate rooms.

The term "accessibility" is revised in Section 508.1.1 to eliminate confusion around the concept of "accessibility" as used in Chapter 11 of the *International Building Code* (IBC).

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510.4.1, 510.4.1.1, 202

Emergency Responder Communication Coverage – Signals

CHANGE TYPE: Modification

CHANGE SUMMARY: The testing criteria for in-building 2-way emergency responder coverage systems is enhanced by requiring 99 percent coverage in critical areas and by adding a second test criteria for inbound signals.

2021 CODE TEXT: **510.4.1 Emergency responder communication ~~enhancement~~ coverage system signal strength.** The building shall be considered to have acceptable in-building 2-way emergency responder ~~communications enhancement system~~ communication coverage when signal strength measurements in 95 percent of all areas and 99 percent in areas designated as critical areas by the fire code official on each floor of the building meet the signal strength requirements in Sections 510.4.1.1 through 510.4.1.3.

510.4.1.1 Minimum signal strength into the building. The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as specified by the fire code official. The inbound signal level shall be a minimum of -95 dBm throughout the coverage area and sufficient to provide not less than a Delivered Audio Quality (DAQ) of 3.0 or an equivalent Signal-to-Interference-Plus-Noise Ratio (SINR) applicable to the technology for either analog or digital signals.

202 Definitions

CRITICAL AREAS. Areas that are designated for the highest level of emergency responder radio coverage including but not limited to areas such as exit stairs, exit passageways, elevator lobbies, fire protection equipment room and control valve locations, fire command centers.



Photo courtesy of rocketegg/E+/Getty Images

Coordinating operations between emergency responders inside a building and personnel outside the building is critical. Emergency responder communication coverage systems provide the ability for responders to communicate.

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CHANGE SIGNIFICANCE: Several revisions occurred in Section 510. The first revision which affects the entire system is the new term of "in-building 2-way emergency responder communication coverage system (ERCCS)." The 2018 *International Fire Code* (IFC) used several different terms interchangeably to refer to these systems. This new term is now consistently used throughout the *International Building Code* (IBC) and IFC when referring to ERCCS. The new term provides a clear description of the communication system and is intended to avoid confusion.

Section 510.4.1 is revised by requiring 99 percent coverage in critical areas of the facility. This requirement correlates with Section 9.6.7.3 in the referenced standard, NFPA 1221 "Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems." NFPA 1221 requires 99 percent coverage of the floor area in critical areas. This change provides consistency with the application and enforcement of the standard.

A new definition is added in Section 202 for "critical areas." Critical areas in a building are vital to the operations of the emergency responders. Critical areas are considered to be fire command centers, exit stairs, exit passageways, elevator lobbies, fire pump rooms and sprinkler control valve locations. These critical areas must be provided with 99 percent coverage of the floor area. These areas are used during fire-fighting operations and are critical to the operation and fire fighter safety. These are areas where fire fighters typically manage operations, use to reach fire locations, stage for suppression operations, use to access and rescue trapped occupants and control fire protection systems. It is imperative that emergency communication, for both transmitting and receiving, is available.

Section 510.4.1.1 is revised by reinserting the minimum design criteria of -95 dBm into the code for the inbound signal also known as the downlink. "dBm" is an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW). This unit of measurement is used in radio, microwave and fiber-optical communication networks as a convenient measure of absolute power because of its capability to express both very large and very small values in a short form. Specifying the minimum design criteria for the downlink provides a benchmark for system designers to utilize when designing a system. The signal must be tested for minimum signal strength in addition to the delivered audio quality (DAQ) or the Signal-to-Interference-Plus-Noise Ratio (SINR), whichever is appropriate for the system. For example, the minimum signal strength of -95 dBm must be provided in addition to a minimum DAQ of 3.0.

See also Significant Change discussion for Emergency Responder Communication – Interference.

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510.4, 510.4.2.4, 510.4.2.5, 510.4.2.8, 510.5.1 (New), 510.5.4

Emergency Responder Communication Coverage – Interference

CHANGE TYPE: Modification

CHANGE SUMMARY: This series of revisions addresses potential sources of radio interference to in-building 2-way emergency responder communication coverage systems.

2021 CODE TEXT: **510.4 Technical requirements.** Equipment required to provide in-building 2-way emergency responder communication coverage shall be listed in accordance with UL 2524. Systems, components and equipment required to provide the in-building 2-way emergency responder ~~radio~~ communication coverage system shall comply with Sections 510.4.1 through 510.4.2.8.

510.4.2.4 Signal booster requirements. If used, signal boosters shall meet the following requirements:

1. through 4. *(No change in text.)*
5. ~~Bi-Directional Amplifiers (BDAs)~~ Active RF emitting devices used in in-building 2-way emergency responder ~~radio~~ communication coverage systems shall have ~~oscillation prevention~~ built-in oscillation detection and control circuitry.



Photo courtesy of Radio Solutions, Inc., Norwell, MA

Emergency responder communication coverage system with a bi-directional amplifier.

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6. The installation of amplification systems or systems that operate on or provide the means to cause interference on any in-building 2-way emergency responder ~~radio~~ communication coverage ~~networks~~ network shall be coordinated and approved by the fire code official.

510.4.2.5 System monitoring. The in-building 2-way emergency responder ~~radio enhancement~~ communication coverage system shall be monitored by a listed fire alarm control unit, or where approved by the fire code official, shall sound an audible signal at a constantly attended on-site location. Automatic supervisory signals shall include the following:

1. through 7. *(No change in text.)*
8. Oscillation of active RF-emitting devices(s).

510.4.2.8 Radio communication antenna density. Systems shall be engineered to minimize the near-far effect. ~~Radio enhancement~~ In-building 2-way emergency communication coverage system designs shall include sufficient antenna density to address reduced gain conditions.

~~Exceptions~~ Exception:

~~1. Class A narrow band signal booster devices with independent AGC/ALC circuits per channel.~~

~~2.~~ Systems where all portable devices within the same band use active power control features.

510.5.1 Mounting of the donor antenna(s). To maintain proper alignment with the system designed donor site, donor antennas shall be permanently affixed on the building or where approved, mounted on a movable sled with a clearly visible sign stating "Movement or repositioning of this antenna is prohibited without approval from the fire code official". The antenna installation shall be in accordance with the applicable requirements in the *International Building Code* for weather protection of the building envelope.

510.5.3~~4~~ Acceptance test procedure. Where an in-building 2-way emergency responder ~~radio~~ communication coverage system is required, and upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is not less than 95 percent. The test procedure shall be conducted as follows:

1. through 7. *(No change in text.)*
8. Systems ~~incorporating Class B signal-booster devices or Class B broadband fiber remote devices~~ shall be tested using two portable radios simultaneously conducting subjective voice quality checks. One portable radio shall be positioned not greater than 10 feet (3048 mm) from ~~the~~ an indoor antenna. The second portable radio shall be positioned at a distance that represents the farthest distance from any indoor antenna. With both portable radios simultaneously keyed up on different frequencies within the same band, subjective audio testing shall be conducted and comply with DAQ levels as specified in Sections 510.4.1.1 and 510.4.1.2.

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CHANGE SIGNIFICANCE: Radio interference is produced by several different factors. These sections are revised to deal with several of interference issues affecting in-building 2-way emergency responder communication coverage systems (ERCCS).

When oscillation occurs, it can create significant interference on ERCCS frequencies, to the point of rendering them inoperable. Therefore, it is not sufficient to just detect oscillation. The equipment must have the capability to control oscillation when it occurs by reducing the gain or shutting itself down, also known as self-healing. Section 510.4.2.4 is revised to specify that active radio frequency (RF) emitting devices utilized in ERCCS shall have a built-in capability to detect and control oscillation.

A revision to Section 510.4 requires communication equipment be listed and tested to perform their intended function. Oscillation detection and control is a component of the listing and testing process.

Section 510.4.2.5 lists various symptoms that have a negative impact on the proper functioning of the ERCCS. Monitoring the occurrence of oscillation in active RF emitting devices is added to this list. Monitoring oscillation will provide detailed documentation of system stability and necessary data for system performance evaluation. The detailed data related to system performance is vital when troubleshooting system issues.

Antenna density essentially is the number of antennae and the spacing of antennae. Antenna density is critical to the design and efficient function of ERCCS. Multiple handsets in a building transmitting simultaneously can result in a near-far effect. Since both handsets transmit at the same power level, the in-building receiver will receive a stronger signal for the handset closest. This is the near-far effect. Systems need to be designed so that all transmissions are received, not just the strongest signal. The near-far effect prohibits a second responder such as an EMS or fire crew working in another area of the structure communicating on a different talk group from being able to transmit on their radios, thereby creating a life safety issue. While the Class A narrow band signal booster devices identified in Section 510.4.2.8, Exception 1 are not affected as much as Class B, the near-far effect can still occur. Therefore, Exception 1 is deleted and now requires that system designers address near-far conditions regardless of equipment type. The revision to Section 510.5.4, Item 8 addresses the same issue with Class B signal booster devices. The combined effect of these two revisions is that all ERCCS, including both Class A and Class B, must be tested using two portable radios simultaneously to conduct voice quality checks as required in Section 510.5.4 Item 8.

The donor antenna is the antenna that provides the link between the jurisdiction's communication system and the in-building communication system. The location and position of the donor antenna is critical to the successful operation of an ERCCS. Section 510.5.1 is added to address mounting of the donor antenna. There are two methods of mounting donor antennas, either permanently fixed or on an antenna sled held down by weights. Mounting the donor antenna in a fixed position limits the amount of movement that may occur. Although antenna sleds are common practice for mounting various types of antennas on a roof, those utilized for ERCCS should be approved by the fire code official. Adding signage about the public safety use alerts others such as roofers or HVAC

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repair personnel to their importance and the need to provide notification prior to moving them and rendering the public safety in-building communications system inoperable.

See also Significant Change discussion for Emergency Responder Communication – Signals.

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603.4

Electrical Working Space

CHANGE TYPE: Modification

CHANGE SUMMARY: Working space dimensions around electrical equipment are revised to correlate with NFPA 70.

2021 CODE TEXT: **603.4 Working space and clearance clearances.** Working space around electrical equipment shall be provided in accordance with Section 110.26 of NFPA 70 for electrical equipment rated 1000 volts or less, and Section 110.33 of NFPA 70 for electrical equipment rated over 1000 volts. ~~A~~ The minimum required working space ~~of~~ shall not be less than 30 inches (762 mm) in width, 36 inches (914 mm) in depth and 78 inches (1981 mm) in height ~~shall be provided~~ in front of electrical service equipment. Where the electrical service equipment is wider than 30 inches (762 mm), the minimum working space shall be not less than the width of the equipment. Storage of materials shall not be located within the designated working space.

~~Exceptions:~~

~~1. Where other dimensions are required or allowed by NFPA 70.~~

~~2. Access openings into attics or under-floor areas that provide a minimum clear opening of 22 inches (559 mm) by 30 inches (762 mm).~~

CHANGE SIGNIFICANCE: The chapter has been reformatted in the 2021 edition. This section was Section 604.3 in the 2018 *International Fire Code* (IFC).



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The depth of the working space in this facility would be based on Condition 3 in the table on the next page.

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Clearance and working space around electrical equipment are provided for several reasons. Most important is the protection of personnel working in or on the electrical equipment. Another reason is for access by fire-fighting personnel during an emergency.

As the voltage increases, the ability for current to leap a gap to ground increases, and the greater the potential for injury of personnel using or working on the equipment. As a result, the separations listed in the 2018 IFC provide for the minimum working space. At higher voltages, the working space and clearances increase.

This section was revised to address those increased separation requirements and correlate the requirements in the IFC with those in NFPA 70 *National Electrical Code*. The dimensions of 30 inches wide, 36 inches deep and 78 inches high are retained in the code as the minimums. Two sections in NFPA 70 are referenced which require greater distances. Section 110.26 contains requirements for equipment operating at 1,000 volts or less and Section 110.33 contains requirements for equipment operating at more than 1,000 volts.

The table below contains the required distances found in NFPA 70. The clear space is dependent on what equipment, if any, is opposite the electrical equipment in question. For example, picture a fire fighter at the electrical panel. The working space must be a minimum of 36 inches deep measured out from the panel. If other electrical equipment is located behind the fire fighter, the separation distance increases. The objects behind the fire fighter create a condition which may create a hazard. These conditions are classified as follows, and are used in the table below:

- Condition 1 – exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials.
- Condition 2 – exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space. Concrete, brick or tile are to be considered grounded.
- Condition 3 – exposed live parts on both sides of the working space.

	Minimum Depth of Working Space (feet)		
Voltage	**Condition 1**	**Condition 2**	**Condition 3**
150 or less	3	3	3
151 – 600	3	3.5	4
601 – 1,000	3	4	5
1,001 – 2,500	3	4	5
2,501 – 9,000	4	5	6
9,001 – 25,000	5	6	9
25,001 – 75,000	6	8	10
Over 75,000	8	10	12

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604.5.4 (New), 604.5.5 (New), 315.3.3

Storage in Elevator Machine Rooms and Lobbies

CHANGE TYPE: Addition

CHANGE SUMMARY: Storage is prohibited in elevator lobbies, elevator cars and elevator machine rooms.

2021 CODE TEXT: **604.5.3 Storage within elevator lobbies.** Where hoistway opening protection is required by Section 3006.2 of the *International Building Code*, elevator lobbies shall be maintained free of storage.

604.7 Storage. Storage is prohibited in elevator cars or elevator machine rooms.

Exceptions:

1. Blankets used for protection of elevator cab walls during construction or renovation.
2. Materials necessary for the operation and maintenance of the elevator equipment.

315.3.3 Equipment rooms. Combustible material shall not be stored in boiler rooms, mechanical rooms, elevator machine rooms, electrical equipment rooms or in fire command centers as specified in Section 508.1.5.

CHANGE SIGNIFICANCE: Chapter 6 in the 2018 *International Fire Code* (IFC) contains provisions prohibiting storage of furniture and combustibles in lobbies serving fire service access elevators and occupant evacuation elevators. The new Section 604.5.4 now prohibits storage in lobbies for elevators that are required to have hoistway opening protection.



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Storage is not allowed in elevator lobbies.

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This prohibition applies if an elevator lobby is provided and if Section 3006.2 of the *International Building Code* (IBC) requires hoistway opening protection. Hoistway protection is required in the following situations:

- The elevator hoistway connects more than three stories and the building contains a Group I-1, Condition 2, Group I-2 or Group I-3 occupancy.
- The elevator hoistway connects more than three stories and the building is a high-rise and the elevator hoistway is more than 75 feet in height.
- The elevator hoistway connects more than three stories and the building is not equipped with an automatic sprinkler complying with NFPA 13 or 13R.
- Regardless of the number of stories connected, if the elevator hoistway opens into a fire-resistance-rated corridor.

Section 604.5.5 prohibits storage in the elevator car and in elevator machine rooms. Exceptions are included to allow blankets and pads used to protect the elevator walls during construction or moving furniture and equipment, and combustibles that are part of the normal operation and maintenance of the elevator and elevator equipment.

A correlating revision was made to Section 315.3.3 to ensure that the elevator machine rooms are not used for storage.

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605.1, 605.4, 605.4.1.1 (New), 605.4.2.1 (New), 605.4.2.2

Fuel Oil Storage Tanks

CHANGE TYPE: Modification

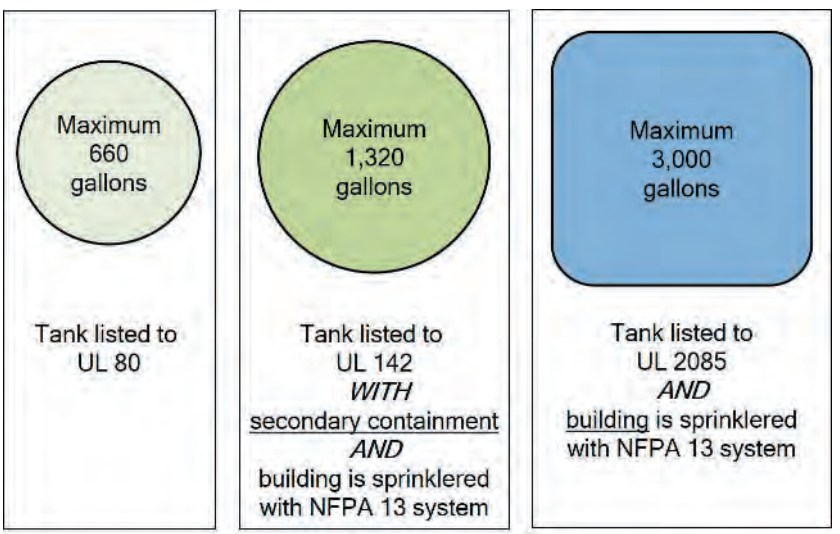
CHANGE SUMMARY: Requirements for fuel-oil tanks are enhanced with specific standards for tank design, a correlating reference to the *International Mechanical Code* (IMC) and additional protection when tanks in a building exceed 660 gallons.

2021 CODE TEXT: **605.1 ~~Installation~~ General.** The design, construction, installation, operation, alteration, repair and maintenance of nonportable gas-fired appliances and systems shall comply with the provisions of this section and the *International Fuel Gas Code*. The design, construction, installation, ~~of nonportable liquid fuel-fired~~ operation, alteration, repair and maintenance of nonportable solid-fuel-fired and oil-fired appliances and systems shall comply with the provisions of this section and the *International Mechanical Code*. The ~~installation of all other~~ construction and use of portable fuel-fired appliances~~, other than portable internal combustion engines, oil lamps and other portable devices~~ not connected to a fixed fuel piping system, such as blow torches, melting pots and weed burners, shall comply with this section ~~and the *International Mechanical Code*~~.

605.4 Fuel oil storage systems. Fuel oil storage systems shall be installed and maintained in accordance with this code. ~~Fuel-oil~~ Tanks and fuel-oil piping systems shall be installed in accordance with Chapter 13 of the *International Mechanical Code*.

605.4.1.1 Approval. Outdoor fuel-oil storage tanks shall be in accordance with UL 80, UL 142 or UL 2085.

605.4.2.1 Approval. Indoor fuel-oil storage tanks shall be in accordance with UL 80, UL 142 or UL 2085.



The capacity of the fuel-oil storage tank determines the level of protection required and the allowed listings for the tank.

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605.4.2.2 Quantity limits. One or more fuel oil storage tanks containing Class II or III combustible liquid shall be permitted in a building. The aggregate capacity of all tanks shall not exceed the following:

1. 660 gallons (2498 L) in unsprinklered buildings, where stored in a tank complying with UL 80, UL 142 or UL 2085.
2. 1,320 gallons (4996 L) in buildings equipped with an automatic sprinkler system in accordance with Section 903.3.1.1, where stored in a tank complying with UL 142. The tank shall be listed as a secondary containment tank, and the secondary containment shall be monitored visually or automatically.
3. 3,000 gallons (11 356 L) in buildings equipped with an automatic sprinkler system in accordance with Section 903.3.1.1, where stored in protected above-ground tanks complying with UL 2085 and Section 5704.2.9.7 ~~and the room is protected by an automatic sprinkler system in accordance with Section 903.3.1.1~~. The tank shall be listed as a secondary containment tank, as required by UL 2085, and the secondary containment shall be monitored visually or automatically.

CHANGE SIGNIFICANCE: Chapter 6 has been reformatted in the 2021 edition. This portion of Chapter 6 was Section 603 in the 2018 *International Fire Code* (IFC). Several revisions occurred which address fuel-oil storage for fuel-fired appliances in a building.

The first change, in Section 605.1, revised the scoping of this section. Section 605 now addresses solid-fuel-fired appliances in addition to the gaseous-fuel-fired (i.e., propane) and liquid-fuel-fired (i.e., diesel) appliances. Additionally, the scope was clarified to specify that this section applies to:

- nonportable solid-fuel-fired and oil-fired appliances.
- portable fuel-fired appliances not connected to a fixed piping system.

Note that the reference to portable appliances is for "fuel-fired" appliances. This would include any fuel, such as solid-fueled (hickory or oak), oil-fueled (diesel or fuel-oil) and gaseous-fueled (propane or butane).

The new Section 605.4.1.1 requires outside tanks storing fuel oil to comply with UL 80, UL 142 or UL 2085. Similarly, Section 605.4.2.1 is added to require storage tanks inside a building to comply with any of these same standards.

Fuel oil is not defined in the IFC, but it is defined in the IMC as "Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C)." Section 201.3 states that terms not defined in the IFC, but defined in other I-Codes, use the definition ascribed in the other code. Therefore, under this definition, diesel fuel with a typical flash point of 125°F is considered a fuel oil, and therefore regulated under this section for fire pump fuel, generator fuel or other uses.

Section 605.4.2.2 limits the size of tanks storing fuel oil. The allowance of 1,320 gallons in Item 2 has been revised to require a secondary containment tank. Tanks built to UL 142 can be constructed as double-wall tanks, which provides the secondary containment. The difference between the UL 142 secondary containment tank and the UL 2085 secondary containment tank is that the UL 2085 tank is designed to withstand

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a 2-hour fire exposure. The UL 142 secondary containment tank will be exposed steel providing the secondary containment. If the UL 142 secondary containment tank is utilized, it requires visual monitoring or automatic monitoring of the interstitial space creating the secondary containment.

Section 605.4.2.2, Item 3 has also been revised. To increase the quantity up to 3,000 gallons, the building must now be fully sprinklered and visual or automatic monitoring of the interstitial space on the UL 2085 tank is also required.

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610

Clothes Dryer Exhaust Ducts

CHANGE TYPE: Addition

CHANGE SUMMARY: Provisions are added to ensure the clothes dryer lint trap and exhaust duct are cleaned and maintained properly.

2021 CODE TEXT:

Section 610
Clothes Dryer Exhaust Systems

610.1 Clothes dryer exhaust ducts. Clothes dryer exhaust ducts shall be in accordance with Sections 610.1.1 and 610.1.2.

610.1.1 Installation. Clothes dryer vent ducts shall be installed and maintained in accordance with the *International Mechanical Code* or the *International Fuel Gas Code* and the manufacturer's installation instructions.

610.1.2 Maintenance. The lint trap, mechanical and heating components, and the exhaust duct system of a clothes dryer shall be maintained in accordance with the manufacturer's operating installation instructions to prevent the accumulation of lint or debris that prevents the exhaust of air and products of combustion.

CHANGE SIGNIFICANCE: National Fire Protection Association (NFPA) tracks fire incidents and causes in the United States. NFPA reports that between 2010 and 2014, over 14,500 fires occurred where the fire origin was a clothes dryer. The leading cause of dryer fires was lack of cleaning.

This new section is added to specifically address the maintenance of clothes dryer exhaust duct systems. The installation of the dryer vent duct must comply with Section 504 of the *International Mechanical Code* (IMC) and the manufacturer's instructions. The maintenance of vent ducts, lint traps and filters is required to ensure these duct systems are maintained in a safe condition.



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The build-up of lint and debris in dryer exhaust ducts causes overheating and presents a fire problem.

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701.6

Maintenance of Fire-Resistance-Rated Construction

CHANGE TYPE: Modification

CHANGE SUMMARY: Owner inspections are required annually for fire-resistance-rated protection of mass timber construction.

2021 CODE TEXT: **701.6 Owner's responsibility.** The owner shall maintain an inventory of all required fire-resistance-rated construction, construction installed to resist the passage of smoke and the construction included in Sections 703 through 707 and Sections 602.4.1 and 602.4.2 of the *International Building Code*. Such construction shall be visually inspected by the owner annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated. Records of inspections and repairs shall be maintained. Where concealed, such elements shall not be required to be visually inspected by the owner unless the concealed space is accessible by the removal or movement of a panel, access door, ceiling tile or similar movable entry to the space.

CHANGE SIGNIFICANCE: The use of cross-laminated timber is becoming more frequent. Several code changes occurred in both the *International Fire Code* (IFC) and *International Building Code* (IBC) to address this construction method. Revisions in the IBC provide definitions for mass timber and noncombustible protection for mass timber as follows:

> **MASS TIMBER.** Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.
>
> **NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER).** Noncombustible material, in accordance with Section 703.5, designed to increase the fire-resistance rating and delay the combustion of mass timber.



Photo courtesy of American Wood Council

Type IVA construction requires mass timber to have noncombustible protection.

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This revision to IFC Section 701.6 addresses the maintenance of the fire-resistant components of mass timber construction. Sections 602.4.1 and 602.4.2 in the IBC are referenced and the IFC requires maintenance of the fire-resistance-rated construction required in those sections.

IBC Section 602.4.1 contains provisions for building construction of the Type IVA. Type IVA is mass timber with fire-resistance-rated components covering the mass timber members. For Type IVA construction, the outside face of mass timber construction in exterior walls must be protected with noncombustible construction providing a 40-minute fire-resistance rating. Interior mass timber elements must be protected with noncombustible construction providing a fire-resistance rating of 80 minutes.

IBC Section 602.4.2 contains provisions for building construction of the Type IVB. Type IVB is mass timber with fire-resistance-rated components covering portions of the mass timber members. For Type IVB construction, the outside face of mass timber construction in exterior walls must be protected with noncombustible construction providing a 40-minute fire-resistance rating. Interior mass timber elements must be protected with noncombustible construction providing a fire-resistance rating of 80 minutes. With Type IVB construction, portions of the mass timber elements are allowed to be unprotected. The allowable portion of exposed mass timber is up to 40 percent of walls and 20 percent of ceilings.

Inclusion of these requirements creates a responsibility for the owner to have inspections completed annually and any damaged or missing protection repaired or replaced. The interior inspection will typically consist of visual inspection of gypsum board. The 80-minute rating can be achieved with two layers of 5/8 inch Type X gypsum board. The construction documents, or an inventory of fire-resistance-rated components as required in IFC Section 701.6, will be necessary to properly conduct an inspection in Type IVB construction since portions of the mass timber can be exposed.

IFC Section 701.6 allows these inspections to be done by building staff. Local jurisdictions may or may not require the annual inspection to be reported. The building management must ensure it is completed, keep records of inspections and take steps to correct any deficiencies identified.

For additional information on Type IV construction and mass timber, see Significant Changes to the 2021 IBC.

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703.2, 704.2

Repair of Penetrations and Voids

CHANGE TYPE: Addition

CHANGE SUMMARY: Specific requirements have been added to the code for repair or replacement of penetrations, joints and voids in fire-resistance-rated construction.

2021 CODE TEXT: **703.2 Repair of Penetrations.** Where damaged, materials used to protect membrane- and through-penetrations shall be replaced or restored with materials or systems that meet or exceed the code requirements applicable at the time when the assembly was constructed, remodeled or altered.

704.2 Repair of Joints and Voids. Where damaged, materials used to protect joints and voids shall be replaced or restored with materials or systems that meet or exceed the code requirements applicable at the time when the assembly was constructed, remodeled or altered.

CHANGE SIGNIFICANCE: Fire barriers, fire walls and horizontal assemblies require protection of penetrations, joints and voids. *International Fire Code* (IFC) Section 701.2 provides a general requirement for maintenance of all fire-resistance ratings. These new sections provide specific guidance for repair or replacement of materials protecting penetrations, joints and voids.

Over the years, the acceptable methods of protecting penetrations and voids have changed. New test standards have been developed and new products have come to market. These revisions specify two things in each section. First, damaged or missing material protecting penetrations must



The through penetrations are sealed and must be properly maintained throughout the life of the building.

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be repaired or replaced. Second, the method of repair does not need to meet the current code. The method or material must meet the requirements of the code applicable at the time of construction.

These sections allow the continued use of previously approved methods of protection. This allowance to grandfather protection methods that may no longer be approved by the code meets the intent of maintaining the level of protection. When the penetration and joint seals are damaged, they need to be repaired or replaced. When replacement occurs, the method of protection is required to meet the requirements that were applicable when the penetration or joint protection was installed.

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708, 708.1

Maintenance of Spray Fire-Resistant Materials

CHANGE TYPE: Addition

CHANGE SUMMARY: Maintenance requirements for spray fire-resistant materials and intumescent fire-resistant materials are added to the code.

2021 CODE TEXT:

SECTION 708

SPRAY FIRE-RESISTANT MATERIALS AND INTUMESCENT FIRE-RESISTANT MATERIALS

708.1 Maintaining protection. Where required when the building was originally permitted and constructed, spray fire-resistant materials and intumescent fire-resistant materials shall be visually inspected to verify that the materials do not exhibit exposure to the substrate.



The spray fire-resistant material on this column has been damaged. The steel underneath is exposed and portions have been compressed.

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CHANGE SIGNIFICANCE: This new section addresses the maintenance of fire-resistant materials applied typically to structural components. Two main categories of products are spray applied fire-resistant materials (SFRM) and intumescent fire-resistant materials (IFRM). The IFRM products can be applied either by spraying or troweling operation.

International Fire Code (IFC) Section 701.2 provides a general requirement for maintenance of all fire-resistance ratings. This new section provides specific guidance for sprayed fire-resistant materials and intumescent fire-resistant materials.

Spray fire-resistant materials are insulating products applied to the surface of the steel structure. They provide insulation to retard heat transfer and are designed to maintain the temperature of the steel below 1,200°F for the specified time duration. Intumescent fire-resistant materials must pass the same test criteria, but IFRMs protect the steel with a different strategy. Intumescent fire-resistant materials react to heat and expand to provide a layer of "insulation." The material provides an insulating char that protects the steel from the fire temperatures for a period of time resulting in the fire resistance of the steel. The level of fire performance is based on the thickness of the applied IFRM. IFRMs do not expand quickly—the expansion process is a slow char growth until it reaches its engineered insulating thickness. Some IFRMs expand up to twenty times the original installed thickness when exposed to fire.

Both products are tested and approved with samples that are not damaged, cracked or compressed. When steel is exposed, it is likely for the steel temperature to exceed the 1,200°F which will weaken the steel member and lead to failure. The damaged areas must be identified and patched or repaired.

Additional information on application and maintenance can be found in the Handbook of Accepted Fireproofing Knowledge published by the National Fireproofing Contractors Association. This document is available at https://www.nfca-online.org/resources/standard-practice.asp.

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808.5 (New)

Play Structures

CHANGE TYPE: Addition

CHANGE SUMMARY: Play structures added to existing buildings must comply with the requirements in the *International Building Code* (IBC).

2021 CODE TEXT: **808.5 Play structures added to existing buildings.** Where play structures that exceed 10 feet (3048 mm) in height or 150 square feet (14 m²) in area are added inside an existing building they shall comply with Section 424 of the *International Building Code*.

CHANGE SIGNIFICANCE: The *International Fire Code* (IFC) contains requirements for interior finishes, decorative materials and furnishings in new and existing buildings so that they do not significantly add, or create, significant fire hazards in buildings. The 2018 IFC does not contain any specific requirements for play structures that are installed in an existing building. IBC Section 424 regulates play structures for new buildings. The IBC deals with play structures at the time of building construction, but these structures are often added into malls, restaurants and gyms after the certificate of occupancy has been granted.

This revision directs the code user to the requirements in the IBC. When the equipment is brought into the building, or the equipment is replaced, this section points to the IBC for the play structure design and construction. Fire tests conducted on play structures showed that these children's playground structures or play structures can release very large amounts of heat when they burn.

When play structures exceed either 10 feet in height or 150 square feet in area they must comply with the requirements in the IBC. Section 424 of the IBC was also revised in the 2021 edition. In general, the requirements are as follows:

1. Materials must be noncombustible or fire-resistant.
2. Foam plastics can have a maximum heat-release rate not greater than 100 kW.



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Play structures contain large volumes of combustible materials and plastics.

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3. Plastic materials used to construct rigid components can have a maximum heat release not exceeding 400 kW/m^2.
4. Balls can have a maximum heat-release rate not greater than 100 kilowatts.
5. Floor covering shall be Class I interior floor finish.
6. Play structures greater than 300 square feet in area or 10 feet in height shall not exceed the flame spread ratings in IBC Table 803.13 based on the occupancy classification for the building.
7. Installation of fire suppression and detection devices as would be required for other structures in the occupancy.
8. Play structures greater than 600 square feet in area shall demonstrate adequate fire safety.
9. Play structures greater than 300 square feet in area or 10 feet in height shall be meet the structural requirements in IBC Section 1601.1.

Note: Items 6 and 9 above are new in the 2021 edition. Item 8 was revised from 300 to 600 square feet in the 2021 edition.

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202 (New), 901.1, 901.2, 901.2.1, 901.4, 901.4.1, 901.4.2, 901.4.3 (New), 901.4.5, 901.6

Life Safety Systems

CHANGE TYPE: Modification

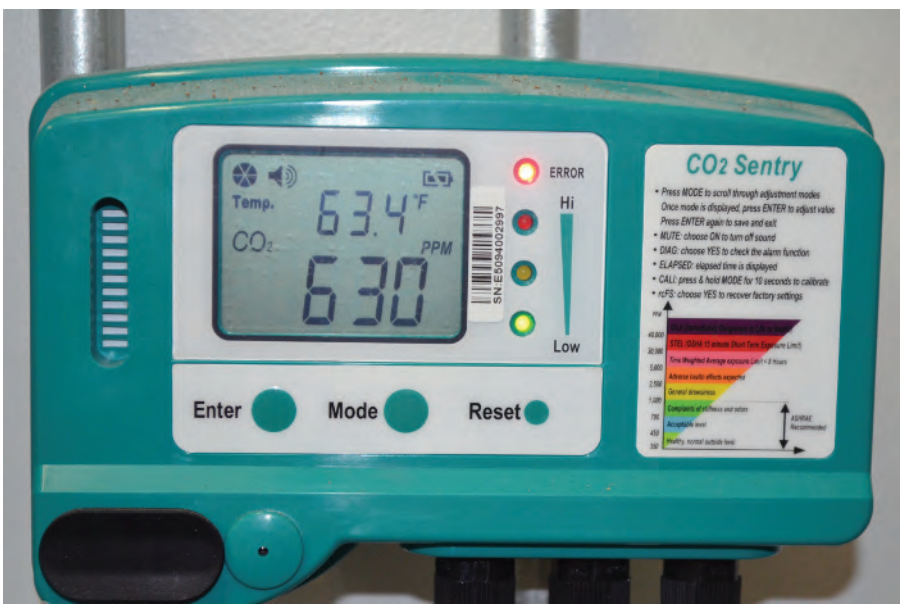
CHANGE SUMMARY: A definition for life safety systems is added and sections modified to address provisions in Chapter 9 that address life safety systems in addition to fire protection systems.

2021 CODE TEXT: **202 LIFE SAFETY SYSTEMS.** Systems, devices and equipment that enhance or facilitate evacuation, smoke control, compartmentation or isolation.

901.1 Scope. The provisions of this chapter shall specify where fire protection and life safety systems are required and shall apply to the design, installation, inspection, operation, testing and maintenance of all fire protection and life safety systems.

901.2 Construction documents. The fire code official shall have the authority to require construction documents and calculations for all fire protection and life safety systems and to require permits be issued for the installation, rehabilitation or modification of any fire protection and life safety system. Construction documents for fire protection and life safety systems shall be submitted for review and approval prior to system installation.

901.2.1 Statement of compliance. Before requesting final approval of the installation, where required by the fire code official, the installing contractor shall furnish a written statement to the fire code official that the subject fire protection or life safety system has been installed in accordance with approved plans and has been tested in accordance with the manufacturer's specifications and the appropriate installation standard. Any deviations from the design standards shall be noted and copies of the approvals for such deviations shall be attached to the written statement.



This carbon dioxide detector would be considered a life safety system.

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901.4 Installation. ~~Fire protection systems shall be maintained in accordance with the original installation standards for that system. Required systems shall be extended, altered or augmented as necessary to maintain and continue protection where the building is altered, remodeled or added to. Alterations to fire protection systems shall be done in accordance with applicable standards.~~ **Fire Protection and life safety systems.** Fire protection and life safety systems shall be installed, repaired, operated and maintained in accordance with this code and the *International Building Code.*

901.4.1 Required fire protection and life safety systems. Fire protection and life safety systems required by this code or the International Building Code shall be installed, repaired, operated, tested and maintained in accordance with this code. A fire protection or life safety system for which a design option, exception or reduction to the provisions of this code or the *International Building Code* has been granted shall be considered to be a required system.

901.4.2 Nonrequired fire protection and life safety systems. ~~A fire protection system~~ Fire protection and life safety systems or portion thereof not required by this code or the *International Building Code* shall be allowed to be furnished for partial or complete protection provided that such installed ~~system meets~~ systems meet the applicable requirements of this code and the International Building Code.

901.4.3 Alterations in Buildings and Structures. For any alteration within a building or structure, the fire protection and life safety systems shall be extended, altered or augmented to maintain and continue protection within the building or structure. Persons shall not remove or modify any fire protection or life safety system installed or maintained under the provisions of this code or the *International Building Code* without approval by the fire code official.

901.4.45 Additional fire protection systems. In occupancies of a hazardous nature, where special hazards exist in addition to the normal hazards of the occupancy, or where the fire code official determines that access for fire apparatus is unduly difficult, the fire code official shall have the authority to require additional safeguards and fire protection systems. ~~Such safeguards include, but shall not be limited to, the following: automatic fire detection systems, fire alarm systems, automatic fire-extinguishing systems, standpipe systems, or portable or fixed extinguishers.~~ Fire protection ~~equipment~~ and life safety systems required under this section shall be installed in accordance with this code and the applicable referenced standards.

901.6 Inspection, testing and maintenance. ~~Fire detection and alarm systems, emergency alarm systems, gas detection systems, fire-extinguishing systems, mechanical smoke exhaust systems and smoke and heat vents~~ Fire protection and life safety systems shall be maintained in an operative condition at all times, and shall be replaced or repaired where defective. Nonrequired fire protection and life safety systems and equipment shall be inspected, tested and maintained or removed in accordance with Section 901.8.

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CHANGE SIGNIFICANCE: In the 2018 *International Fire Code* (IFC) and *International Building Code* (IBC), the title of Chapter 9 was revised to include life safety systems. The inclusion of life safety systems acknowledges that Chapter 9 addresses fire protection systems and other systems which are life safety systems rather than fire protection systems. These systems include emergency alarms, carbon monoxide detection, mass notification and gas detection. This new code change adds a definition for the term "life safety system."

Section 901.4 is revised by including life safety systems in the requirement for fire protection systems and life safety systems to comply with appropriate installation and maintenance criteria. Additionally, a portion of Section 901.4 is relocated into a new Section 901.4.3 to address alterations in existing buildings. This new section specifically states that fire protection systems and life safety systems must be extended or modified to continue to provide proper coverage when buildings are altered.

Section 901.6 is revised by removing the partial list of fire protection systems and simply referring to fire protection systems in general. This revision also includes life safety systems, requiring inspection, testing and maintenance of the life safety systems. Required and nonrequired life safety systems must be maintained, in line with requirements for fire protection systems; however, a nonrequired system can be removed with the approval from the fire code official, as indicated in Section 901.8.

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903.2.4.2 (New), 903.2.9.3 (New)

Distilled Spirits

CHANGE TYPE: Addition

CHANGE SUMMARY: Fire areas containing Group F-1 occupancies used for the manufacturing of distilled spirits or Group S-1 occupancies used for the storage of distilled spirits or wine are required to be equipped with an automatic sprinkler system.

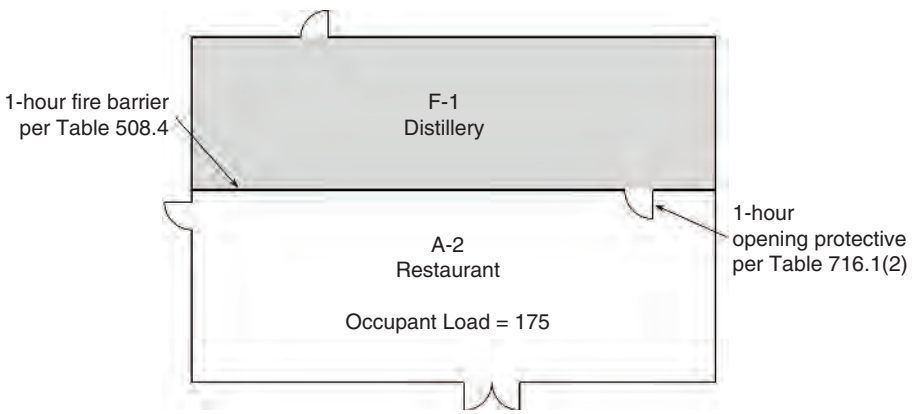
2021 CODE TEXT: **903.2.4.2 Group F-1 distilled spirits.** An automatic sprinkler system shall be provided throughout a Group F-1 fire area used for the manufacture of distilled spirits.

903.2.9.3 Group S-1 distilled spirits or wine. An automatic sprinkler system shall be provided throughout a Group S-1 fire area used for the bulk storage of distilled spirits or wine.

CHANGE SIGNIFICANCE: The manufacturing of distilled spirits occurs frequently as accessory to a restaurant or club, creating an increased hazard in these facilities. This set of changes addresses distilleries and the storage of distilled spirits and wine. The restaurant will have an occupancy classification of Group A-2 if the occupant load is 50 or more. When attached to a Group A-2 occupancy, the distillery portion must receive a separate occupancy classification based on the use and operation in that portion of the building.

Section 903.2.4.2 requires that the fire area containing a distillery operation must be equipped with an automatic sprinkler system. This requirement is regardless of size of the fire area. Note that typical Group F-1 sprinkler requirements stipulate that the building is sprinklered (Section 903.2.4). However, this requirement for distilleries only requires the fire area to be protected with fire sprinklers.

When the distillery is attached to a restaurant or bar with an occupant load of 100 or more, the requirements for fire sprinklers in the Group A-2 occupancy require that the entire floor is sprinklered and all floors to and including the level of exit discharge.



This restaurant and attached distillery are constructed as a separated mixed occupancy and require a 1-hour fire barrier separating the Group A-2 from the Group F-1 when the entire building is sprinklered.

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Section 903.2.9.3 is also added which requires fire areas classified as Group S-1 occupancies and used for bulk storage of distilled spirits or wine to be equipped with an automatic sprinkler system. Storage of wine with alcohol content 16 percent or less would be classified as a Group S-2 occupancy.

Neither of these new code sections include a threshold that must be exceeded. Therefore, any stored quantity of bulk distilled spirits or wines requires an automatic sprinkler system throughout the fire area. Also, any fire area classified as Group F-1 where distilled spirits or wines are manufactured requires an automatic sprinkler system.

See also commentary for Chapter 40 "Storage of Distilled Spirits and Wines."

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903.2.4, 903.2.4.3 (New), 903.2.7, 903.2.7.2 (New), 903.2.9, 903.2.9.4 (New)

Upholstered Furniture and Mattresses

CHANGE TYPE: Modification

CHANGE SUMMARY: Requirements for the installation of an automatic sprinkler system in facilities manufacturing, storing or selling upholstered furniture and mattresses have been revised.

2021 CODE TEXT: **903.2.4 Group F-1.** An automatic sprinkler system shall be provided throughout all buildings containing a Group F-1 occupancy where one of the following conditions exists:

1. A Group F-1 fire area exceeds 12,000 square feet (1115 m²).
2. A Group F-1 fire area is located more than three stories above grade plane.
3. The combined area of all Group F-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m²).
4. ~~A Group F-1 occupancy used for the manufacture of upholstered furniture or mattresses exceeds 2,500 square feet (232 m²).~~

903.2.4.3 Group F-1 upholstered furniture or mattresses. An automatic sprinkler system shall be provided throughout a Group F-1 fire area that exceeds 2,500 square feet (232 m²) used for the manufacture of upholstered furniture or mattresses.

903.2.7 Group M. An automatic sprinkler system shall be provided throughout buildings containing a Group M occupancy where one of the following conditions exists:

1. A Group M fire area exceeds 12,000 square feet (1115 m²).
2. A Group M fire area is located more than three stories above grade plane.



This self-service storage facility would not require fire sprinklers because it is only one story and all units can be accessed from the exterior.

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3. The combined area of all Group M fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m²).

~~4. A Group M occupancy used for the display and sale of upholstered furniture or mattresses exceeds 5,000 square feet (464 m²).~~

903.2.7.2 Group M upholstered furniture or mattresses. An automatic sprinkler system shall be provided throughout a Group M fire area where the area used for the display and sale of upholstered furniture or mattresses exceeds 5,000 square feet (464 m²).

903.2.9 Group S-1. An automatic sprinkler system shall be provided throughout all buildings containing a Group S-1 occupancy where one of the following conditions exists:

1. A Group S-1 fire area exceeds 12,000 square feet (1115 m²).
2. A Group S-1 fire area is located more than three stories above grade plane.
3. The combined area of all Group S-1 fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m²).
4. A Group S-1 fire area used for the storage of commercial motor vehicles where the fire area exceeds 5,000 square feet (464 m²).

~~5. A Group S-1 occupancy used for the storage of upholstered furniture or mattresses exceeds 2,500 square feet (232 m²).~~

903.2.9.4 Group S-1 upholstered furniture and mattresses. An automatic sprinkler system shall be provided throughout a Group S-1 fire area where the area used for the storage of upholstered furniture or mattresses exceeds 2,500 square feet (232 m²).

Exception: Self-service storage facilities not greater than one story above grade plane where all storage spaces can be accessed directly from the exterior.

CHANGE SIGNIFICANCE: Since the fire sprinkler requirements for upholstered furniture and mattresses were first added into the code there has been debate and discussion on exactly how the provisions should be applied. Because the language could be interpreted in several ways, it has led to inconsistent application and in some situations to sprinklers being required although many felt there was not a great enough hazard to justify the need for the protection. This code change modifies the sprinkler requirements for these special hazard items in Groups F-1, M and S-1 occupancies to clarify not only when the sprinkler requirements apply, but also what portions of the building require fire sprinkler systems.

Looking at the 2018 *International Fire Code* (IFC) text for a Group F-1 occupancy will help illustrate not only the problem with the previous language, but also how the provision has changed. Under the 2018 code text, if a business involved in the manufacture of upholstered furniture was 5,000 square feet in size, but the area "used for the manufacture" of the furniture was only 1,000 square feet it was difficult to determine how the provision was to be applied. In addition, even if the area used for the actual manufacturing was very limited, for example 500 square feet, then

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the sprinkler protection was required not only in the area to address the unique hazard the upholstered furniture creates, but it also needed to be extended throughout the building.

The first change is that the requirement for sprinklers is relocated from the list of items under each occupancy classification into a separate section. These new sections specify that when fire sprinklers are required, they are only required to be installed throughout the fire area. This is different from the main requirement for each occupancy which requires fire sprinklers to be installed throughout the building. This revision provides for the fire sprinkler system to be installed within the fire area creating the higher hazard.

An exception has been added to Section 903.2.9.4 for Group S-1 occupancies used as self-storage facilities that are only one story. This exception allows for the elimination of fire sprinklers if all of the units in the self-service storage facility can be accessed directly from the exterior.

Finally, a revision has occurred in the wording of the requirement itself for Group M and S-1 occupancies. For example, Section 903.2.7.2 requires fire sprinklers in a Group M if "the ***fire area used for the display and sale*** [emphasis added] of upholstered furniture or mattresses exceeds 5,000 square feet." This subtle change means that there are actually 5,000 square feet of upholstered furniture or mattresses, rather than meaning that the fire area exceeds 5,000 square feet. This change results from the wording of the section in prior editions, which required an automatic fire sprinkler system throughout the entire building where a Group M fire area greater than 5,000 square feet had a single upholstered chair on display. These changes now look at the size of the actual area occupied by upholstered furniture or mattresses.

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903.2.10, 903.2.11.3

Group S-2 Parking Garages

CHANGE TYPE: Modification

CHANGE SUMMARY: Open parking garages are required to be equipped with an automatic sprinkler system when the fire area exceeds 48,000 square feet.

2021 CODE TEXT: **903.2.10 Group S-2 ~~enclosed~~ parking garages.** An automatic sprinkler system shall be provided throughout buildings classified as ~~enclosed~~ parking garages ~~in accordance with Section 406.6 where either~~ where any of the following conditions exist:

1. Where the fire area of the enclosed parking garage, in accordance with Section 406.6 of the *International Building Code,* exceeds 12,000 square feet (1115 m^2).
2. Where the enclosed parking garage, in accordance with Section 406.6 of the *International Building Code* is located beneath other groups.

   Exception: Enclosed parking garages located beneath Group R-3 occupancies.
3. Where the fire area of the open parking garage in accordance with Section 406.5 of the *International Building Code* exceeds 48,000 square feet (4460 m^2).

903.2.11.3 Buildings 55 feet or more in height. An automatic sprinkler system shall be installed throughout buildings that have one or more stories with an occupant load of 30 or more located 55 feet (16 764 mm) or more above the lowest level of fire department vehicle access, measured to the finished floor.

~~Exceptions:~~ Exception:

~~1. Open parking structures.~~

~~2.~~ Occupancies in Group F-2.



New construction of an open parking garage with a fire area exceeding 48,000 square feet is required to install an automatic sprinkler system.

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CHANGE SIGNIFICANCE: Historically, open parking garages have been considered to have a very low fire risk, which has led to dozens of special allowances for reduced code requirements in these occupancies. Fire tests run decades ago offered support for this perspective. However, it is common knowledge that many components of vehicles currently manufactured are combustible. Many of the body and interior components that previously have been steel are now plastic, rubber, fiberglass and lightweight metals. The new methods of vehicle construction facilitate vehicle-to-vehicle fire spread and production of dense combustible smoke layers. Stored energy systems in electric vehicles also increase the fuel load. Nevertheless, the wisdom of exempting open parking garages from many code requirements that would otherwise apply has largely gone unchallenged, lacking sufficient evidence to demonstrate the existence of a problem.

An open parking garage fire in Liverpool, UK on January 1, 2018 demonstrated the fire risk associated with the new methods of vehicle construction. The concrete building and 1,400 cars were destroyed by a fire that reportedly started in a single vehicle's engine compartment. The concept of fire risk mitigation by allowing heat and smoke to escape through the open perimeter of an open parking garage has been debunked by this incident.

This revision acknowledges that these structures and their contents can present significant fire challenges and result in catastrophic fire losses. The requirement for fire sprinklers in enclosed parking garages remains for fire areas exceeding 12,000 square feet. This new requirement for open parking garages is added and requires fire sprinklers when the fire area exceeds 48,000 square feet. This threshold is four times the threshold applicable to enclosed garages, recognizing that, while there may be some benefit to perimeter openings, the fire service will ultimately be relied on to control these fires if sprinklers are not provided.

An open parking garage will typically consist of one fire area. To create multiple fire areas, IBC Table 707.3.10 requires 2-hour fire-resistance-rated construction.

Section 903.2.11.3 is revised by deleting the exception that eliminated the need to install fire sprinklers when an open parking garage exceeds 55 feet in height. This correlates with the requirement for fire sprinklers in open parking garages in Section 903.2.10, Item 3.

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903.2.10.2, IBC 202

Mechanical-Access Parking Garages

CHANGE TYPE: Addition

CHANGE SUMMARY: Mechanical-access enclosed parking garages are defined and now require an automatic sprinkler system.

2021 IFC CODE TEXT: **903.2.10.2 Mechanical-access enclosed parking garages.** An approved automatic sprinkler system shall be provided throughout buildings used for the storage of motor vehicles in a mechanical-access enclosed parking garage. The portion of the building that contains the mechanical-access enclosed parking garage shall be protected with a specially engineered automatic sprinkler system.

2021 IBC CODE TEXT: **202 MECHANICAL-ACCESS ENCLOSED PARKING GARAGE.** An enclosed parking garage which employs parking machines, lifts, elevators or other mechanical devices for vehicle moving from and to street level and in which public occupancy in the garage is prohibited in all areas except the vehicle access bay.

CHANGE SIGNIFICANCE: Enclosed mechanical-access parking garages are being constructed in the United States on an increasing basis. These occupancies are unique from the traditional open mechanical-access parking garage in that there are no openings: the entire structure is enclosed. These occupancies are comparable to automated high-rack storage systems. These facilities have no floors, no stairwells and no above-ground level access, except maintenance walkways and ladders, and are classified as Group S-2 occupancies. The definition for mechanical-access parking garages has been added to the *International Building Code* (IBC).

An enclosed mechanical-access parking garage offers many fire-fighting challenges. Most are constructed within a building shell and there is no floor access to the upper levels. The vehicles are parked in a rack



Photo courtesy of Paul Armstrong, Paul Armstrong Code Consulting Services

Vehicles are moved automatically to one of various levels of parking spaces in this mechanical-access parking garage.



Photo courtesy of Todd LaBerge, P.E., TLB Fire Protection Engineering, Inc.

The interior of the mechanical-access parking garage with automatic sprinkler piping and sprinklers located below each storage tier.

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system with no safe elevated access to the interior of the structure. The construction components of newer vehicles along with the new fuel sources being used create a substantial fire problem. An automatic sprinkler system is required to be installed in these facilities.

In addition to the fire sprinkler requirement, Section 406.6 has been added to the IBC requiring mechanical-access enclosed parking garages to provide the following:

- Separation from other occupancies by 2-hour fire barriers or horizontal assemblies.
- Fire department access doors at the ground level as required for high-piled combustible storage.
- Mechanical smoke removal system.
- Manual emergency shutdown switch for use by emergency personnel.
- Fire control equipment room with exterior access housing the fire alarm control unit, mechanical ventilation controls and emergency shut down switch.

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903.3.1.2

NFPA 13R Sprinkler Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: The allowable use of NFPA 13R sprinkler systems in Group R occupancies is reduced, especially those built with the podium concept, which increases the fire protection in these buildings.

2021 CODE TEXT: **903.3.1.2 NFPA 13R sprinkler systems.** Automatic sprinkler systems in Group R occupancies ~~up to and including four stories in height in buildings not exceeding 60 feet (18 288 mm) in height above grade plane~~ shall be permitted to be installed throughout in accordance with NFPA 13R where the Group R occupancy meets all of the following conditions:~~.~~

1. Four stories or less above grade plane.
2. The floor level of the highest story is 30 feet (9114 mm) or less above the lowest level of fire department vehicle access.
3. The floor level of the lowest story is 30 feet (9114 mm) or less below the lowest level of fire department vehicle access.

The number of stories of Group R occupancies constructed in accordance with Sections 510.2 and 510.4 shall be measured from ~~the horizontal assembly creating separate buildings~~ grade plane.

CHANGE SIGNIFICANCE: Major concerns have arisen with the recent advent of podium-style buildings when considered with the changes in allowance for installation of fire sprinkler systems designed to NFPA 13R "Standard for the Installation of Sprinkler Systems in Low-rise Residential Occupancies." The scope of the original NFPA 13R (2007) reads "This standard shall cover the design and installation of automatic sprinkler systems for protection against fire hazards in residential occupancies up to and including four stories in height." In 2013, the scope of NFPA 13R



The maximum building height where an NFPA 13R sprinkler system is permitted has been reduced. This Group R-2 occupancy will need to sprinklered in accordance with NFPA 13 since it is five stories when measured from grade plane.

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was changed to read "This standard shall cover the design and installation of automatic sprinkler systems for protection against fire in residential occupancies up to and including four stories in height in buildings not exceeding 60 feet (18 m) in height above grade plane."

This revision to NFPA 13R followed a change in the 2009 IBC that greatly expanded the use of the podium concept. After the expansion of the podium concept, the increase in height for NFPA 13R systems was permitted. In the 2018 IBC, five- or six-story buildings can be created where the lower podium building is one or two stories (above grade plane) and the upper building, atop the podium, is four stories of Group R. This measurement is allowed since the number of stories in the upper building is measured from the podium in the 2018 IFC. Since the upper portion is no more than four stories, and the building height is less than 60 feet, the fire sprinkler system can be designed in accordance with NFPA 13R.

There are differences in the level of protection provided between NFPA 13R and NFPA 13 systems, such as required design density, number of sprinklers operating and the areas protected with fire sprinklers. These differences occur because the NFPA 13R sprinkler system is primarily intended as a life safety system, whereas the NFPA 13 sprinkler system is intended to protect the structure and contents in addition to the occupants. Allowing the NFPA 13R sprinkler system for these taller podium style buildings leads to a significant decrease in the property protection provided by fire sprinklers.

This revised section now limits the height of the building where NFPA 13R sprinkler systems can be utilized. This results in the use of NFPA 13 "Standard for the Installation of Automatic Sprinkler Systems" when a floor level is more than 30 feet above or below the lowest level of fire department vehicle access. This is the same height at which a standpipe system is required in the building. The reference to 60 feet above grade plane is no longer applicable since the measurement of 30 feet above the lowest level of fire department vehicle access will be more restrictive. NFPA 13R still states that the standard is applicable to structures up to 60 above grade plane. The code reads differently, and as stated in Section 102.7.1, the code language takes precedence over the standard language. So, the 30-foot criteria applies.

This revision also addresses a concern of a possibly unsprinklered attic when the fire sprinkler system is designed to NFPA 13R. NFPA 13 will require the installation of fire sprinklers in the attic if there are combustible materials in the attic.

The sprinkler system can be designed to NFPA 13R if all of the following criteria are met:

- The upper floor of the Group R occupancy is no more than four stories above grade plane.
- The upper floor level is no more than 30 feet above the lowest level of fire department vehicle access.
- The lowest floor level is no more than 30 below the lowest level of fire department vehicle access.

Typically, other sections of the code will measure stories below grade to the highest level of fire department vehicle access. This section measures both the 30 feet above, and the 30 feet below, from the lowest level of fire department vehicle access.

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903.3.1.2.2

Sprinklers on Means of Egress Balconies

CHANGE TYPE: Modification

CHANGE SUMMARY: This revision modifies the requirements in NFPA 13R and specifies that sprinklers are required to protect corridors and egress balconies that are not adequately open to the exterior to provide for heat and smoke to escape.

2021 CODE TEXT: **903.3.1.2.2 ~~Open-ended corridors~~ Corridors and balconies in the means of egress.** Sprinkler protection shall be provided in ~~open-ended corridors and associated exterior stairways and ramps as specified in Section 1027.6, Exception 3.~~ corridors and for balconies in the means of egress where any of the following conditions apply:

1. Corridors with combustible floor or walls.
2. Corridors with an interior change of direction exceeding 45 degrees (0.79 rad).
3. Corridors that are less than 50 percent open to the outside atmosphere at the ends.
4. Open-ended corridors and associated exterior stairways and ramps as specified in Section 1027.6, Exception 3.
5. Egress balconies not complying with Sections 1021.2 and 1021.3.

CHANGE SIGNIFICANCE: The requirements in NFPA 13R "Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies" have migrated to a place where great liberties are allowed to exempt corridors from sprinkler requirements in multifamily occupancies. These new allowances go far beyond what is intended under the IFC. The current text in NFPA 13R allows any "open corridor" to be unsprinklered in a building protected with an NFPA 13R sprinkler system, and the NFPA Residential Sprinkler Handbook commentary on page 296 of the 2016



This egress balcony is at least 50 percent open to the exterior and would not be required to be provided with sprinklers even though the building is sprinklered.

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edition interprets "open" to mean any corridor that is open to outside temperature regardless of how small the opening may be. Carried to the extreme, an enclosed, unconditioned corridor with an air vent would be permitted to be an unsprinklered space based on the NFPA 13R Handbook and the guidance in the annex. In contrast, the original allowance in model codes for open corridors to be unsprinklered was associated with breezeway style units that were essentially fully open on one end or both, where the corridor connects to the stairs. In these cases, smoke accumulation in the corridor was minimal because of the large openings to the exterior.

These provisions in the code are different from the requirements in NFPA 13R. Section 102.7.1 stipulates that when the language in the code conflicts with the language in a referenced standard, the code provisions apply. When these conflicts exist, they are done intentionally to amend the standard. As was accomplished in this code change, the voting membership decided that the language in the standard was not restrictive enough—the code language is overriding the standard language and making a change in the application of the standard.

While Section 903.3.1.2.1 requires the NFPA 13R sprinkler protection to be extended onto balconies and decks, it is important to recognize the difference in the scoping of that section compared to egress balconies addressed by Item 5 of the new text. While Section 903.3.1.2.1 regulates the balconies and decks "of dwelling units and sleeping units," the new text in Section 903.3.1.2.2, Item 5 applies to "egress balconies" that serve as a part of the means of egress system and typically serve the overall building or areas that are not a part of a dwelling unit or sleeping unit. Therefore, the requirement in Item 5 applies to locations that are different from the spaces regulated by Section 903.3.1.2.1.

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905.3.1

Standpipes in Parking Garages

CHANGE TYPE: Modification

CHANGE SUMMARY: When a standpipe is required in a parking garage, whether open or enclosed, the standpipe will be a Class I standpipe without the requirement for spacing hose connections as required for Class II standpipes.

2021 CODE TEXT: **905.3.1 Height.** Class III standpipe systems shall be installed throughout buildings where any of the following conditions exist:

1. Four or more stories are above or below grade plane.
2. The floor level of the highest story is located more than 30 feet (9144 mm) above the lowest level of fire department vehicle access.
3. The floor level of the lowest story is located more than 30 feet (9144 mm) below the highest level of fire department vehicle access.

Exceptions:

1. Class I standpipes are allowed in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.



Class I standpipe connection in a parking garage.

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2. Class I standpipes are allowed in Group B and E occupancies.
3. Class I ~~manual~~ standpipes are allowed in ~~open~~ parking garages ~~where the highest floor is located not more than 150 feet (45 720 mm) above the lowest level of fire department vehicle access~~.

~~4. Class I manual dry standpipes are allowed in open parking garages that are subject to freezing temperatures, provided that the hose connections are located as required for Class II standpipes in accordance with Section 905.5.~~

~~5~~4. Class I standpipes are allowed in basements equipped throughout with an automatic sprinkler system.

~~6~~5. Class I standpipes are allowed in buildings where occupant-use hose lines will not be utilized by trained personnel or the fire department.

~~7~~6. In determining the lowest level of fire department vehicle access, it shall not be required to consider either of the following:

~~7.1~~6.1. Recessed loading docks for four vehicles or less.

~~7.2~~6.2. Conditions where topography makes access from the fire department vehicle to the building impractical or impossible.

CHANGE SIGNIFICANCE: Exceptions 3 and 4 deal with standpipe installations in parking garages. These two exceptions have been unchanged in the *International Fire Code* (IFC) and *International Building Code* (IBC) since the 2000 edition while the materials in vehicles have evolved to include more combustible synthetic material, thinner and lighter metals and alternative fuels including hydrogen, CNG, LPG and lithium-ion batteries. Electric vehicle charging stations are being installed in parking garages. The revision to this section modifies those two exceptions addressing standpipe system installed in open parking garages.

The current requirements for parking garages, open or closed, in the codes are based on old vehicle concepts and studies. Several large fires have occurred in parking garages causing significant damage, and the danger presented by fire has increased as the use of alternative fueled vehicles has increased. As with any multistory building, effective fire-fighting operations need to be able to quickly apply water to the fire. See also Significant Change discussion to Section 903.2.10 for sprinkler requirements in parking garages.

This revision deletes the option for manual standpipes which generally require extra effort on the part of the fire service to get water to upper stories and attempt extinguishment of the fire. Class I standpipes are required to be automatic.

Deleting Exception 4 also eliminates the requirement for connections to be located in accordance with a Class II standpipe. Standard requirements for Class I hose connection locations will apply.

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906.1

Portable Fire Extinguishers

CHANGE TYPE: Modification

CHANGE SUMMARY: Portable fire extinguisher requirements can be provided on vehicles in lieu of fixed installation in the building for certain Group S and Group U occupancies.

2021 CODE TEXT: **906.1 Where required.** Portable fire extinguishers shall be installed in all of the following locations:

Exception: Portable fire extinguishers are not required in unoccupied Group U communication equipment structures.

1. In Group A, B, E, F, H, I, M, R-1, R-2, R-4 and S occupancies.

Exceptions:

1. In Group R-2 occupancies, portable fire extinguishers shall be required only in locations specified in Items 2 through 6 where each dwelling unit is provided with a portable fire extinguisher having a minimum rating of 1-A:10-B:C.



Photo courtesy of Marc Dufresne/iStock / Getty Images Plus/Getty Images

This forklift is equipped with a portable fire extinguisher within reach of the operator.

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2. In Group E occupancies, portable fire extinguishers shall be required only in locations specified in Items 2 through 6 where each classroom is provided with a portable fire extinguisher having a minimum rating of 2-A:20-B:C.

3. In storage areas of Group S occupancies where forklift, powered industrial truck or powered cart operators are the primary occupants, fixed extinguishers, as specified in NFPA 10, shall not be required where in accordance with all of the following:

   3.1 Use of vehicle mounted extinguishers shall be approved by the fire code official.

   3.2 Each vehicle shall be equipped with a 10-pound, 40A:80B:C extinguisher affixed to the vehicle using a mounting bracket approved by the extinguisher manufacturer or the fire code official for vehicular use.

   3.3 Not less than two spare extinguishers of equal or greater rating shall be available onsite to replace a discharged extinguisher.

   3.4 Vehicle operators shall be trained in the proper operation, use and inspection of extinguishers.

   3.5 Inspections of vehicle mounted extinguishers shall be performed daily.

2. Within 30 feet (9144 mm) distance of travel from commercial cooking equipment and from domestic cooking equipment in Group I-1; I-2, Condition 1; and R-2 college dormitory occupancies.
3. In areas where flammable or combustible liquids are stored, used or dispensed.
4. On each floor of structures under construction, except Group R-3 occupancies, in accordance with Section 3316.1.
5. Where required by the sections indicated in Table 906.1.
6. Special-hazard areas, including but not limited to laboratories, computer rooms and generator rooms, where required by the fire code official.

CHANGE SIGNIFICANCE: Two revisions occurred in this section. The first exempts unoccupied Group U communication facilities and the second addresses fire extinguishers in Group S warehouses.

Group U communication facilities are normally unmanned. Technicians travel to the sites only when needed for repairs or maintenance activities. Installation of portable fire extinguishers at the site requires compliance with NFPA 10, which requires monthly inspections. These sites are rarely visited and providing the fire extinguisher monthly inspection becomes the only reason for a site visit. If a fire occurred at the site when it was unoccupied, the fire extinguisher would not be utilized. However, when the technicians visit the site, a fire extinguisher is available on the technician's vehicle. The portable fire extinguisher carried on the vehicle can be inspected and maintained per NFPA 10 to be ready for use if necessary.

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A similar situation occurs in storage Group S warehouses where the occupants are primarily operating on powered industrial trucks. It makes more sense to provide a fire extinguisher on the forklift. The employee is operating the forklift or truck and locating the fire extinguisher directly on that vehicle makes is easily accessible. Since the fire extinguisher is more readily accessible to the operator, it improves the speed of deployment and action against the fire.

This allowance requires daily inspections of the fire extinguisher, operator training in the use of fire extinguishers and the availability of spare extinguishers to replace the discharged devices and improve reliability.

Note that this allowance is only applicable to Group S occupancies. Even though many retail facilities are arranged in a configuration similar to a warehouse, this allowance does not apply to the Group M portion of the facility. While in Group S the occupants are employees, the occupants in a Group M occupancy are mainly public, and may number in the hundreds.

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907.2.10 (New)

Manual Fire Alarm in Public-Storage and Self-Storage Facilities

CHANGE TYPE: Addition

CHANGE SUMMARY: A manual fire alarm system is required in self-storage facilities which are three stories or more and have interior corridors.

2021 CODE TEXT: **907.2.10 Group S.** A manual fire alarm system that activates the occupant notification system in accordance with Section 907.5 shall be installed in Group S public- and self-storage occupancies three stories or greater in height for interior corridors and interior common areas. Visible notification appliances are not required within storage units.

> **Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1, and the occupant notification appliances will activate throughout the notification zones upon sprinkler water flow.

CHANGE SIGNIFICANCE: Manual fire alarm systems are required in new self-storage facilities that consist of three stories or more and have interior corridors or interior common areas. A single building could have dozens of storage units, each with a different owner. The owners know how to access their unit, but typically are not familiar with the entire facility. The fire alarm will provide notification to the various occupants who could be inside at any one time.

There are two exceptions to the requirement for a manual fire alarm. First, visible notification appliances are not required within the storage units. This means that visible notification appliances will be installed in the interior corridors and common areas. Second, manual fire alarm boxes are not required if the building is sprinklered. Section 903.4.2 already



This four-story self-storage facility will require a manual fire alarm system.

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requires that where a fire alarm system is installed, the fire sprinkler system shall be monitored by the fire alarm system and shall actuate the fire alarm system when the fire sprinkler operates. Therefore, this exception results in the elimination of the manual fire alarm boxes, but retains the audible and visible notification devices. Section 907.2 states that when the code allows the elimination of manual fire alarm boxes due to the installation of fire sprinklers, at least one manual fire alarm box must be installed. This single fire alarm box is to be installed in an approved location.

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907.4, 907.5, 907.5.1 (New), 907.5.2.1.3 (New), 907.5.2.1.3.1 (New), 907.5.2.1.3.2 (New)

Low-frequency Alarms in Sleeping Rooms

CHANGE TYPE: Modification

CHANGE SUMMARY: Audible fire alarm notification with a 520 Hz low frequency signal is designed to enhance the waking effectiveness of high-risk segments of the population and is required in Group R-1 and R-2 occupancies when a fire alarm system is required.

2021 CODE TEXT: **907.4 Initiating devices.** Where ~~manual or automatic alarm initiation is required as part of a fire alarm system, the initiating~~ a fire alarm system is required by another section of this code, occupant notification in accordance with Section 907.5 shall be initiated by one or more of the following:

1. Manual fire alarm boxes.
2. Automatic fire detectors.
3. Automatic sprinkler system waterflow devices.
4. Automatic fire-extinguishing systems.

Initiating devices shall be installed in accordance with Sections 907.4.1 through 907.4.3.1.

907.5 Occupant notification ~~systems~~. ~~A fire alarm system shall annunciate at the fire alarm control unit and shall initiate occupant notification upon activation, in accordance with Sections 907.5.1 through 907.5.2.3.3. Where a fire alarm system is required by another section of this code, it shall be activated by:~~

~~1. Automatic fire detectors.~~

~~2. Automatic sprinkler system waterflow devices.~~

~~3. Manual fire alarm boxes.~~

~~4. Automatic fire-extinguishing systems.~~

~~**Exception:** Where notification systems are allowed elsewhere in Section 907 to annunciate at a constantly attended location.~~



Photo courtesy of Daniel P. Finnegan, Siemens Industry, Inc., Florham Park, NJ

This smoke detector is equipped with an optional sounder base to produce the 520 Hz low-frequency alarm signal.

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Occupant notification by fire alarms shall be in accordance with Sections 907.5.1 through 907.5.2.3.3. Occupant notification by smoke alarms in Group R-1 and R-2 occupancies shall comply with Section 907.5.2.1.3.2.

907.5.1 Alarm activation and annunciation. Upon activation, fire alarm systems shall initiate occupant notification and shall annunciate at the fire alarm control unit, or where allowed elsewhere in Section 907, at a constantly attended location.

907.5.2.1.3 Audible signal frequency in Group R-1 and R-2 sleeping rooms. Audible signal frequency in Group R-1 and R-2 occupancies shall be in accordance with Sections 907.5.2.1.3.1 and 907.2.1.3.2.

907.5.2.1.3.1 Fire alarm system signal. In sleeping rooms of Group R-1 and R-2 occupancies, the audible alarm activated by a fire alarm system shall be a 520 Hz low-frequency signal complying NFPA 72.

907.5.2.1.3.2 Smoke alarm signal in sleeping rooms. In sleeping rooms of Group R-1 and R-2 occupancies that are required by Sections 907.2.8 or 907.2.9 to have a fire alarm system, the audible alarm signal activated by single or multiple-station smoke alarms in the dwelling unit or sleeping unit shall be a 520 Hz signal complying NFPA 72. Where a sleeping room smoke alarm is unable to produce a 520 Hz signal, the 520 Hz alarm signal shall be provided by a listed notification appliance or a smoke detector with an integral 520 Hz sounder.

CHANGE SIGNIFICANCE: The first modification in this code change consists of relocating the list of fire alarm components which will activate the fire alarm from Section 907.5 to Section 907.4. There is no change in application, the items are simply relocated to Section 907.4 "Initiating devices." Section 907.5 is additionally modified by referring occupant notification systems as part of a fire alarm system to Sections 907.5.1 through 907.5.2.3.3 and notification for smoke alarms to Section 907.5.2.1.3.2.

The goal of this code change is to have the notification appliances in sleeping rooms provide an alarm at 520 Hz, which is stipulated in Sections 907.5.2.1.3.1 and 907.5.2.1.3.2. Peer-reviewed research conducted by Ian R. Thomas and Dorothy Bruck has concluded the 520 Hz low frequency is six times more effective than the standard 3 KHz signal at waking high-risk segments of the population. People considered to be high-risk fall into one or more of these categories: over 65, hard of hearing, school aged children and people who are alcohol impaired. [See "Waking Effectiveness of Alarms for Adults Who Are Hard of Hearing" (Melbourne, Australia: Victoria University), published by National Fire Protection Association, 2007.] The standard 3 KHz audible alarm signal has been used in the majority of fire alarm horns and smoke alarms since the early 1990s.

Currently, audible devices which produce the 520 Hz low-frequency signal are available as part of a fire alarm system. However, not all single-station or multiple-station smoke alarms are capable of producing the low-frequency sound. To address this, Section 907.5.2.1.3.1 requires that where a fire alarm system is installed, audible notification devices are required in the sleeping rooms which produce the 520 Hz low-frequency alarm. Section 907.5.2.1.3.2 then addresses sleeping rooms where smoke

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alarms are installed. Since not all smoke alarms are capable of this low-frequency alarm, an option is provided to either install a device with an integral 520 Hz sounder or utilize a listed notification device as the sounder.

The 2019 edition of NFPA 72 *National Fire Alarm Code* contains two different requirements for audible notification in sleeping rooms. Chapter 18 of NFPA 72 requires audible notification appliances to produce the 520 Hz low-frequency signal in all sleeping rooms of buildings with a protected premises fire alarm system. Chapter 29 for smoke alarms requires the smoke alarm to produce the 520 Hz low-frequency signal only in rooms housing people with hearing loss or provided voluntarily for persons with hearing loss. Since the occupants in each room are not predetermined, the *International Fire Code* (IFC) requires the 520 Hz alarm signal in all sleeping rooms.

This revision in the IFC requires the 520 Hz low-frequency signal in the sleeping rooms regardless of whether smoke alarms are installed in the sleeping room or if smoke detectors are installed as part of a fire alarm system.

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907.5.2.1.2

Sound Pressure Level for Audible Alarms

CHANGE TYPE: Modification

CHANGE SUMMARY: The threshold for elimination of audible notification appliances has increased from 95 to 105 dBA.

2021 CODE TEXT: **907.5.2.1.2 Maximum sound pressure.** The ~~maximum~~ total sound pressure level ~~for audible alarm~~ produced by combining the ambient sound pressure level with all audible notification appliances operating shall ~~be~~ not exceed 110 dBA at the minimum hearing distance from the audible appliance. Where the average ambient noise is greater than ~~95~~ 105 dBA, visible alarm notification appliances shall be provided in accordance with NFPA 72 and audible alarm notification appliances shall not be required.

CHANGE SIGNIFICANCE: In areas with a high ambient sound pressure level, it is critical to ensure that the occupants can receive adequate notification of a fire alarm activation. This section is revised to correlate with revisions to NFPA 72 *National Fire Alarm and Signaling Code*.

The first portion of the revision addresses the concept that this section does not actually limit each individual appliance to a maximum of 110 dBA. Rather, this section limits combined sound pressure levels of the ambient noise along with the operation of the all audible notification



The total sound pressure level cannot exceed 110 dBA when all notification appliances are operating.

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appliances. Sound pressure levels are not additive. In other words, if a room contains two 60 dBA audible notification appliances, the total sound pressure level is not 120 dBA. The sound pressure levels are added logarithmically resulting in a total sound pressure level of 63 dBA, even though each device is only 60 dBA. Based on this same logarithmic calculation, two 110 dBA devices could produce 113 dBA. See Chapter 40 of the "SFPE Handbook of Fire Protection Engineering, Fifth Edition."

When measuring the total sound pressure level for audible notification appliances, the maximum sound pressure level cannot be exceeded throughout the space. Depending on the layout and arrangement of devices, the sound level can fluctuate throughout the area. The sound pressure level of an audible notification appliances is tested 10 feet from the device. This does not mean that acceptance of a system is tested 10 feet from devices. The maximum sound pressure level is tested throughout the area.

The second revision changes the threshold where visible notification appliances must be provided. Audible alarm notification appliances are no longer required. This threshold is now 105 dBA. This will result in audible appliances being installed in areas now with a higher ambient sound pressure level. Keep in mind this is a construction requirement, therefore, in accordance with *International Fire Code* (IFC) Section 102.1 it will apply to new construction and is not retroactive.

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907.5.2.2.5, 1203.2.4

Standby Power for Emergency Voice/Alarm Communications Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: A standby power supply can now be used for emergency voice/alarm communication systems.

2021 CODE TEXT: **907.5.2.2.5 Standby Emergency power.** Emergency voice/alarm communications systems shall be provided with ~~emergency~~ standby power in accordance with Section 1203. ~~The system shall be capable of powering the required load for a duration of not less than 24 hours, as required in NFPA 72.~~

1203.2.4 ~~Emergency voice/alarm~~ Voice alarm communication systems. ~~Emergency~~ Standby power shall be provided for emergency voice/alarm communication systems ~~as required in Section 907.5.2.2.5. The system shall be capable of powering the required load for a duration of not less than 24 hours, as required~~ in accordance with NFPA 72.

CHANGE SIGNIFICANCE: The requirements for secondary power for emergency voice/alarm communication systems are revised to correlate with NFPA 72 *National Fire Alarm and Signaling Code*. This results in two changes.

First, the requirement for emergency power is changed to standby power. This is consistent with NFPA 72. However, Section 10.6.6.3 in NFPA 72 still requires the secondary power supply to provide full operational power within 10 seconds of primary power failure. This can be accomplished with an internal battery with a standby generator. The battery will cover the power loss until the standby generator is operating.



Standby generators can be used to power the emergency voice/alarm communication system.

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Second, the requirement for the secondary power to operate the full system for 24 hours is deleted. NFPA 72 requires secondary power for 24 hours under quiescent load, and then under full operational load for an additional 15 minutes.

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907.5.2.3.3, 907.5.2.3.3.1 (New)

Expansion Capability for Fire Alarms in Group R-2

CHANGE TYPE: Modification

CHANGE SUMMARY: The code specifies three options designing a fire alarm system in Group R-2 occupancies to allow for the future addition of visible notification appliances.

2021 CODE TEXT: **907.5.2.3.3 Group R-2.** In Group R-2 occupancies required by Section 907 to have a fire alarm system, each story that contains dwelling units and sleeping units shall be provided with the ~~future~~ capability to support future visible alarm notification appliances in accordance with Chapter 10 of ICC A117.1. Such capability shall accommodate wired or wireless equipment. ~~The future capability shall include one of the following:~~

~~1. The interconnection of the building fire alarm system with the unit smoke alarms.~~

~~2. The replacement of audible appliances with combination audible/visible appliances.~~

~~3. The future extension of the existing wiring from the unit smoke alarm locations to required locations for visible appliances.~~



Photo courtesy of Kscott

Notification appliance which provides audible and visible signals.

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907.5.2.3.3.1 Wired equipment. Where wired equipment is used to comply with the future capability required by Section 907.5.2.3.3, the system shall include one of the following capabilities:

1. The replacement of audible appliances with combination audible/visible appliances or additional visible notification appliances.
2. The future extension of the existing wiring from the unit smoke alarm locations to required locations for visible appliances.
3. For wired equipment, the fire alarm power supply and circuits shall have not less than 5-percent excess capacity to accommodate the future addition of visible alarm notification appliances, and a single access point to such circuits shall be available on every story. Such circuits shall not be required to be extended beyond a single access point on a story. The fire alarm system shop drawings required by Section 907.1.2 shall include the power supply and circuit documentation to accommodate the future addition of visible notification appliances.

CHANGE SIGNIFICANCE: Section 907.5.2.3.3 was revised in the 2018 *International Fire Code* (IFC) to clarify application of these requirements. This code changes complements those previous changes. These sections address the ability of a fire alarm system to add visible notification in the future.

In Group R-2 occupancies, the residents can be permanent. As the residents age, they may become hearing impaired resulting in the need for visible notification appliances. Section 907.5.2.3.3.1 lists three methods for providing for the future addition of visible notification appliances.

- Under Item 1, the system would be designed to allow replacement of existing audible devices with audible/visible devices.
- Item 2 considers connection of visible devices to the existing smoke alarms in each dwelling unit.
- Item 3 specifies that the fire alarm system is designed to provide 5 percent excess capacity. With this option, a wired connection point must be installed to every story of the building. Additionally, the power supply and the circuitry must be designed to accommodate usage of the 5-percent increase.

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907.6.6.1, 907.6.6.2 (New)

Fire Alarm System Monitoring

CHANGE TYPE: Modification

CHANGE SUMMARY: Fire alarm monitoring must be in accordance with NFPA 72 and must go through a human interface prior to alarms being transmitted to the emergency dispatch center.

2021 CODE TEXT: ~~**907.6.6.1 Automatic telephone-dialing devices.** Automatic telephone-dialing devices used to transmit an emergency alarm shall not be connected to any fire department telephone number unless approved by the fire chief.~~

907.6.6.1 Transmission of alarm signals. Transmission of alarm signals to a supervising station shall be in accordance with NFPA 72.

907.6.6.2 MIY Monitoring. Direct transmission of alarms associated with Monitor it Yourself (MIY) transmitters to a public safety answering point (PSAP) shall not be permitted unless approved by the fire code official.



The Monitor it Yourself (MIY) system is capable of sending alarm signals directly to a cell phone.

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CHANGE SIGNIFICANCE: Recent changes in the communications industry have impacted the transmission of alarm, trouble and supervisory signals from the protected premises to the supervising station. The technology used since the late 1980s utilized private copper telephone lines with power originating at the telephone central office. This technology is becoming unsustainable by the telephone companies. It is estimated that some 70,000 plain old telephone system (POTS) lines are canceled by consumers every month. Costs of maintaining the traditional copper lines are growing and in 2018 AT&T announced a phaseout for POTS.

Automatic dialer devices are no longer used or approved under NFPA 72. Section 907.6.6.1 is revised to eliminate the reference to telephone dialers and simply refer to the provisions in NFPA 72 for transmission of alarms. This direct reference to NFPA 72 will allow for advancements in technologies as they move forward.

With the advancements of technology, Do it Yourself (DIY) fire alarm devices and Monitor it Yourself (MIY) practices are now used. Smoke detectors and fire alarm systems can easily communicate with phones, tablets, watches and laptops. As this technology expands, the potential exists for these devices to directly contact the Emergency Communication Center (911) without human interface. This will lead to an increase in unwanted alarm dispatches and place first responders at risk.

Section 907.6.6.2 limits the transmission of alarms directly to the emergency dispatch center when approved by the fire code official. Even though requiring a human interface creates a slight delay in relaying this alarm to the dispatch center, it is a better option since the human can make the determination to call 911.

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908.3

Emergency Alarm and Fire Alarm Interface

CHANGE TYPE: Addition

CHANGE SUMMARY: When the emergency alarm system is interfaced with the fire alarm control unit, the fire alarm control unit shall respond with a supervisory signal.

2021 CODE TEXT: **908.3 Fire alarm system interface.** Where an emergency alarm system is interfaced with a building's fire alarm system, the signal produced at the fire alarm control unit shall be a supervisory signal.

CHANGE SIGNIFICANCE: Emergency alarms are required in all Group H occupancies. Emergency alarms are utilized to provide indication and warning of emergency situations involving hazardous materials. Activation of an emergency alarm system may or may not require evacuation. At minimum, the emergency alarm will initiate a response from the emergency response team in Group H-5 occupancies or the spill mitigation team, but it should not activate the fire alarm system for general evacuation. In fact, the audible and visible notification are to be different from notification of the fire alarm.

Many of these buildings will also be equipped with a fire alarm system. Where interface between the emergency alarm system and the fire alarm system occurs, such as when providing off-site monitoring services, it is important to ensure that unwanted activations of the fire alarm system are avoided.

This new section requires that the response from the fire alarm control unit will be a supervisory signal. In this fashion, the fire alarm system still performs its intended function while the emergency alarm system meets its requirements. Group H occupancies require that activation of the emergency alarm operates a local alarm and sends a signal to a



Activation of the emergency alarm will result in a supervisory signal at the fire alarm control unit.

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supervising station or on-site constantly attended location. Specifying the response from the fire alarm control unit as a supervisory signal does not eliminate the local alarm.

Section 403.7 requires a fire safety and evacuation plan in all Group H occupancies. The plan needs to include directives for responding to the emergency alarm and the fire alarm. The responses should be different depending on the type of alarm activation.

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909.17

Smoke Control System Response Time

CHANGE TYPE: Modification

CHANGE SUMMARY: The time for a smoke control system to achieve full operation is limited to 90 seconds.

2021 CODE TEXT: **909.17 System response time.** Smoke-control system activation shall be initiated immediately after receipt of an appropriate automatic or manual activation command. Smoke control systems shall activate individual components (such as dampers and fans) in the sequence necessary to prevent physical damage to the fans, dampers, ducts and other equipment. For purposes of smoke control, the fire fighter's control panel response time shall be the same for automatic or manual smoke control action initiated from any other building control point. The total response time, including that necessary for detection, shutdown of operating equipment and smoke control system startup, shall allow for full operational mode to be achieved before the conditions in the space exceed the design smoke condition. Upon receipt of an alarm condition at the fire alarm control panel, fans, dampers and automatic doors shall have achieved their proper operating state and the final status shall be indicated at the smoke control panel within 90 seconds. The system response time for each component and their sequential relationships shall be detailed in the required rational analysis and verification of their installed condition reported in the required final report.

CHANGE SIGNIFICANCE: The code specifies a maximum time of 90 seconds in which the smoke control system is required to configure and be fully operational.

Previous editions of the code do not specify a time, which results in debate as to system function. Designers can argue that the fire department response times, which can be expected to take several minutes, should



Within 90 seconds of receipt of an alarm at the fire alarm control unit, this motorized fire damper must be in the appropriate position for smoke control system operation.

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dictate the duration in which the smoke control system should configure. However, in many cases, the smoke control system can impact the viability of egress systems.

The third sentence of Section 909.17 states that the operating time limitation for manual activation from the fire fighter's control panel should be no different from automatic operation. The 90-second time frame for the smoke control systems to be fully operational from either manual or automatic initiation is now specified in the code.

There are a number of time delays inherent to the activation of smoke control systems. There is the delay between when the activation of the initiating device and when the fire alarm panel registers an alarm condition. These delays can be inherent in the components or even programmed into the system. Waterflow alarms on sprinkler systems are allowed to have a delay up to 90 seconds to compensate for surges in the piping network.

The time delay is measured from when the fire alarm control panel indicates an alarm condition to when the smoke control system is fully operational. This 90-second delay provides time for smoke dampers to configure and annunciate their status (open or closed). Section 8.1 of UL 555S, which governs smoke dampers, requires them to fully configure (open or close) within 75 seconds. The additional time (15 seconds for a total of 90 seconds) allows for delays in data transfer and confirmation, as well as ample time for all other components to be fully operational (e.g., fans).

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910.3.4 (New), 910.3.5 (New)

Smoke and Heat Vent Operation

CHANGE TYPE: Addition

CHANGE SUMMARY: Smoke and heat vents must have a manual release in addition to an automatic release. If the automatic release is a fusible link, a minimum operating temperature is now specified.

2021 CODE TEXT: **910.3.4 Vent Operation.** Smoke and heat vents shall be capable of being operated by approved automatic and manual means.

910.3.5 Fusible link temperature rating. Where vents are installed in areas provided with automatic fire sprinklers and the vents operate by fusible link, the fusible link shall have a temperature rating of 360° F (182° C).

CHANGE SIGNIFICANCE: Several code changes have revised the smoke and heat vent requirements over the past several cycles. Most recently, F195-13 removed much of the requirements in the *International Fire Code* (IFC) and *International Building Code* (IBC) regarding smoke and heat vents and replaced them with a requirement for compliance with UL 793 or FM 4430, along with a reference to NFPA 204 "Smoke and Heat Venting" for maintenance. The requirement for both automatic and manual operation was lost in these changes. The 2018 IFC does not require that smoke and heat vents be capable of both automatic and manual operation. While this requirement is found in Section 5.3.5 of NFPA 204, the standard is not referenced for installation, only for maintenance.

Neither UL 793 nor FM 4430 require a manual release, but if a manual release is provided, it will be tested. One can find UL listed smoke and heat vents with and without a manual release. The manual release required in Section 910.3.4 is critical since the smoke and heat vent most likely will not open automatically in a sprinklered building if the



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Smoke and heat vents must be capable of manual operation in addition to the automatic operation.

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sprinkler system is adequately cooling the ceiling temperatures. Therefore, the fire fighters must have the ability to open the smoke and heat vents manually.

Section 910.3.5 has been added to address the operating temperature of the fusible link in sprinklered buildings. There have been studies that show that smoke and heat vents can have negative consequence on fire sprinkler performance in storage buildings if they open prior to sprinkler operation. One item that is not addressed within the IFC is related to the acceptable temperature rating of fusible links used to operate smoke and heat vents. FM guidance indicates 360°F is an appropriate operating temperature for fusible links in smoke and heat vents. This modification specifies the use of fusible links with a temperature rating of 360°F. This temperature will ensure that the fire sprinklers activate prior to the smoke and heat vents opening.

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913.1

Fire Pumps

CHANGE TYPE: Clarification

CHANGE SUMMARY: Pumps for fire sprinkler systems designed to *International Residential Code* (IRC) Section P2904 or NFPA 13D are not required to be listed fire pumps or comply with NFPA 20.

2021 CODE TEXT: **913.1 General.** Where provided, fire pumps for fire protection systems shall be installed in accordance with this section and NFPA 20.

> **Exception:** Pumps for automatic sprinkler systems installed in accordance with Section 903.3.1.3 or Section P2904 of the *International Residential Code*.

CHANGE SIGNIFICANCE: A couple subtle changes occurred to this section. First, the charging section now stipulates that it applies to fire pumps for fire protection systems. While this language may seem redundant, it actually provides a distinction between a pump at the municipal water facility and the pump at the site connected to the fire sprinkler system, fire hydrant system or standpipe system. The pump at the municipal water distribution facility supplies water to fire hydrants and fire sprinklers in addition to domestic and industrial water supply. This particular pump is not the fire pump addressed in this section. The pump at the business site that has the sole function of providing water for fire protection systems, is the fire pump. This fire pump must comply with NFPA 20 "Standard for Installation of Stationary Pumps for Fire Protection."

However, neither Section P2904 of the IRC nor NFPA 13D "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes" require pumps for fire sprinkler systems



Photo courtesy of Panupong Piewkleng/iStock / Getty Images Plus/Getty Images

This fire pump serving the fire sprinkler system and standpipe system is required to comply with NFPA 20.

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to be fire pumps, or to follow NFPA 20. Often pumps are required to meet the fire sprinkler system demand, but the pump is not required to be listed for fire protection.

Since the term "fire pump" is not defined, it could be interpreted to follow NFPA 20 for NFPA 13D systems, IRC Section P2904 systems or the water pump at the municipal facility. This revision and the new exception specify that compliance to NFPA 20 is required for other water-based fire protection systems, such as NFPA 13, NFPA 13R, NFPA 14, NFPA 750 and others.

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913.2.2

Protection of Circuits for Electric Fire Pumps

CHANGE TYPE: Modification

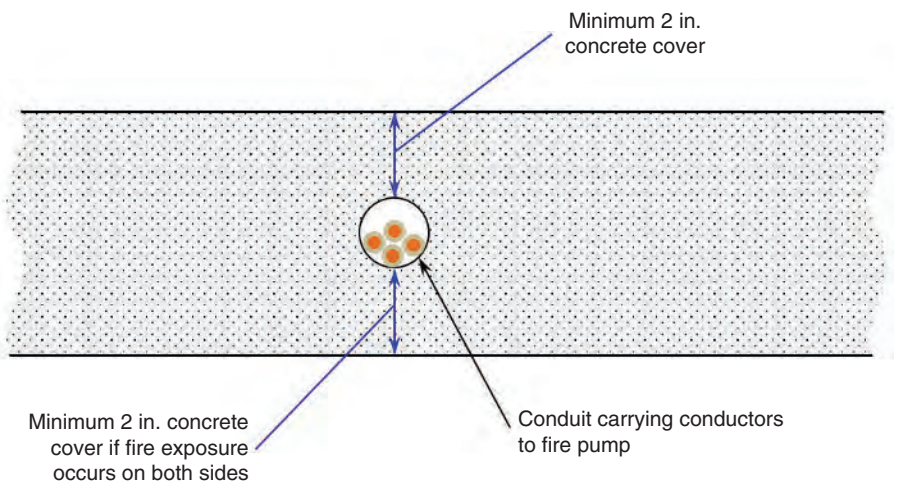
CHANGE SUMMARY: Conductors powering a fire pump can be covered with a minimum of 2 inches of concrete to provide the required fire-resistance-rated protection.

2021 CODE TEXT: **913.2.2 Circuits supplying fire pumps.** Cables used for survivability of circuits supplying fire pumps shall be protected using one of the following methods:

1. Cables used for survivability of required critical circuits shall be listed in accordance with UL 2196 and shall have a fire-resistance rating of not less than 1 hour.
2. Electrical circuit protective systems shall have a fire-resistance rating of not less than 1 hour. Electrical circuit protective systems shall be installed in accordance with their listing requirements.
3. Construction having a fire-resistance rating of not less than 1 hour.
4. The cable or raceway is encased in a minimum of 2 inches (51 mm) of concrete.

Exception: This section shall not apply to cables, or portions of cables, located within a fire pump room or generator room which is separated from the remainder of the occupancy with fire-resistance-rated construction.

CHANGE SIGNIFICANCE: Where fire protection systems need fire pumps to provide the required flows or pressures, the continued operation of the fire pump is essential. Protecting the power supply for electric-motor driven fire pumps is critical, especially when the fire pump is located within the building. Conductors traversing the building, whether from utility supplied power or an on-site generator, need to be protected. Item 4 is added as another optional method of providing this protection.



A minimum of 2 inches of concrete will provide fire protection for the power supply for electric motor-driven fire pumps.

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Item 4 stipulates that cables or conduit encased in concrete can provide the minimum fire protection. The cables must have at least 2 inches of concrete cover to be acceptable. This cable run could be in the foundation of the building and daylight inside the fire pump room.

Section 913.2.1 of the *International Building Code* (IBC) requires fire pump rooms located with the protected building to be separated by 2-hour fire-resistance-rated construction. This can be reduced to 1-hour construction when the building is not a high-rise and the building is equipped with fire sprinklers. Section 913.2.2 requires the power supply conductors for fire pumps to be protected with a minimum of 1-hour fire-resistance rating. Conductors located within the fire pump room do not need the protection provided the fire pump room has a minimum of 1-hour separation from the remainder of the building. The fire pump room itself provides the fire protection.

The exception also states that the cables do not need to be protected inside the generator room if the generator provides the minimum 1-hour fire-resistive separation. Generator rooms are not required to be separated by fire-resistance-rated construction except in high-rise buildings. (See IBC Section 403.4.8.1.) Section 903.3.1.1.1 allows sprinklers to be omitted from generator rooms if a fire detection system and 2-hour separation are provided. If the generator room is so protected, the conductors between the generator and the fire pump only need to be protected when they are outside of the generator room and fire pump room.

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914.3.1.2

Water Supply to Fire Pumps

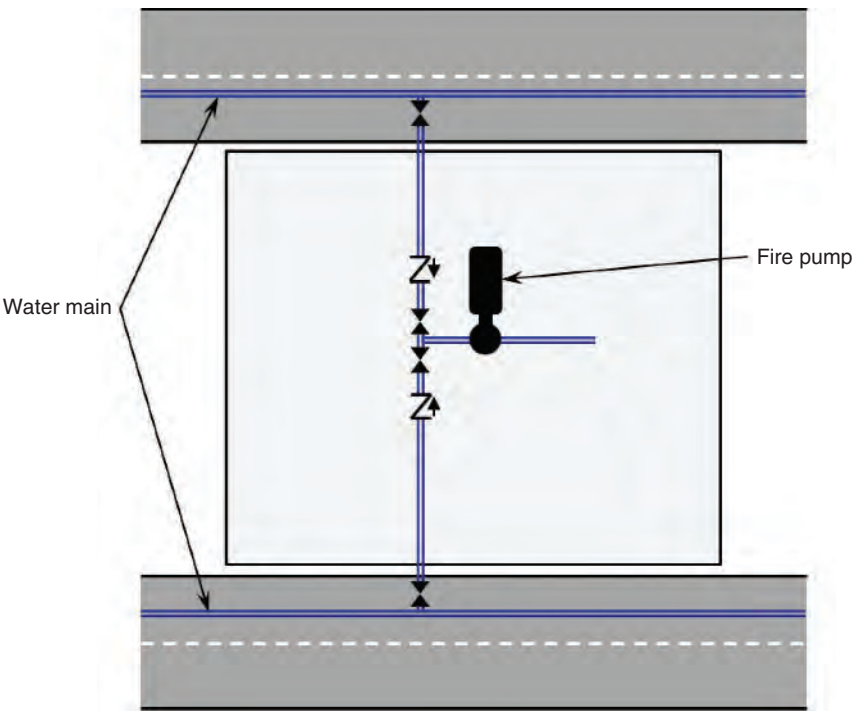
CHANGE TYPE: Modification

CHANGE SUMMARY: Redundant water supply connections are required for fire pumps in high-rise buildings over 120 feet in height where constructed of Type IVA or IVB construction.

2021 CODE TEXT: **914.3.1.2 Water supply to required fire pumps.** In all buildings that are more than 420 feet (128 m) in building height, and buildings of Type IVA and IVB construction that are more than 120 feet (36.6 m) in building height, required fire pumps shall be supplied by connections to not fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

> **Exception:** Two connections to the same main shall be permitted provided that the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through not fewer than one of the connections.

CHANGE SIGNIFICANCE: The 2018 *International Fire Code* (IFC) and *International Building Code* (IBC) require connection to two separate water mains for fire water supply to high-rise buildings 420 feet in height and higher. This recommendation was highlighted in the National Institute of Standards and Technology's (NIST) report on the structural collapses on September 11, 2001. This new change expands that requirement



Connection to two water mains, each in a different street, is required for water supply to the fire pump in specified high-rise buildings.

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to include high-rise buildings with a height of more than 120 feet when of Type IVA or IVB construction.

In Type IVA construction, the mass timber is entirely protected (no exposed timber) with Type X sheetrock and the fire rating is considered equivalent to Type IA construction. Type IVB is considered equivalent to Type IB construction.

Due to the reach limitations of fire service aerial apparatus it is appropriate to provide this requirement to add some redundancy to the reliability of the water supply to the fire sprinkler system. This new requirement incorporates active fire protection features into these tall wood buildings.

The Ad Hoc Committee on Tall Wood Buildings submitted a package of code changes addressing tall wood building construction. Companion code changes in the 2021 IBC allow greater heights and areas for mass timber construction than is allowed in the 2018 IBC. This water supply redundancy provided in this code change is one of the mitigation measures allowing these larger buildings of heavy timber construction. Type IVC construction is not included in this provision because Type IVC cannot be built to this height. Type IVC has a maximum height of 85 feet.

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914.7, 914.7.1, 914.7.2, 202

Puzzle Rooms

CHANGE TYPE: Modification

CHANGE SUMMARY: Specific provisions are added to the code to address puzzle rooms.

2021 CODE TEXT: **914.7 Special amusement ~~buildings~~ areas.** Special amusement ~~buildings~~ areas shall comply with Sections 914.7.1 and 914.7.2.

914.7.1 Automatic sprinkler system. ~~Special~~ Buildings containing special amusement ~~buildings~~ areas shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1. Where the special amusement ~~buildings~~ area is temporary, the sprinkler water supply shall be of an approved temporary means.

> **Exception:** Automatic sprinklers are not required where the total floor area of a temporary special amusement ~~buildings~~ area is less than 1,000 square feet (93 m²) and the exit access travel distance from any point in the special amusement area to an exit is less than 50 feet (15 240 mm).

914.7.2 Automatic smoke detection. Special amusement ~~buildings~~ areas shall be equipped with an automatic smoke detection system in accordance with Section 907.2.11.

202 DEFINITIONS

PUZZLE ROOM. A puzzle room is a type of special amusement area in which occupants are encouraged to solve a challenge to escape from a room or series of rooms.



Photo courtesy of JackF/iStock / Getty Images Plus/Getty Images

Puzzle rooms, or escape rooms, are now treated as special amusement areas.

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202 DEFINITIONS

SPECIAL AMUSEMENT ~~BUILDING~~ AREA. A special amusement ~~building~~ area is any temporary or permanent building or portion thereof that is occupied for amusement, entertainment or educational purposes and ~~that contains a device or system that conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the means of egress path is not readily apparent due to visual or audio distractions or is intentionally confounded or is not readily available because of the nature of the attraction or mode of conveyance through the building or structure~~ is arranged in a manner that:

1. Makes the means of egress path not readily apparent due to visual or audio distractions.
2. Intentionally confounds identification of the means of egress path.
3. Otherwise makes the means of egress path not readily available because of the nature of the attraction or mode of conveyance through the building or structure.

CHANGE SIGNIFICANCE: Puzzle rooms are a new business model where participants enter a room and are tasked either to find a way out of the room or to find their way to the next room in the puzzle. The rooms are typically small and often classified as Group B. Each puzzle room is designed in a way to provide a unique experience for the participant. This unique design incorporates a number of possible features to disorient the occupants and disguise the exit route. Such a design is contrary to the general code foundations for exiting.

Puzzle rooms are now specifically addressed in the 2021 *International Fire Code* (IFC) and *International Building Code* (IBC). This is accomplished via a set of revisions, first of which is the definition of "puzzle room" and a revised definition of "special amusement area" ("special amusement building" in the 2018 edition). The new definition for puzzle room states it is a type of special amusement area. The definition of special amusement building is revised by changing the term to special amusement area and incorporating puzzle rooms into the special amusement areas. This means that puzzle rooms must comply with the requirements for special amusement areas, which includes a smoke detection system, emergency voice/alarm communication system and a fire sprinkler system when over 1,000 square feet or with an exit access travel distance greater than 50 feet.

The typical issue the code official has faced with puzzle rooms is egress. By design, the exit out of the puzzle room is hidden or disguised. To deal with this a new Section 411.5 is added to the 2021 IBC. The egress design for puzzle rooms could meet one of three designs: (1) comply with Chapter 10, (2) exits shall be made readily available up the activation of the fire sprinklers, fire alarm or from a manual switch at a constantly attended location, or (3) approval of an alternate design. The puzzle room can comply with Chapter 10 and still be considered a puzzle room if the room has an exit that is obvious and usable plus another door that is

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hidden. The goal is to find the hidden door and egress that direction, however, if something were to go wrong, there is an adequate and obvious egress path.

Additionally, a puzzle room is classified as Group B occupancy provided the occupant load is less than 50. When over 50 occupants, the special amusement area is classified as Group A.

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1006.3, 1006.3.1, 1006.3.2, 1017.3.2.3

Exit Access Stairways in Atriums

CHANGE TYPE: Modification

CHANGE SUMMARY: Clarifies that egress requirements are determined for each story or occupied roof level, and allows the path egress to traverse more than one story within an atrium.

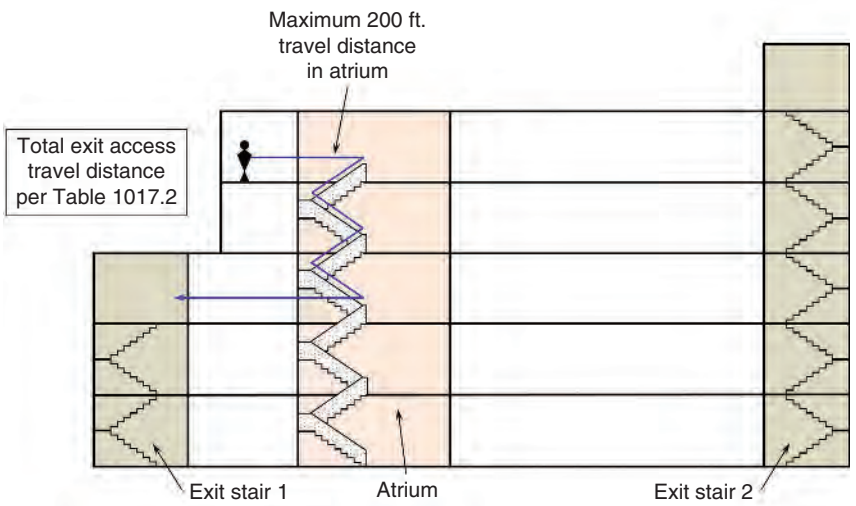
2021 CODE TEXT: **1006.3 Egress from stories or occupied roofs.** The means of egress system serving any story or occupied roof shall be provided with the number of separate and distinct exits or access to exits based on the aggregate occupant load served in accordance with this section. ~~Where stairways serve more than one story, only the occupant load of each story considered individually shall be used in calculating the required number of exits or access to exits serving that story.~~

1006.3.1 Occupant load. Where stairways serve more than one story, or more than one story and an occupied roof, only the occupant load of each story or occupied roof, considered individually, shall be used when calculating the required number of exits or access to exits serving that story.

~~**1006.3.1**~~ **1006.3.2** ~~**Adjacent story.**~~ **Path of egress travel.** The path of egress travel to an exit shall not pass through more than one adjacent story.

Exception: The path of egress travel to an exit shall be permitted to pass through more than one adjacent story in any of the following:

1. In Group R-1, R-2 or R-3 occupancies, exit access stairways and ramps connecting four stories or less serving and contained within an individual dwelling unit, sleeping unit or live/work unit.
2. Exit access stairways serving and contained within a Group R-3 congregate residence or a Group R-4 facility.
3. Exit access stairways and ramps within an atrium comply with the provisions of Section 404 of the *International Building Code*.



The path of egress can pass through more than one story in the atrium.

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~~3.~~4. Exit access stairways and ramps in open parking garages that serve only the parking garage.

~~4.~~5. Exit access stairways and ramps serving open-air assembly seating complying with the exit access travel distance requirements of Section 1030.7.

~~5.~~6. Exit access stairways and ramps between the balcony, gallery or press box and the main assembly floor in occupancies such as theaters, places of religious worship, auditoriums and sports facilities.

7. Exterior exit access stairways and ramps between occupied roofs. *[For discussion of this item see Significant Change 1006.3.2, Exception 7]*

1017.3.2.3 Exit access travel distance at other than the level exit discharge. Where the path of egress travel is not at the level of exit discharge from the atrium, that portion of the total permitted exit access travel distance that occurs within the atrium shall be not greater than 200 feet (60 960 mm).

CHANGE SIGNIFICANCE: This is the first of two discussions to revisions to these sections. See also Significant Change for Section 1006.3.2, Exception 7.

The addition of Exception 3 to Section 1006.3.2 allows the exit route utilizing an exit access stairway to traverse more than one story if that exit access stairway is located within in atrium complying with Section 404 of the *International Building Code* (IBC). This allows the required path of egress to start in, or enter, the atrium and pass through more than one story before reaching an exit. The exit access stairway within the atrium is not an enclosed stairway—it is open to the atrium. The requirements in IBC Section 404.5 require that the atrium be separated from the remainder of the building, but this is at best a 1-hour separation. An exception allows for a reduction from the 1-hour rating to a glass wall with fire sprinklers located on both sides. Therefore, the stairway in the atrium is not an "exit," exit access travel distance must still be measured. Section 1017.3.2.3 limits the length of the path of egress within the atrium to a maximum of 200 feet. While this section appears as a new section in Chapter 10, the requirement to limit egress travel within an atrium is not new to the codes. In the 2018 editions, this requirement appeared as Section 404.9.3 in the IBC.

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1006.3.2, Exception 7; 1006.3, 1006.3.1

Egress from Occupied Roofs

CHANGE TYPE: Modification

CHANGE SUMMARY: Egress travel on exit access stairways and ramps that are exterior to the building and connecting occupied roofs are allowed to traverse more than one story.

2021 CODE TEXT: **1006.3 Egress from stories or occupied roofs.** The means of egress system serving any story or occupied roof shall be provided with the number of separate and distinct exits or access to exits based on the aggregate occupant load served in accordance with this section. ~~Where stairways serve more than one story, only the occupant load of each story considered individually shall be used in calculating the required number of exits or access to exits serving that story.~~

1006.3.1 Occupant load. Where stairways serve more than one story, or more than one story and an occupied roof, only the occupant load of each story or occupied roof, considered individually, shall be used when calculating the required number of exits or access to exits serving that story.

~~**1006.3.1**~~ **1006.3.2** ~~**Adjacent story.**~~ **Path of egress travel.** The path of egress travel to an exit shall not pass through more than one adjacent story.

Exception: The path of egress travel to an exit shall be permitted to pass through more than one adjacent story in any of the following:

1. In Group R-1, R-2 or R-3 occupancies, exit access stairways and ramps connecting four stories or less serving and contained within an individual dwelling unit, sleeping unit or live/work unit.

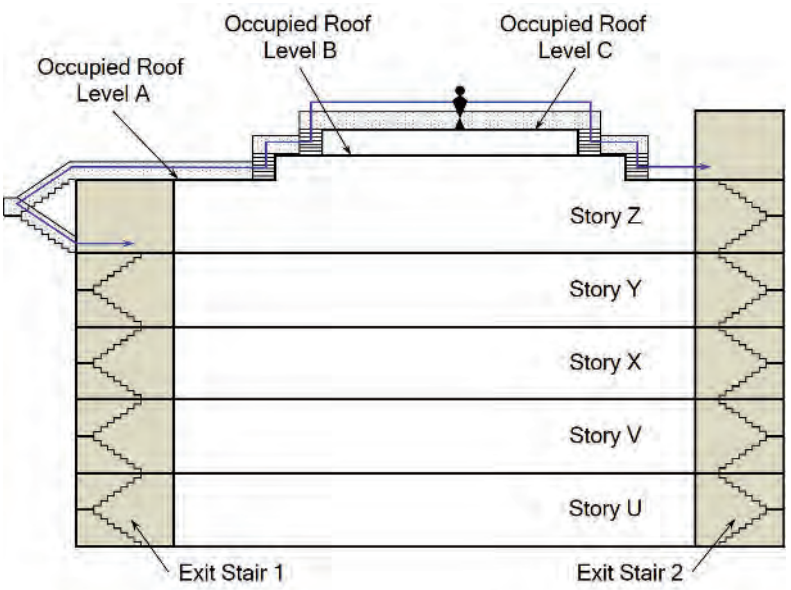


Figure A: Two paths of egress for Occupied Roof Level C.

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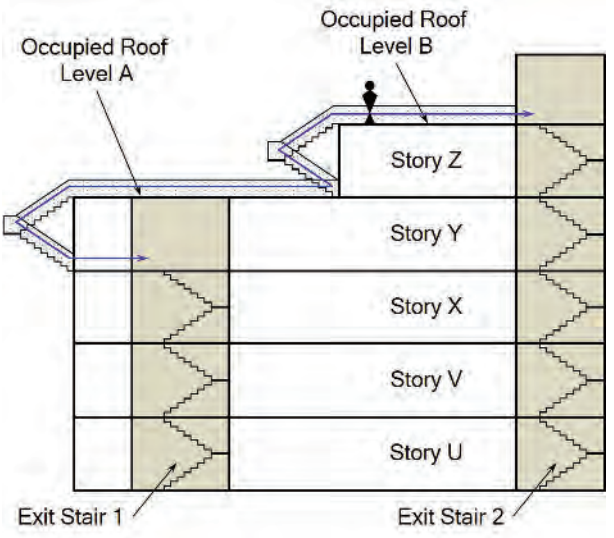


Figure B: Two paths of egress for Occupied Roof Level B.

2. Exit access stairways serving and contained within a Group R-3 congregate residence or a Group R-4 facility.
3. Exit access stairways and ramps within an atrium comply with the provisions of Section 404 of the *International Building Code*. *[For discussion of this item see Significant Change 1006.3]*

~~3.~~4. Exit access stairways and ramps in open parking garages that serve only the parking garage.

~~4.~~5. Exit access stairways and ramps serving open-air assembly seating complying with the exit access travel distance requirements of Section 1030.7.

~~5.~~6. Exit access stairways and ramps between the balcony, gallery or press box and the main assembly floor in occupancies such as theaters, places of religious worship, auditoriums and sports facilities.

7. Exterior exit access stairways and ramps between occupied roofs.

CHANGE SIGNIFICANCE: The addition of Exception 7 to Section 1006.3.2 continues the trend over the past couple code cycles of addressing egress provisions as they apply to occupied roofs. This revision relocates the second sentence from Section 1006.3 into a separate section, Section 1006.3.1, and clarifies the intent. The 2018 *International Fire Code* (IFC) clearly stated that only the occupant load of a single story was to be used for calculating the egress requirements, but that statement began with the limitation that it applied "where stairways serve more than one story." If a literal reading of the code was used, because a roof did not meet the definition for a story, it could be argued that perhaps a combined occupant load should

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be used where a story and an occupied roof were the levels under consideration. The code now specifically states that the occupant load of an occupied roof is considered separately from the occupant load on an adjacent story. While the change may not seem significant to many code users, the simple fact that the code specifically addresses this issue now should provide more consistency in applying the code and make understanding the intent easier and more consistent.

Exception 7 is added to Section 1006.3.2 and allows exit access stairways or exit access ramps to pass through more than one story, **IF**:

1. The stairway or ramp is exterior to the building.
2. The stairway or ramp is between occupied roofs. In other words, it connects one roof level to another roof level.

These two criteria are important, as they limit the application of this new exception. To understand the complete application of these requirements several code sections come into play. Section 1006.3.3 requires that each story or occupied roof must have a minimum of two exits or access to two exits based on the occupant load served. The requirement for two egress paths may be reduced to only one means of egress where the facility complies with Table 1006.3.4(1) or Table 1006.3.4(2). Based on those tables, one means of egress is possible for buildings up to three stories in Group R-2, but only up to two stories for all other occupancies.

In Figure A, the occupied roof over Story Z has multiple roof levels. Occupants egressing from Occupied Roof C must have two paths of egress. Each path of egress consists of exterior exit access stairs down to Occupied Roof B. From Occupied Roof B exterior exit access stairs lead down to Occupied Roof A. The exterior exit access stairs have connected more than one level as they travel between occupied roofs. The stairs from Occupied Roof B to Occupied Roof A need to be sized for the combined occupant load from Occupied Roof C and Occupied Roof B. The new Section 1006.3.1 states that occupant load is not combined where the stairs "serve more than one story, or more than one story and an occupied roof," but neither scenario fits for Occupied Roofs B and C—this is two roof levels. Similar to the occupant loads from mezzanines, the occupant load is combined as the occupants continue down to Occupied Roof A. At Occupied Roof A, one path of egress enters Exit Stair 2, while the other path utilizes an exterior exit access stair to reach Exit Stair 1 on Story Z. The exit access stairway leading to Story Z is limited to one story since it is no longer serving different occupied roof levels.

Consider egress from Occupied Roof B in the building depicted in Figure B. Occupied Roof B requires two paths of egress and two are provided—one directly into Exit Stair 2 and one via an exterior exit access stairway. The exterior exit access stairway continues down to Story Y where the occupant can then enter the building and Exit Stair 1. While it may be a shorter travel distance for the occupant to use the exterior exit access stairway and enter the building on Story Z, this path cannot serve as the required exit since both exit routes utilize Exit Stair 2.

Exception 7 allows the egress path to traverse more than one story when using an exterior exit access stairway between roofs. It is the subtle language of "between roofs" that is applied with regard to egress from Occupied Roof B. Occupants from Occupied Roof B utilize the exterior exit access stairway to traverse two stories to reach Exit Stair 1.

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Even though Exception 7 allows the exterior exit access stairway to pass through more than one story, the exit access travel distance must still be considered and may be a limiting factor. When measuring the travel distance, the design must ensure that the travel distance on the stairway is considered. Section 1017.3.1 specifies that the travel distance on an exit access stairway must be included in the exit access travel distance. For example, a building with floor levels 14 feet apart can incur a travel distance of approximately 33 feet.

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1006.3.4, Table 1006.3.4(1), Table 1006.3.4(2)

Single Exit – Exit Access vs. Common Path

CHANGE TYPE: Clarification

CHANGE SUMMARY: When dealing with buildings or stories provided with only one exit or access to one exit, the travel distance requirement has been revised to now measure the exit access travel distance as opposed to the common path of egress travel.

2021 CODE TEXT: ~~**1006.3.3**~~ **1006.3.4 Single exits.** A single exit or access to a single exit shall be permitted from any story or occupied roof, where one of the following conditions exists:

1. The occupant load, number of dwelling units and ~~common path of egress~~ exit access travel distance do not exceed the values in Table ~~1006.3.3(1)~~ 1006.3.4(1) or 1006.3.~~3~~4(2).
2. through 5.2. *(No change to text.)*

TABLE ~~1006.3.3(1)~~ 1006.3.4(1) Stories with One Exit or Access to One Exit for R-2 Occupancies

STORY	OCCUPANCY	MAXIMUM NUMBER OF DWELLING UNITS	MAXIMUM ~~COMMON PATH OF EGRESS~~ EXIT ACCESS TRAVEL DISTANCE
Basement, first, second or third story above grade plane	R-2[a,b]	4 dwelling units	125 feet
Fourth story above grade plane and higher	NP	NA	NA

For SI: 1 foot = 3048 mm.
NP = Not Permitted.
NA = Not Applicable.
a. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section ~~1030~~ 1031.
b. This table is used for R-2 occupancies consisting of dwelling units. For R-2 occupancies consisting of sleeping units, use Table ~~1006.3.3(2)~~ 1006.3.4(2).

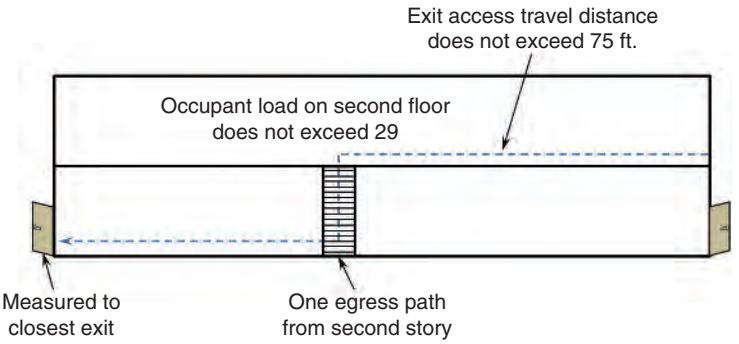
TABLE ~~31006.3.3(2)~~ 1006.3.4(2) Stories with One Exit or Access to One Exit for other Occupancies

STORY	OCCUPANCY	MAXIMUM OCCUPANT LOAD PER STORY	MAXIMUM ~~COMMON PATH OF EGRESS~~ EXIT ACCESS TRAVEL DISTANCE (feet)
First story above or below grade plane	A, B[b], E F[b], M, U	49	75
	H-2, H-3	3	25
	H-4, H-5, I, R-1, R-2[a,c]	10	75
	S[b,d]	29	75
Second story above grade plane	B, F, M, S[d]	29	75
Third story above grade plane and higher	NP	NA	NA

For SI: 1 foot = 304.8 mm.
NP = Not Permitted.
NA = Not Applicable.
a. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section ~~1030~~ 1031.
b. Group B, F and S occupancies in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 shall have a maximum exit access travel distance of 100 feet.
c. This table is used for R-2 occupancies consisting of sleeping units. For R-2 occupancies consisting of dwelling units, use Table ~~1006.3.3(1)~~ 1006.3.4(1).
d. The length of exit access travel distance in a Group S-2 open parking garage shall be not more than 100 feet.

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Occupants on the second floor have only one exit access stairway. This is allowed if the allowed occupant load is not exceeded and the exit access travel distance to an exit is not exceeded.

CHANGE SIGNIFICANCE: Whether this revision is viewed as being significant will depend on how the code user had previously applied the requirement and which viewpoint they had previously taken when applying the provision. This code change will take the code back to its application under the 2012 edition, although some people had probably not changed the way they applied the provision even under the 2015 and 2018 code.

"Common path of egress travel" is generally only applied to locations where a single means of egress is available. It is used as a second trigger, along with the occupant load, to determine when a second means of egress is needed from an area. The confusion that prompted this code change was that Tables 1006.3.4(1) and 1006.3.4(2) both measured the travel distance as the common path of egress travel. But in some building designs, the measure may be to the only required exit. In these cases, there is no "common path of egress travel." A two-story building could have a top floor with only one egress path because when the occupants reached the first floor which had multiple exits providing a choice on egress path, the common path of travel distance measurement was terminated. Therefore, the debate was whether it was appropriate to use "common path of egress travel" in a compliant single means of egress space or whether it should be "exit access travel" distance. Since the travel distances and how the lengths are measured are different, this modification impacts the end point for that measurement.

The "common path" measurement is measured to the "point where the occupants have separate and distinct access to two exits or exit access doorways." This change to "exit access travel distance" now means that the occupants must actually reach the door of an exit within that specified distance. With this code change they will no longer have the opportunity of simply reaching a point where the egress path can split to lead to two separate exits. This change in terminology is subtle, but it means that the occupants must be able to reach an exit within that travel distance limitation, and simply having a divergent path to two means of egress will not suffice.

While some jurisdictions have applied the code this way, others by following the definition of "common path of egress travel" would have accepted having the option of going towards separate exits. Some jurisdictions may have accepted this because the story was no longer being served by a single exit, and therefore no longer regulated by Tables

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1006.3.4(1) or (2), while others expected people to reach the door of an exit within that distance due to the application of previous code language or by recognizing that the common path of travel portion of an egress path is the first portion of "exit access." The significant change is recognizing the subtle distinction that by referencing "exit access travel distance" the occupant must be able to reach the door of an exit within the distance limits.

Code users will want to remember that common path of travel is still a valid concept and that it does still exist in the code. They should recognize that Section 1006.2 and Table 1006.2.1 will continue to use "common path of egress travel" as the distance measurement and that spaces with a small occupant load and limited travel can be accepted with a single means of egress provided they can reach a point where they have egress options within that distance limitation. It is primarily for Section 1006.3 and when a story has a single egress path that they must use the more limited and restrictive "exit access travel distance" that is specified within the code and reach the safety of an exit.

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1009.2.1

Elevator Serving Occupied Roof

CHANGE TYPE: Modification

CHANGE SUMMARY: Adds a requirement for an elevator to serve occupied roofs when the roof level is essentially the fourth story above the level of exit discharge.

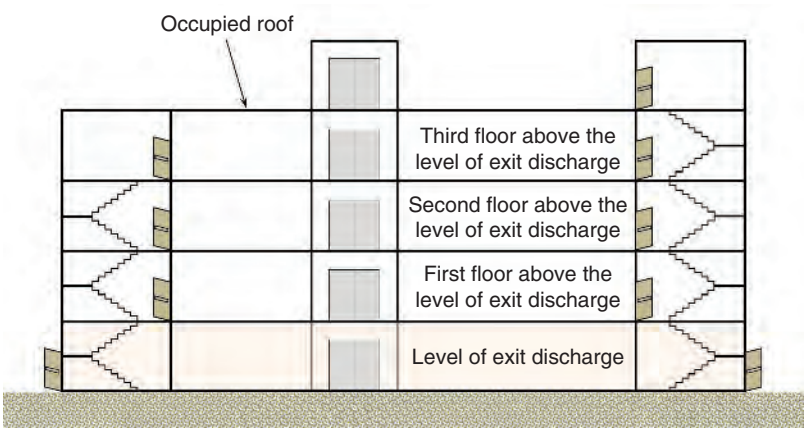
2021 CODE TEXT: **1009.2.1 Elevators required.** In buildings where a required accessible floor or occupied roof is four or more stories above or below a level of exit discharge, not less than one required accessible means of egress shall be an elevator complying with Section 1009.4.

Exceptions:

1. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, the elevator shall not be required on floors provided with a horizontal exit and located at or above the levels of exit discharge.
2. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, the elevator shall not be required on floors provided with a ramp conforming to the provisions of Section 1012.

CHANGE SIGNIFICANCE: The past several code change cycles have attempted to provide better and more consistent guidance on how to deal with occupied roofs. In the 2018 edition, the *International Building Code* (IBC) was modified to specifically include occupied roofs as needing to be served by an accessible route similar to how accessible stories in a multistory building were addressed. Though the IBC specifically stated that an accessible route was required to the occupied roof, there was some debate as to how the accessible means of egress provisions should be applied. One of those issues was elevator access.

The occupied roof clearly had to be provided with an accessible route, however the elevator provisions only counted accessible floors when determining if an elevator was required. Section 1009.2.1 required an elevator where an accessible "floor" was four or more "stories" above a



This occupied roof will require access via an elevator since it is the fourth level above the level of exit discharge.

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level of exit discharge. As an example, if there was an occupied roof on a four-story building, that roof level had only three "stories" between it and the level of exit discharge and the roof itself did not qualify as a story under the definition in the code. Therefore, there were not "four or more stories" above the level of exit discharge and it seemingly would not require elevator service. It was clearly the code's intent for the occupied roof to comply with accessible means of egress. Since the occupied roof is not a "story," this issue was often debated.

Under the 2021 code, the occupied roof on a four story or taller building will generally impose the requirements of Section 1009.2.1 that an elevator provide "not less than one" of the required accessible means of egress. Having the elevator available for independent or possibly assisted rescue will help emergency responders who would help people from the occupied roof. This will help limit the number of levels where people must be carried or assisted down the stairways as well as generally ensure that people who use wheelchairs will be able to be brought down from upper levels with their chair. Addressing the occupied roof level even though it is not a "story" will lead to greater consistency when applying the elevator requirement.

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1010.1.1

Size of Doors

CHANGE TYPE: Modification

CHANGE SUMMARY: The width for a swinging door is no longer limited to 48 inches and a consolidated exception allows for reduced size doors for single user showers, saunas, toilet compartments, dressing, fitting or changing rooms.

2021 CODE TEXT: **1010.1.1 Size of doors.** The required capacity of each door opening shall be sufficient for the occupant load thereof and shall provide a minimum clear opening width of 32 inches (813 mm). The clear opening width of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees (1.57 rad). Where this section requires a minimum clear opening width of 32 inches (813 mm) and a door opening includes two door leaves without a mullion, one leaf shall provide a minimum clear opening width of 32 inches (813 mm). In Group I-2, doors serving as means of egress doors where used for the movement of beds shall provide a minimum clear opening width of 41½ inches (1054 mm). ~~The maximum width of a swinging door leaf shall be 48 inches (1219 mm) nominal.~~ The minimum clear opening height of doors shall be not less than 80 inches (2032 mm).

Exceptions:

1. In Group R-2 and R-3 dwelling and sleeping units that are not required to be an Accessible unit, Type A unit or Type B unit, the minimum ~~and maximum~~ width shall not apply to door openings that are not part of the required means of egress.
2. *(No change to text.)*
3. *(No change to text.)*



Exit doors and exit access doors are no longer limited to 48 inches in width. The width will be controlled by the pressure needed to open the door.

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4. The maximum width of door leaves in revolving doors that comply with Section ~~1010.1.4.1~~ 1010.3.1 shall not be limited.
5. The maximum width of door leaves in power-operated doors that comply with Section ~~1010.1.4.2~~ 1010.3.2 shall not be limited.
6. *(No change to text.)*
7. *(No change to text.)*
8. *(No change to text.)*
9. *(No change to text.)*
10. *(No change to text.)*
11. ~~The minimum clear opening width shall not apply to doors for nonaccessible shower or sauna compartments.~~ Doors serving nonaccessible single user shower or sauna compartments; toilet stalls; or dressing, fitting or changing rooms shall have a minimum clear opening width of 20 inches (508 mm).
12. ~~The minimum clear opening width shall not apply to the doors for nonaccessible toilet stalls.~~

CHANGE SIGNIFICANCE: For over 50 years the maximum width of a swinging egress door has been limited to 48 inches. This was based principally on the weight of the door and that wider doors tended to be heavier and require greater maintenance to assure proper functioning and reasonable opening effort. Eliminating this width limitation was based on the several factors:

- Section 1010.1.3 will always limit the door opening force regardless of the height, width or weight of the door.
- Wider doors are often needed in locations such as in hospitals or other occupancies where the movement of patient beds, merchandise or equipment may create the need for a wider door.
- Installing multiple leaves of doors, which has been a typical solution, was not always effective since it could require the person moving through the door, or moving the equipment through the door, to operate both doors at the same time in order to gain passage through the doorway.

Eliminating the maximum width requirement in the base paragraph also required revisions to Exceptions 1 and 4 in order to coordinate with the revised general requirement and to what the exceptions were applicable.

The modifications that are shown in Exception 11 will accomplish several changes. In the 2018 edition of the code, Exceptions 11 and 12 were added to address nonaccessible shower, saunas or toilet compartments. It became apparent that small dressing, fitting or changing rooms at many retail stores were being required to provide 32-inch minimum width doors simply because there was no exception. Ultimately the change was made to consolidate existing Exceptions 11 and 12 along with these new items into one exception.

Another change occurred to place a minimum door width into the new Exception 11. The width of 20 inches was selected as a minimum since it will accommodate a typical 24-inch wide single user toilet compartment doors and individual saunas, while fitting room doors typically

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were 32 inches in width and commercial showers had a 22-inch width. Therefore, the 20 inches maintains the use of existing industry standard door sizes.

One issue of discussion and debate that will require the designer and code official to evaluate and use some judgement is that Exception 11 includes a limitation of serving "single user" elements. This phrasing was inserted considering the fact these spaces which are "nonaccessible" are typically clustered with or adjacent to a similar accessible element. The other issue is to recognize that the intent of the "single user" wording is not to prohibit situations such as where a parent enters the changing room with their child, or a friend goes in with someone to offer their opinion. The purpose of the language is really to ensure that spaces which are required to be accessible or that are intended for common use by multiple people will be provided with the 32-inch minimum clear door width. As an example, a changing room for a bridal party at a wedding venue, or for a sports team or group of referees at a gym would not be viewed as being intended for a "single user" and therefore should not use the exception. However, a toilet stall, or the typical changing or fitting room in a retail space would generally be considered a "single user" space even if there might be more than one person in the space on some occasions.

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1010.2.4
Locks and Latches

CHANGE TYPE: Modification

CHANGE SUMMARY: Two additional exceptions have been added into the general locking section to allow locked doors in the egress system when needed for either the clinical needs of care recipients or where exterior areas egress back into the building.

2021 CODE TEXT: ~~**1010.1.9.4**~~**1010.2.4 Locks and latches.** Locks and latches shall be permitted to prevent operation of doors where any of the following exist:

1. Places of detention or restraint.
2. In Group I-1 Condition 2 and Group I-2 occupancies where the clinical needs of persons receiving care require containment or where persons receiving care pose a security threat, provided that all clinical staff can readily unlock doors at all times, and all such locks are keyed to keys carried by all clinical staff at all times or all clinical staff have the codes or other means necessary to operate the locks at all times.

~~2.~~3. *(No change to text.)*

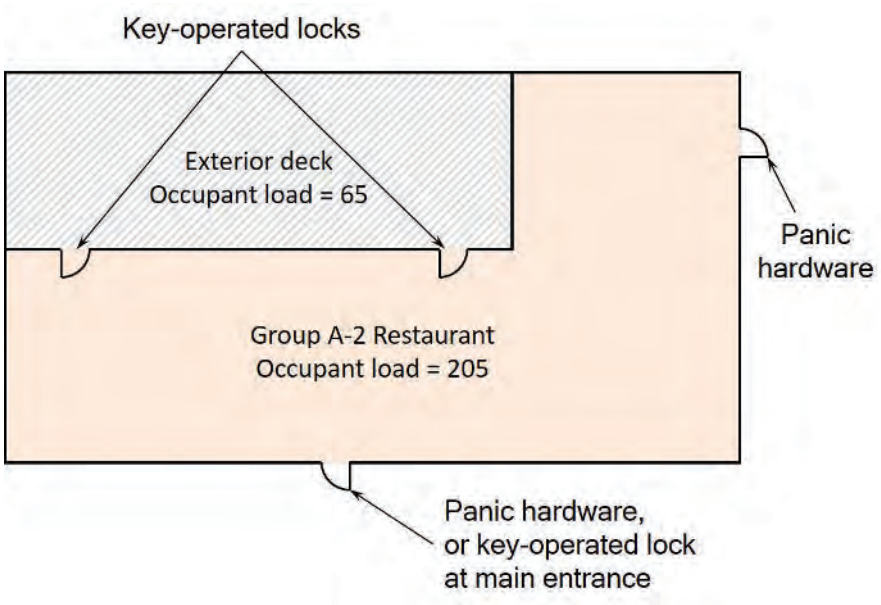
~~2.1.~~3.1 *(No change to text.)*
~~2.2.~~3.2 *(No change to text.)*
~~2.3.~~3.3 *(No change to text.)*

~~3.~~4. *(No change to text.)*

~~4.~~5. *(No change to text.)*

~~5.~~6. *(No change to text.)*

~~6.~~7. *(No change to text.)*



The doors from the exterior deck are required to swing in the direction of egress. The locking device on these doors can be a key-operated deadbolt when specific precautions are taken.

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8. Other than egress courts, where occupants must egress from an exterior space through the building for means of egress, exit access doors shall be permitted to be equipped with an approved locking device where installed and operated in accordance with all of the following:
   8.1. The maximum occupant load shall be posted where required by Section 1004.9. Such sign shall be permanently affixed inside the building and shall be posted in a conspicuous space near all the exit access doorways.
   8.2. A weatherproof telephone or two-way communication system installed in accordance with Sections 1009.8.1 and 1009.8.2 shall be located adjacent to not less than one required exit access door on the exterior side.
   8.3. The egress door locking device is readily distinguishable as locked and shall be a key-operated locking device.
   8.4. A clear window or glazed door opening, not less than 5 square feet (0.46 m²) square feet in area, shall be provided at each exit access door to determine if there are occupants using the outdoor area.
   8.5. A readily visible durable sign shall be posted on the interior side on or adjacent to each locked required exit access door serving the exterior area stating: THIS DOOR TO REMAIN UNLOCKED WHEN THE OUTDOOR AREA IS OCCUPIED. The letters on the sign shall be not less than 1 inch (25.4 mm) high on a contrasting background.
   8.6. The occupant load of the occupied exterior area shall not exceed 300 in accordance with Section 1004.
9. Locking devices are permitted on doors to balconies, decks or other exterior spaces serving individual dwelling or sleeping units.
10. Locking devices are permitted on doors to balconies, decks or other exterior spaces of 250 square feet (23.23 m²) or less, serving a private office space.

CHANGE SIGNIFICANCE: While four new exceptions have been added into this general locking section, they really address two basic situations. The first is that Exception 2 will address certain institutional occupancies where the needs of the care recipients are better addressed by containment. Exceptions 8, 9 and 10 address exterior areas that must enter back into the building for their required egress path.

Exception 2 coordinates the code with federal regulations for healthcare facilities. This exception will allow locked egress doors and thus restricted movement allowed for the safety of patients or public in certain assisted living facilities, hospitals or nursing facilities. This type of restricted egress is often used where additional security, elopement prevention or dementia wandering need to be addressed. While Section 1010.2.14 can be used to address electric locking systems, this new Exception 2 in Section 1010.2.4 can be used for manual locking systems having keys or codes that may not be covered by the provisions in Section 1010.2.14. One of the important aspects of this requirement was the inclusion of the word all at three locations so that "all" clinical staff are capable of unlocking these egress doors should a need arise.

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Exceptions 8, 9 and 10 try to strike a balance between egress safety and building security that has been left unaddressed in previous editions of the code. Technically, Section 1004.7 requires an unobstructed path of egress which would not permit exterior doors to be equipped with locks where the path of egress from exterior spaces travels back through the building. However, for security purposes, building owners and tenants want to install locks on these doors to prevent people from being able to enter building through unlocked doors. Building owners and code officials have long recognized this conflict between security and safety, and generally had to accept locks being installed by using either the modification or alternative methods sections of the code or occasionally without any involvement or approval from the code official. These new exceptions will provide guidance to directly address how these exterior doors can be locked and still used for egress purposes from exterior spaces. Having these provisions included within the code will provide greater consistency and make owners and code officials more comfortable with accepting these arrangements.

The locking device on the exit access door from the exterior area back into the building must be a key-operated lock that is readily distinguishable when in the locked position. When the exterior area is in use, the doors are unlocked and egress from the exterior back into the building is unobstructed.

While Exceptions 9 and 10 will be somewhat self-limiting due to the size or use involved, a maximum occupant load limit of 300 is allowed under Exception 8. A correlating change was made with regard to requirements for panic hardware. A new exception to Section 1010.2.9 eliminates the requirement for panic or fire exit hardware for exit access doors serving exterior areas when designed in accordance with Section 1010.2.4. This is similar in concept in Item 3 which allows the elimination of panic hardware on the main entrance door in Group A with an occupant load of 300 or less.

Note that this exception eliminates the need for panic hardware when serving an occupant load of 50 or more but does not eliminate the requirement for door swing in the direction of egress.

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1010.2.8, 1010.2.8.1, 1031.2.2

Locking Arrangements in Educational Occupancies

CHANGE TYPE: Modification

CHANGE SUMMARY: Exit door locks for protection from intruders are allowed in Group E occupancies, Group B educational occupancies and Group I-4 occupancies. When remote operation is provided, the door must still be unlockable from outside the room.

2021 CODE TEXT: ~~**1010.1.4.4**~~**1010.2.8 Locking arrangements in educational occupancies.** In Group E ~~and~~ occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors from classrooms, offices and other occupied rooms ~~shall be permitted to be provided~~ with locking arrangements designed to keep intruders from entering the room, ~~where~~ shall comply with all of the following conditions ~~are met~~:

1. The door shall be capable of being unlocked from outside the room with a key or other approved means.
2. The door shall be openable from within the room in accordance with Section ~~1010.1.9~~1010.2.

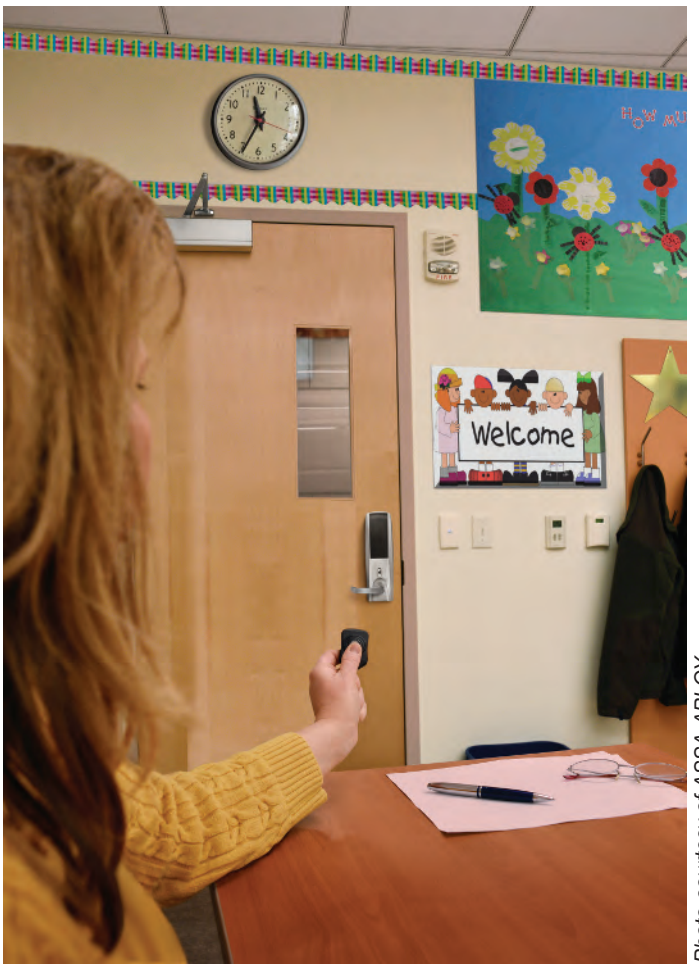


Photo courtesy of ASSA ABLOY

This classroom security lock can be operated remotely from inside the room or from the exterior.

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3. Modifications shall not be made to listed panic hardware, fire door hardware or door closers.
4. Modifications to fire door assemblies shall be in accordance with NFPA 80.

Remote locking or unlocking of doors from an approved location shall be permitted in addition to the unlocking operation in Item 1.

~~**1010.1.4.4.1 Remote operation of locks.** Remote operation of locks complying with Section 1010.1.4.4. shall be permitted.~~

~~**1031.2.2** **1032.2.2 Locking arrangements in educational occupancies.** In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors ~~from classrooms, offices and other occupied rooms shall be permitted to be provided~~ with locking arrangements designed to keep intruders from entering the room shall comply with Section 1010.2.8. ~~where all of the following conditions are met:~~

~~1. The door shall be capable of being unlocked from outside the room with a key or other approved means.~~
~~2. The door shall be openable from within the room in accordance with Section 1010.1.9.~~
~~3. Modifications shall not be made to existing listed panic hardware, fire door hardware or door closers.~~
~~4. Modifications to fire door assemblies shall be in accordance with NFPA 80.~~

CHANGE SIGNIFICANCE: The issue of security during lockdown situations has been in the code development process for the past several cycles. This proposal is intended to correlate the provisions for new construction (Section 1010) and the provisions for new locking devices installed in existing buildings (Section 1032).

The purpose of these locking devices is to allow for lockdown to occur, but also provide (1) capability to lock the door from the egress side without needing to open the door, (2) unimpeded egress from the interior with a single operation and (3) the ability for staff or emergency responders to unlock the doors from the non-egress side.

The ability to conduct lockdown and secure the building is not required in the *International Building Code* (IBC) or *International Fire Code* (IFC), but IFC Section 404.2.3 requires a lockdown plan if lockdown devices are provided. Many new schools and day care facilities design for lockdown situations, and many existing facilities desire to provide lockdown operations. The goal of lockdown is the same whether it occurs in a new or existing facility: to protect the occupants. For educational facilities and Group I-4 occupancies, these changes provide consistent requirements for both new and existing buildings.

Some of the requirements appeared in Section 1010 while others were in Section 1032. All of the requirements are now found in Sections 1010.2.8 and 1032.2.2 simply references those same requirements when new locking devices are installed at an existing facility. The allowance for remote unlocking was relocated so it a part of the main requirement.

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1010.2.9, 1010.2.9.1, 1010.2.9.2

Panic Hardware and Fire Exit Hardware

CHANGE TYPE: Modification

CHANGE SUMMARY: Panic or fire exit hardware is now required in electrical rooms with equipment greater than 800 amperes rather than 1,200 amperes, and in refrigeration machinery rooms exceeding than 1,000 square feet.

2021 CODE TEXT: ~~**1010.1.10**~~ **1010.2.9 Panic and fire exit hardware.** Swinging doors serving a Group H occupancy and swinging doors serving rooms or spaces with an occupant load of 50 or more in a Group A or E occupancy shall not be provided with a latch or lock other than panic hardware or fire exit hardware.

Exceptions:

1. A main exit of a Group A occupancy shall be permitted to have locking devices in accordance with Section ~~1010.1.9.4~~ 1010.2.4, Item ~~2~~3.
2. Doors provided with panic hardware or fire exit hardware and serving a Group A or E occupancy shall be permitted to be electrically locked in accordance with Section ~~1010.1.9.9~~ 1010.2.11 or ~~1010.1.9.10~~ 1010.2.12.



Panic hardware aids in efficient and effective evacuation.

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3. Exit access doors serving occupied exterior areas shall be permitted to be locked in accordance with Section 1010.2.4, Item 8.
4. Courtrooms shall be permitted to be locked in accordance with Section 1010.2.13, Item 3.

~~Electrical rooms with equipment rated 1,200 amperes or more and over 6 feet (1829 mm) wide, and that contain overcurrent devices, switching devices or control devices with exit or exit access doors, shall be equipped with panic hardware or fire exit hardware. The doors shall swing in the direction of egress travel.~~

1010.2.9.1 Refrigeration machinery rooms. Refrigeration machinery rooms larger than 1,000 square feet (93 m²) shall have not less than two exits or exit access doorways that swing in the direction of egress travel and are equipped with panic hardware or fire exit hardware.

1010.2.9.2 Rooms with electrical equipment. Exit or exit access doors serving transformer vaults, rooms designated for batteries or energy storage systems or modular data centers shall be equipped with panic hardware or fire exit hardware. Rooms containing electrical equipment rated 800 amperes or more and that contain overcurrent devices, switching devices or control devices and where the exit or exit access door is less than 25 feet from the equipment working space as required by NFPA 70, such doors shall not be provided with a latch or lock other than panic hardware or fire exit hardware. The doors shall swing in the direction of egress travel.

CHANGE SIGNIFICANCE: Several revisions occurred regarding the requirements for the installation of panic hardware or fire exit hardware. Exception 3 was added to Section 1010.2.9. For discussion of this item see Significant Change for Section 1010.2.4. Exception 4 was added to correlate with the delayed egress allowance in courtrooms. The requirements for electrical rooms were relocated into new Section 1010.2.9.2 and revised. The revision changes the threshold for panic hardware on electrical room doors from 1,200 amperes to 800 amperes and considers additional requirements in NFPA 70 *National Electrical Code*®.

The new criteria in Section 1010.2.9.2 correlates with the requirements in NFPA 70. Note that the requirement for panic hardware or fire exit hardware is not limited to an electric room. The following uses require panic or fire exit hardware:

- Electric room with electrical equipment rated at 800 amperes or more where the exit or exit access door is within 25 feet of the equipment working space. The working space referred to in NFPA 70 is the same as the working space regulated in *International Fire Code* (IFC) Section 603.4.
- Electric rooms with switchgear or control panels greater than 6 feet in width where the exit or exit access door is within 25 feet of the equipment working space.
- Electrical vaults.
- Transformer vaults.

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- Rooms containing energy storage systems. These systems would include battery storage systems. Capacitor rooms would also be regulated under IFC Section 1206.
- Modular data centers. NFPA 70 defines a modular data center as "Prefabricated units, rated 1000 volts or less, consisting of an outer enclosure housing multiple racks or cabinets of information technology equipment (ITE) (e.g., servers) and various support equipment, such as electrical service and distribution equipment, HVAC systems, and the like." NFPA 70 goes on to say that a modular data center could be a room or space in a building, or is often a cargo container.

Section 1010.2.9.1 is added to require panic hardware on doors to refrigeration machinery rooms. This revision is appropriate because of the risk of a rapid release of hazardous or asphyxiant gases. The need for rapid escape from refrigeration machinery rooms is not unlike what is needed for Group H Occupancies, which are required by Section 1010.1.10 to have panic hardware on all swinging doors. Section 608 requires ammonia refrigeration systems to comply with IIAR 2 "Safe Design of Closed-circuit Ammonia Refrigerating Systems" which requires fire exit hardware or panic hardware for ammonia refrigeration machinery rooms. This new section makes a similar requirement for all refrigeration machinery rooms.

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1020.5

Dead-End Corridors in Group I-2

CHANGE TYPE: Modification

CHANGE SUMMARY: In hospitals, dead-end corridors are now allowed a maximum length of 30 feet where they do not serve patient rooms or treatment spaces.

2021 CODE TEXT: ~~**1020.4**~~ **1020.5 Dead ends.** Where more than one exit or exit access doorway is required, the exit access shall be arranged such that dead-end corridors do not exceed 20 feet (6096 mm) in length.

Exceptions:

1. In Group I-3, Condition 2, 3 or 4 occupancies, the dead end in a corridor shall not exceed 50 feet (15 240 mm).
2. In occupancies in Groups B, E, F, I-1, M, R-1, R-2, S and U, where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the length of the dead-end corridors shall not exceed 50 feet (15 240 mm).



Dead-end corridors in non-patient areas of a hospital are allowed to be 30 feet in length.

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3. A dead-end corridor shall not be limited in length where the length of the dead-end corridor is less than 2.5 times the least width of the dead-end corridor.
4. In Group I-2, Condition 2 occupancies, the length of dead-end corridors that do not serve patient rooms or patient treatment spaces shall not exceed 30 feet (9144 mm).

CHANGE SIGNIFICANCE: To limit egress time and limit confusion while wandering in the wrong direction away from an exit, the code has traditionally limited the length of a dead-end corridor to a maximum of 20 feet. While several of the previous exceptions did allow for longer dead-ends, especially from Group B or S occupancies, they did not apply to Group I-2 occupancies such as hospitals. Keeping the dead-end limited in hospitals was generally viewed as being appropriate for the areas where patients might not be easily or rapidly moved. However, while the *International Building Code* (IBC) did place a 20-foot maximum limit on the dead-end corridors, NFPA 101 *Life Safety Code*® permitted a 30-foot maximum limit for healthcare occupancies.

Since most hospitals are regulated by the federal Centers for Medicare and Medicaid Services (CMS), differences between the IBC and *Life Safety Code*® have caused confusion and resulted in the more restrictive 20-foot limitation being applied throughout the area of the hospital classified as a Group I-2. The proponents of this change to the code noted that many areas within a hospital, such as staff areas, waiting areas and other non-patient areas are functionally similar to Group B occupancies that are allowed a longer dead-end length. Therefore, this proposal attempts to provide a balance by using the 30-foot limit in dead-end corridors "that do not serve patient rooms or patient treatment spaces" while still maintaining the general 20-foot limitation where patients would be served. Because the 30-foot limitation aligns with the requirements established by CMS and the *Life Safety Code*® it was accepted as being a reasonable distance for these areas that are similar to Group B. Therefore, this exception will permit dead-end corridors that do not serve patients to be increased to 30-feet in correlation with the *Life Safety Code*®.

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1030.16, 1030.16.1

Handrails at Social Stairs

CHANGE TYPE: Modification

CHANGE SUMMARY: Provides guidance to address handrails on stepped aisles, often called "social stairs," which are somewhere between general stairway provisions and assembly seating provisions.

2021 CODE TEXT: ~~**1029.16**~~ **1030.16 Handrails.** Ramped aisles having a slope exceeding one unit vertical in 15 units horizontal (6.7-percent slope) and stepped aisles shall be provided with handrails in compliance with Section 1014 located either at one or both sides of the aisle or within the aisle width. Where stepped aisles have seating on one side and the aisle width is 74 inches (1880 mm) or greater, two handrails are required. Where two handrails are required, one of the handrails shall be within 30 inches horizontally of the side of the tiered floor adjacent to the stepped aisle.

Exceptions:

1. Handrails are not required for ramped aisles with seating on both sides.
2. Handrails are not required where, at the side of the aisle, there is a guard with a top surface that complies with the graspability requirements of handrails in accordance with Section 1014.3.

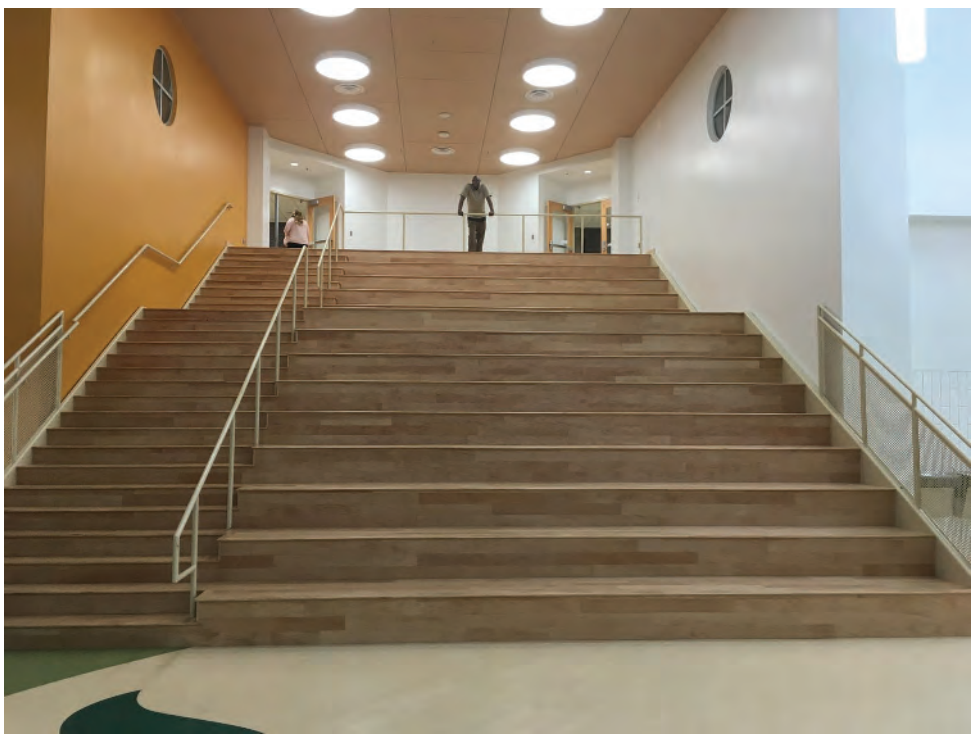


Photo courtesy of John R. Swanson

The stepped aisle serving these social stairs requires a handrail on one side when the stepped aisle is less than 74 inches wide.

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3. Handrail extensions are not required at the top and bottom of stepped aisles and ramped aisles to permit crossovers within the aisles.

~~1029.16.1~~ 1030.16.1 Discontinuous mid-aisle handrails. Where there is seating on both sides of the aisle, the mid-aisle handrails shall be ~~discontinuous with~~. Where a stepped aisle is required to have two handrails, the mid-aisle handrails shall be discontinuous. ~~gaps~~ Gaps or breaks shall be provided at intervals not exceeding exceed five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of not less than 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the mid-aisle handrail shall have rounded terminations or bends.

CHANGE SIGNIFICANCE: Social stairs have become common especially in educational and assembly occupancies, but they have not been clearly classified or regulated by the code. The many designs and the lack of any clear means of regulation have led to inconsistent and either very restrictive or almost a total lack of enforcement. Depending on the design and jurisdiction, the provisions for bleachers, stairways, stepped aisles or some other alternate system have been used to accept these stairs. In some cases, the effort to make them comply with the code's existing provisions have made them less safe by locating handrails where the users must either climb over or under the rail to reach the seating platforms.

Social stairways will be regulated using the assembly stepped aisle provisions of Section 1030. The rationale is that these are essentially an assembly seating area with seating platforms located to the side of a stepped aisle. These requirements address the stepped aisle width as well as the location of handrails serving the stepped aisle or, if also included, a stairway adjacent to the stepped aisle.

Section 1030.16 requires handrails at one or both sides of the aisle or will allow a handrail to be in the middle of the aisle. In situations where there is seating to one side, Section 1030.16 then continues to state that two handrails are required where the aisle width exceeds 74 inches. The 74-inch width is designed to establish a width that will keep the steps usable. This width accounts for a 30-inch reach dimension to a stairway handrail addressed in Section 1014.9, plus the normal 44-inch stairway width required by Section 1011.2. Using these two dimensions to establish the 74-inch requirement and the need for having two handrails ensures that the handrails will be provided where needed and not be required on narrower stairs where the second handrail may impede movement on the stair.

Once two handrails are required, Section 1030.16.1 will require that handrails not located along the side of the stairs must be discontinuous handrails. The discontinuous handrail provisions are the same as what has previously been required for center aisle handrails in assembly seating. Using discontinuous handrails will allow for a stepped aisle adjacent to the seating platforms but also allow people to move from that aisle to any adjacent stairway without having to climb over or under the rail or needing to go to the top or bottom to get to the other side. This will allow

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people to use an actual stepped aisle to access the platforms of the social stairway instead of requiring them to walk on the seating platforms that may have larger riser heights and depths.

To see several good examples of both acceptable designs and of what the code is trying to prevent, users may wish to look at the figures submitted with code change E106-18 and the public comments which modified that proposal.

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1103.5.4

Sprinklers in High-Rise Buildings

CHANGE TYPE: Addition

CHANGE SUMMARY: Unsprinklered high-rise buildings must either install an automatic sprinkler system or meet specific egress and fire alarm criteria.

2021 CODE TEXT: **1103.5.4 High-rise buildings.** Where Appendix M has not been adopted, existing high-rise buildings that do not have a previously approved fire sprinkler system shall be equipped with an automatic sprinkler system in accordance with Section 903.3.1.1 where any of the following conditions apply:

1. The high-rise building has an occupied floor located more than 120 feet (36 576 mm) above the lowest level of fire department vehicle access.
2. The high-rise building has occupied floors located more than 75 feet (22 860 mm) and not more than 120 feet (36 576 mm) above the lowest level of fire department vehicle access and the building does not have at least two interior exit stairways



Unsprinklered high-rise buildings with a floor greater than 120 feet above the lowest level of fire department vehicle access would be required to be retrofit with an automatic sprinkler system.

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complying with Section 1104.10 that are separated from the building interior by fire assemblies having a fire-resistance rating of not less than 2 hours with opening protection in accordance with Table 716.1(2) of the *International Building Code*.

3. The high-rise building has occupied floors located more than 75 feet (22 860 mm) and not more than 120 feet (36 576 mm) above the lowest level of fire department vehicle access and the building does not have a fire alarm system that includes smoke detection in mechanical equipment, electrical, transformer, telephone equipment and similar rooms; corridors; elevator lobbies; and at doors penetrating interior exit stairway enclosures.

Building owners shall file a compliance schedule with the fire code official not later than 365 days after receipt of a written notice. The compliance schedule shall not exceed 12 years for completion of the automatic sprinkler system retrofit.

CHANGE SIGNIFICANCE: Unsprinklered high-rise buildings represent a significant risk to occupants and emergency responders. The risk increases as a function of building height and when a building has an insufficient means of egress and inadequate fire detection systems. These risks have been well documented over time in the news media and NFPA reports (https://www.nfpa.org/News-and-Research/Fire-statistics-and-reports/Fire-statistics/Fires-by-property-type/High-Rise-Building-Fires), and while catastrophic fires may be infrequent, Grenfell Tower provided another grim reminder of the potential consequences.

This section is added to Chapter 11 as a retroactive requirement for existing high-rise buildings. This new section complements Appendix M, which is an optional appendix that requires all high-rise buildings to be retrofitted with sprinklers when the appendix is adopted by a jurisdiction. For those jurisdictions not adopting Appendix M, this section provides a less stringent retrofit requirement that offers incremental steps between retrofitting all high-rise buildings with sprinklers versus ignoring them all together.

The three conditions actually fall into two categories: (1) high-rise buildings with an occupied floors located more than 120 feet above the lowest level of fire department access and (2) high-rise buildings where the highest occupied floor is more than 75 feet and not exceeding 120 feet above the lowest level of fire department access.

High-rise buildings with an occupied floors located more than 120 feet above the lowest level of fire department access represent an extreme difficulty with respect to mustering resources on upper floors for interior fire attack, and are difficult to evacuate, particularly when mobility challenged occupants are involved. The 120-foot threshold correlates with Section 907.2.13.3 requiring multiple-channel voice evacuation systems and *International Building Code* (IBC) Section 403.6.1 for fire service access elevators. Item 1 stipulates that these buildings are required to be retrofit with an automatic sprinkler system.

The challenge of occupant evacuation with the counterflow of emergency responders taking equipment to the fire floor, particularly when mobility challenged occupants must be brought down the stairs, is sufficient to justify the need for sprinklers. If the stairs are compromised and charged with smoke, occupants cannot be evacuated, and fire fighter access is further hampered by low visibility and the need to use SCBA while

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climbing to the fire floor. To address occupant safety and fire fighter operations, Items 2 and 3 provide for mitigation measures other than fire sprinklers. These items should not be read as a suggestion that any high-rise building is sufficiently safe without a fire sprinkler system. A fire sprinkler system has proven its value and benefits in multiple fires. However, these new criteria provide an incremental step toward the goal of life safety.

Items 2 and 3 are applicable to high-rise buildings that do not fall under Item 1 (highest floor does not exceed 120 feet). Item 2 requires that the high-rise building has at least two interior exit stairs enclosed by a 2-hour fire-resistance-rated construction. The rise and run of the stairs must meet Section 1104.10, which allows a rise of 8¼ inches and a run of 9 inches. Openings into the stairway enclosure must comply with IBC Section 716.1(2) which specifies the ratings for opening protectives. If the egress system does not meet this design, the building is required to be retrofit with an automatic sprinkler system.

Item 3 requires a fire alarm system in the building. The fire alarm system must include smoke detection in equipment rooms, corridors, elevator lobbies and at every door penetrating into the interior exit stairways. The requirement for smoke detection in these specific areas exceeds the requirements for a typical fire alarm system in a high-rise building. Fires grow at an exponential rate, and delayed detection, alarm and emergency response significantly increase the risk to occupants and emergency responders. The fire alarm system will provide such early notification.

It should be noted that any existing, unsprinklered high-rise building with a top floor greater than 75 feet but not more than 120 feet above the lowest level of fire department vehicle access must comply with both Item 2 and Item 3 in order to avoid retrofitting the building with a fire sprinkler system. For these buildings, the owner still has option to either make the building comply with Items 2 and 3 or install fire sprinklers.

Similar to Appendix M, once the decision is made to install fire sprinklers, the owner has a maximum of 12 years to complete the installation.

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1103.7.5.1

Group R-1 Hotel and Motel Fire Alarm System

CHANGE TYPE: Modification

CHANGE SUMMARY: The requirements for retrofitting a fire alarm system in existing hotels and motels is reformatted and a new requirement for retrofitting unsprinklered single story hotels and motels is added.

2021 CODE TEXT: **1103.7.5.1 Group R-1 hotel and motel manual fire alarm system.** A manual fire alarm system that activates the occupant notification system in accordance with Section 907.5 shall be installed in existing Group R-1 hotels and motels more than ~~three stories~~ one story in height or with more than 20 sleeping units.

Exceptions:

1. ~~Buildings~~ A manual fire alarm system is not required in buildings less than two stories in height where all sleeping units, attics and crawl spaces are separated by 1-hour fire-resistance-rated construction and each sleeping unit has direct access to a public way, egress court or yard.
2. A manual fire alarm system is not required in buildings not more than three stories in height with not more than 20 sleeping units and equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.
3. Manual fire alarm boxes are not required throughout the building where the following conditions are met:
    - ~~2.1.~~3.1. The building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.
    - ~~2.2.~~3.2. The notification appliances will activate upon sprinkler water flow.
    - ~~2.3.~~3.3. Not less than one manual fire alarm box is installed at an approved location.



This existing unsprinklered, two-story hotel would be required to install a manual fire alarm system.

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CHANGE SIGNIFICANCE: Automatic sprinkler systems were not required in all Group R occupancies until the 2003 edition of the *International Fire Code* (IFC) and the *International Building Code* (IBC). Fires in some older multiple story unsprinklered hotels without fire alarm systems have resulted in multiple fire fatalities and fire injuries. This often occurs where a fire on the first floor renders the means of egress unusable by occupants from floors above. Such fires in two-story motels without automatic sprinkler systems occurred on January 4, 2010 in South Birmingham, AL (four fatalities on the second floor), on December 14, 2013 in Wausau, WI (20 injuries), in Point Pleasant Beach, NJ on March 21, 2014 (four fatalities on the second floor) and in Newport, OR on August 5, 2016 (four fatalities and three injuries). Fatalities occurred as second floor occupants could not escape due to the means of egress being blocked by smoke and flames.

This section requires that a fire alarm system be retrofit into existing Group R-1 hotels and motels when the building is greater than one story or has more than 20 sleeping rooms. There are three exceptions to this requirement:

- Exception 1 applies to one story buildings with more than 20 sleeping rooms. If all the sleeping rooms are separated by 1-hour construction and each sleeping room has a direct exit, then the fire alarm system is not required.
- Exception 2 applies to buildings up to three stories in height with no more than 20 sleeping rooms. If the building is sprinklered with a system complying with NFPA 13 or 13R, a fire alarm system is not required.
- Exception 3 applies to buildings where the fire alarm system is to be retrofit. If the building is equipped with sprinkler system complying with NFPA 13 or 13R, manual fire alarm boxes are not required except for one in an approved locations.

Retrofit of Manual Fire Alarm System in Existing *SPRINKLERED* Group R-1

Number of Units	Number of Stories		
	1 story	2 or 3 stories	>3 stories
≤20 units	Not required	Not Required	Required[b]
>20 units	Required[a,b]	Required[b]	Required[b]

a. Exception 1 eliminates the fire alarm system for one-story buildings if the building meets the requirements.
b. Exception 3 eliminates all but one manual fire alarm box.

Retrofit of Manual Fire Alarm System in Existing *NONSPRINKLERED* Group R-1

Number of Units	Number of Stories		
	1 story	2 or 3 stories	>3 stories
≤20 units	Not required	Required	Required
>20 units	Required[a]	Required	Required

a. Exception 1 eliminates the fire alarm system for one-story buildings if the building meets the requirements.

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1103.9

Carbon Monoxide Detection in Existing Buildings

CHANGE TYPE: Modification

CHANGE SUMMARY: Carbon monoxide detection is required in existing Group I-1, I-3, I-4 and R occupancies and in existing classrooms in Group E.

2021 CODE TEXT: **1103.9 Carbon monoxide ~~alarms~~ detection.** Carbon monoxide ~~alarms~~ detection shall be installed in existing ~~dwelling units and sleeping units~~ Group I-1, I-2, I-4 and R occupancies and in classrooms in Group E occupancies where those units include any of the conditions identified in Sections 915.1.2 through 915.1.6. The carbon monoxide alarms shall be installed in the locations specified in Section 915.2 and the installation shall be in accordance with Section 915.4.

Exceptions:

1. Carbon monoxide alarms are permitted to be solely battery operated where the code that was in effect at the time of construction did not require carbon monoxide detectors to be provided.
2. Carbon monoxide alarms are permitted to be solely battery operated in dwelling units that are not served from a commercial power source.
3. A carbon monoxide detection system in accordance with Section 915.5 shall be an acceptable alternative to carbon monoxide alarms.



This carbon monoxide alarm is a combination smoke alarm and CO alarm.

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CHANGE SIGNIFICANCE: Carbon monoxide poisoning incidents routinely occur in Group I and R occupancies and in classrooms. In many states and jurisdictions these incidents have resulted in legislative and regulatory solutions that addressed this problem. This proposal aligns the retroactive requirement for carbon monoxide detection with the requirements for new construction for these facilities.

Rather than specifying sleeping units and dwelling units, this revision specifies certain occupancies and uses. The reference to Sections 915.1.2 through 915.1.6 limits the application of these requirements to facilities that have a direct source of carbon monoxide.

This section now requires carbon monoxide detection. The general requirement of detection allows a carbon monoxide detection system or carbon monoxide alarms to be installed in existing buildings.

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1203.1.2

Fuel Line Piping Protection

CHANGE TYPE: Modification

CHANGE SUMMARY: Several options are provided for protecting the fuel line supplying emergency and standby generators.

2021 CODE TEXT: **1203.1.2 Fuel line piping protection.** Fuel lines supplying a generator set inside a building shall be separated from areas of the building other than the room the generator is located in by ~~an approved method, or an~~ one of the following methods:

1. A fire-resistant pipe-protection system that has been tested in accordance with UL 1489. The system shall be installed as tested and in accordance with the manufacturer's installation instructions, and shall have a rating of not less than 2 hours. Where the building is protected throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1, the required rating shall be reduced to 1 hour.
2. An assembly that has a fire-resistance rating of not less than 2 hours. Where the building is protected throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1, the required fire-resistance rating shall be reduced to 1 hour.
3. Other approved methods.

CHANGE SIGNIFICANCE: Emergency and standby generators are expected to operate for the duration of an incident in a building. When the generator is located inside the building, components need to be protected



Photo courtesy of 3M

Listed piping protection with a 2-hour fire-resistance rating has been installed to protect the piping carrying fuel to the generator.

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to allow for reliable operation. This change provides options for protecting the fuel lines supplying a generator located inside a building.

The fuel line must be protected for a 2-hour duration. Both Item 1 and 2 allow for a reduction from 2 hours to 1 hour when the building is sprinklered with a fire sprinkler system designed to NFPA 13. The fuel line protection system can be listed to UL 1489, "Fire Resistant Pipe Protection Systems Carrying Combustible Liquids" in Item 1. Item 2 allows for a fuel line to be located within a fire-resistance-rated assembly. Note that protection of the fuel line piping is not required within the room housing the generator.

UL 1489 addresses the fire-resistive performance of fuel lines protected for an hourly rating. The code references test standards for construction of a fire-resistance-rated assembly: ASTM E119 and UL 263. Similar to these test standards, the UL 1489 standard describes the same test equipment and same time-temperature fire exposure as ASTM E119 and UL 263. However, the sample testing configuration specifically addresses pipe-protection systems. The Conditions of Acceptance follow the intent of ASTM E119 and UL 263, but specifically address the performance requirements for fire-resistant pipe-protection systems. Specifically, the Conditions of Acceptance require (1) resistance to the fire and hose stream exposure without developing openings in the pipe and (2) preventing a temperature increase exceeding 325°F at any single point or 250°F at any cross section along the pipe.

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1204
Portable Generators

CHANGE TYPE: Addition

CHANGE SUMMARY: Portable generators are now regulated and safety issues are addressed.

2021 CODE TEXT:

SECTION 1204 PORTABLE GENERATORS

1204.1 Portable generators. The use, operation and maintenance of portable generators shall comply with this section.

1204.2 Listing. Portable generators manufactured after January 1, 2021 shall be listed and labeled in accordance with the UL 2201.

1204.3 Operation and maintenance. Portable generators shall be operated and maintained in accordance with the manufacturer's instructions.

1204.4 Grounding. Portable generators shall be grounded in accordance with NFPA 70.

1204.5 Operating locations. Portable generators shall be operated only outdoors a minimum of 5 feet (1524 mm) from any building openings such as windows and doors or air intakes. Portable generators shall not be operated within buildings or enclosed areas. Additional separation shall be provided for tents, membrane structures and outdoor assembly events as specified in Chapter 31.



This mobile generator is considered a portable generator and is required to be provided with a grounding rod during use.

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1204.6 Cords and wiring. Extension cords and temporary wiring used to connect portable generators shall be in accordance with Section 604 and shall be provided with GFCI protection.

1204.7 Connections to premise wiring. Connections to a premise wiring system shall comply with all of the following:

1. Power shall not be provided in a manner that "back feeds" receptacles or the premise wiring system.
2. Connection to a premise served by commercial power shall be made through a listed transfer switch installed, used and maintained in accordance with NFPA 70.
3. Connections to buildings not served by commercial power shall comply with NFPA 70.

1204.8 Refueling. Portable generators shall not be refueled while operating.

1204.9 Storage and repair. Storage and repair of fuel-fired portable generators shall comply with Section 313.

1204.10 Fire extinguisher. A listed portable fire extinguisher complying with Section 906 and a minimum rating of 2-A:20-B:C shall be provided not more than 50 feet (15 240 mm) from the portable generator.

Section 202 Definitions

PORTABLE GENERATOR. A mobile internal combustion engine-driven device that provides temporary electrical power. This includes hand portable, wheeled, trailer mounted, and motor vehicle mounted generator sets. It does not include generators in permanent, fixed installations.

CHANGE SIGNIFICANCE: The use of portable generators is generally unregulated in the *International Fire Code* (IFC), except for minimal storage, use and repair requirements in Chapter 3 and some setback requirements in Chapter 31. These products are frequently used to provide power at special outdoor events and construction sites, and during power outages. In 2016, the U.S. Consumer Product Safety Commission released the report "Incidents, Deaths, and In-Depth Investigations Associated with Non-fire Carbon Monoxide from Engine-driven Generators and other Engine-driven Tools, 2004–2014." This report indicated that in the 9-year period ending in 2012, there were 8,703 injuries and 666 fatalities resulting from carbon monoxide (CO) produced by operating portable generators. The report also indicated that a typical engine powering a 5 kW portable generator emits a weighted average CO rate of 1500 grams per hour nominally, compared to an idling midsize late 1990s vintage car that emits 2.4–5.4 grams per hour of CO.

A new definition is provided for portable generator. This regulates portable devices; permanent generator installations must comply with the *National Electrical Code*.

Section 1204.2 requires that portable generators manufactured after January 1, 2021 be listed and labeled in accordance with UL 2201 Standard for Tests for Determining Carbon Monoxide (CO) Emission Rate of

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Portable Generators. The standard tests the CO levels generated, limits the amount of CO produced by a portable generator and requires the portable generator to shutoff in elevated CO environments. These requirements were developed based on an analysis of the CPSC CO incident data, and are complementary, addressing both indoor misuse and outdoor use incidents. In accordance with UL 2201, the CO emission rate shall not exceed 150 grams per hour, and the generator shall shutoff at any time when there is a peak 400 ppm CO concentration, or the average CO concentration is greater than 150 ppm during a rolling 600 seconds during the test.

Section 1204.5 restricts use to outdoors and specifies a minimum of 5 feet from building openings and air intakes.

Back feeding power through electrical outlets is an unsafe practice that bypasses the built-in overcurrent protection and can create a dangerous situation when the local commercial power comes back online. It can also endanger utility workers while they repair power lines, when they are assuming the power supply is shut down. Connection to a building can be completed, but must be provided with a transfer switch where a utility provides routine electric power.

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1205.3.3

Smoke Ventilation with Solar PV

CHANGE TYPE: Clarification

CHANGE SUMMARY: The requirement for access pathways to smoke and heat vents is clarified.

2021 CODE TEXT: ~~**1204.3.3**~~ **1205.3.3 Smoke ventilation.** The solar installation shall be designed to meet the following requirements:

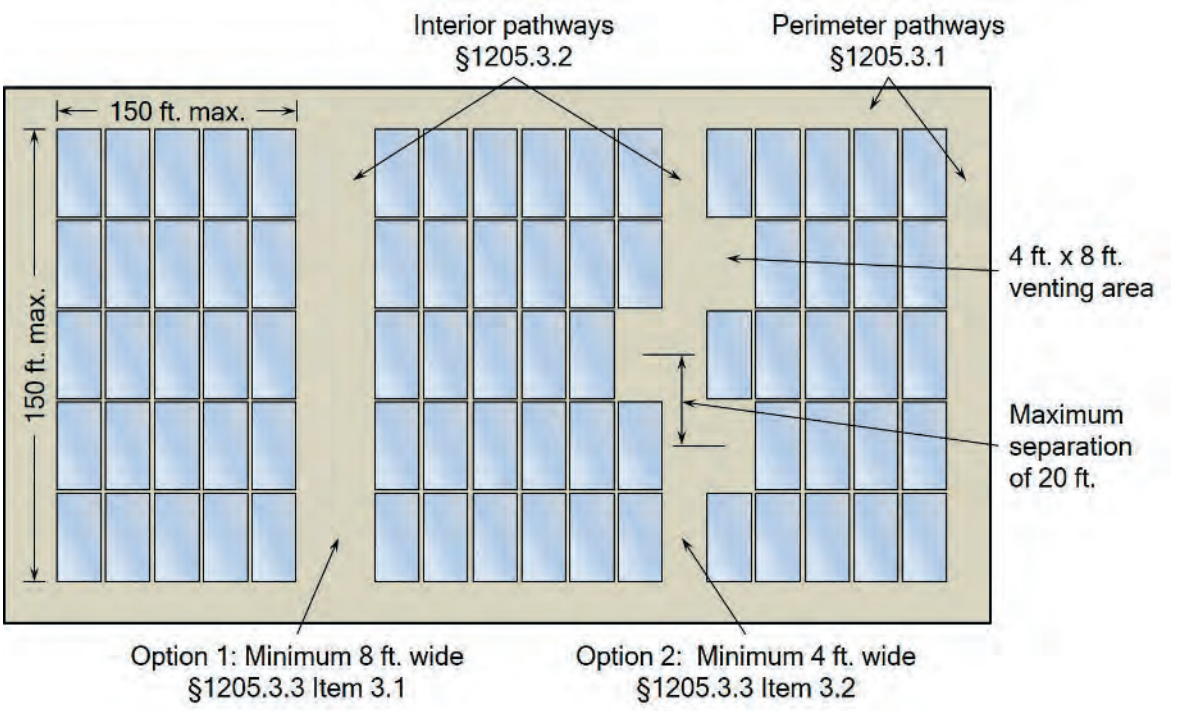
1. Where nongravity-operated smoke and heat vents occur, a pathway not less than 4 feet (1219 mm) wide shall be provided bordering all sides.
2. ~~Smoke ventilation options between array sections shall be one of the following:~~ Where gravity-operated dropout smoke and heat vents occur, a pathway not less than 4 feet (1290 mm) wide on not less than one side.

   ~~2.1. A pathway not less than 8 feet (2438 mm) wide.~~

   ~~2.2. Where gravity-operated dropout smoke and heat vents occur, a pathway not less than 4 feet (1290 mm) wide on not less than one side.~~
3. Smoke ventilation options between array sections shall be one of the following:

   3.1. A pathway not less than 8 feet (2438 mm) wide.

   ~~2.3~~3.2 A pathway not less than 4 feet (1290 mm) wide bordering 4-foot by 8-foot (1290 mm by 2438 mm) venting cutouts every 20 feet (6096 mm) on alternating sides of the pathway.



There are two options for the width of the interior pathways separating solar photovoltaic (PV) panel arrays.

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CHANGE SIGNIFICANCE: The original intent of this section was to require fire fighter access to all smoke and heat vents, regardless if the smoke and heat vents are nongravity-operated or gravity-operated dropout. The 2018 *International Fire Code* (IFC) was written in such a way that access to gravity-operated dropout smoke and heat vents was only required when the panel arrays are required to be separated. The requirement for separating panel arrays is not found in this section. Section 1205.3.2 contains the requirement for separation and requires an interior pathway through the panel array at intervals not greater than 150 feet. The width of that pathway is specified in this section and the revised Item 3 requires the pathway to be either 8 feet wide, or 4 feet wide with ventilation locations provided every 20 feet.

The 8-foot wide pathway provides more options for ventilation locations. However, it is a designer's choice which configuration is selected. The structural components of the roof should be considered when determining where the interior pathways are located.

The requirement to provide access to gravity-operated smoke and heat vents is now a standalone requirement.

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1207

Electrical Energy Storage Systems

CHANGE TYPE: Modification

CHANGE SUMMARY: The requirements for energy storage systems have been reformatted and revised to better address this growing and changing technology.

2021 CODE TEXT: The entirety of Section 1207 (Section 1206 in the 2018 IFC) was reformatted and replaced. Due to the length of this section a very abbreviated outline of this section is included below. For the complete code language, see the 2021 edition of the International Fire Code.

SECTION ~~1206~~ 1207 ELECTRICAL ENERGY STORAGE SYSTEMS (ESS)

1207.1 General.

1207.2 Commissioning, decommissioning, operation and maintenance.

1207.3 Equipment.

1207.4 General installations requirements.

1207.5 Electrochemical ESS protection.

1207.6 Electrochemical ESS technology specific protection.

1207.7 Indoor installations.

1207.8 Outdoor installations.

1207.9 Special installations.



Photo courtesy of Getty Images

Battery storage systems and other types of energy storage systems are regulated in Section 1207.

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1207.10 Mobile ESS equipment and operations.

1207.11 ESS in Group R-3 and R-4 Occupancies.

CHANGE SIGNIFICANCE: The addition of energy storage system (ESS) requirements into the 2018 code was an initial effort to address safety hazards associated with the increased use of lithium-ion batteries, capacitors and other modern energy storage system (ESS) technologies for a growing number of energy storage applications. The 2018 requirements were a huge step toward addressing modern ESS technologies and grid-based applications. However, as written the requirements made it difficult to apply appropriate safety requirements for different installations, each with their own risks and exposures. For example, a lead-acid battery ESS installation in an unmanned rural telecommunications repeater does not present the same risks and exposures as a lithium-ion battery ESS installation in a mixed occupancy high rise in an urban area. Since publication of the 2018 *International Fire Code* (IFC), a significant amount of evaluation and testing by private and government stakeholders has occurred to better address the hazards and exposures associated with various types of ESS installations, technologies and operations.

This section rewrite not only retains many of the basic protection concepts in the 2018 code, but also provides customized requirements for different types of installations and different types of ESS technologies.

Several revisions have occurred in Table 1207.1, which is the table used to determine when Section 1207 applies to an ESS system.

- Nickel metal hydride technology has been added.
- "Other battery technologies" is listed along with "other electrochemical ESS technologies."
- Sodium batteries are no longer listed separately. They fall into "Other electrochemical ESS technologies" and are regulated at 3 KWh.
- Capacitor ESS systems are included and are regulated at 3 KWh.

Mobile ESS operations consisting of lithium-ion batteries on trailers or skids are being deployed to locations to provide a temporary source of power. The mobile ESS operations are now addressed in Section 1207.10. Additionally, both construction and operational permits are required for the mobile ESS equipment.

The 2018 IFC contains certain variances based on large scale fire and fault condition testing, however the criteria for conducting such testing was undefined. Section 12067.1.5 has been revised to specify that the large scale fire testing shall be conducted in accordance with UL 9540A "Standard for Safety Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems."

Section 1207.1.6 is added to address fire events involving lithium-ion battery systems, since lithium-ion battery fires have the potential to re-ignite hours or even days after initial extinguishment by the fire department, who cannot remain on scene indefinitely until the fire damaged ESS is safely removed from the premises. The fire remediation requirements, similar to fire watch requirements, make the owner responsible for sending mitigation personnel to the scene to take over the remediation process.

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New requirements in Section 1207.2 include criteria on commissioning, decommissioning, maintenance and testing requirements. These provisions are important considerations for providing a safe installation.

The ESS equipment is addressed in Section 1207.3. New requirements in this section address retrofitting existing energy storage systems and reuse or repurposing of electric vehicle batteries that are converted for ESS use in buildings. This can only occur if the equipment is refurbished in accordance with UL 1974 and the use and installation is approved by the code official.

A definition has been added for walk-in units and recognizes ISO type shipping containers being used to house ESS in various outdoor and mobile applications.

Section 1207.5 identifies the specific protection requirements applicable for each type of battery technology. The requirements differ based on the exposure hazard, such as indoor versus outdoor, dedicated use building versus nondedicated use buildings, remote locations or rooftop installations.

Table 1207.5.2 lists the maximum allowable quantity of energy storage allowed in a room or walk-in units. The ESS can only exceed these amounts if justified by a hazard mitigation analysis or large scale fire testing. The facility no longer becomes a Group H occupancy. Rather, mitigation measures are added to address the increased hazard.

All ESS rooms and walk-in units must be protected by an automatic fire-extinguishing system. The 2018 code required a fire sprinkler system unless the ESS was water reactive. When designing the sprinkler system, it was difficult or impossible to determine the required design density. Section 1207.5.5 now specifies a minimum design density. Additionally, other fire-extinguishing agents and systems are allowed when the design is based on large scale testing in accordance with UL 9540A.

Lithium-ion battery systems and other electrochemical ESS technologies have the potential to rapidly build up potentially explosive atmospheres in the battery or electrochemical ESS room during thermal runaway and other conditions. Section 1207.6.3 addresses explosion control in these rooms.

A revision to Table 509 in the *International Building Code* (IBC) removes ESS from classification as an incidental use. Therefore, the ESS rooms are no longer limited to 10 percent of the floor area. The entire building could contain the ESS and would now be considered a dedicated use building. Dedicated use buildings will typically be utility grid related facilities. In these buildings, the administrative or support operations are the incidental use and are limited to 10 percent of floor area. Dedicated use buildings are classified as Group F-1 and are not limited to the maximum allowable quantities. Section 1207.7.1 requires additional protection measures for dedicated use buildings.

Section 1207.7.4 requires that rooms containing ESS be separated from the remainder of the building. The separation must be fire-resistance construction with a minimum of 2-hour rating. The 2018 IFC and IBC allowed Group B, F, M, S and U occupancies to have a 1-hour rating.

Section 1207.10 covers mobile ESS operations. Mobile ESS are regulated at their home facility where it is stored awaiting deployment, and at the location where the mobile ESS provides temporary energy. Deployment and use of mobile ESS is limited to 30 days with some exceptions. An operational permit is required for each mobile ESS deployment.

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PART 4

Special Occupancies and Operations

Chapters 20 through 40



- **Chapter 20** Aviation Facilities No changes addressed
- **Chapter 21** Dry Cleaning No changes addressed
- **Chapter 22** Combustible Dust-Producing Operations
- **Chapter 23** Motor Fuel-Dispensing Facilities and Repair Garages
- **Chapter 24** Flammable Finishes
- **Chapter 25** Fruit and Crop Ripening No changes addressed
- **Chapter 26** Fumigation and Insecticidal Fogging No changes addressed
- **Chapter 27** Semiconductor Fabrication Facilities
- **Chapter 28** Lumber Yards and Agro-industrial, Solid Biomass and Woodworking Facilities
- **Chapter 29** Manufacture of Organic Coatings No changes addressed
- **Chapter 30** Industrial Ovens No changes addressed
- **Chapter 31** Tents, Temporary Special Event Structures and Other Membrane Structures No changes addressed
- **Chapter 32** High-piled Combustible Storage
- **Chapter 33** Fire Safety During Construction and Demolition
- **Chapter 34** Tire Rebuilding and Tire Storage No changes addressed
- **Chapter 35** Welding and Other Hot Work No changes addressed
- **Chapter 36** Marinas No changes addressed
- **Chapter 37** Combustible Fibers No changes addressed
- **Chapter 38** Higher Education Laboratories
- **Chapter 39** Processing and Extraction Facilities
- **Chapter 40** Storage of Distilled Spirits and Wines
- **Chapters 41 through 49** (reserved)

Chapters 20 through 40 of the *International Fire Code* (IFC) establish the minimum requirements for special processes and uses. These processes or uses involve a variety of combustible and hazardous materials and are unique to particular applications, such as semiconductor facilities or industrial ovens. For certain activities, such as aviation facilities or motor fuel-dispensing facilities, these processes or uses typically require the storage and handling of thousands of gallons of flammable or combustible liquids. Other chapters address the safe handling and storage of combustible and flammable materials. Chapters 41 through 49 are reserved and serve as placeholders for future code provisions addressing new special occupancies or operations that require regulation by the IFC. One of those "future" was added in the 2021 IFC — Chapter 40 Storage of Distilled Spirits and Wine. ■

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CHAPTER 22

Combustible Dust-Producing Operations

2308.1, 2308.2, 2308.2.3, 2308.2.4

CNG Vehicle Fueling

2311.8

Repair of Lighter-than-Air Fueled Vehicles

2404.3.3.6

Size of Spray Booths

TABLE 2704.2.2.1

Water-Reactive Solids in Semiconductor Fabs

2808.3, 2808.3.1, 2808.4

Sizes of Piles and Stacks

TABLE 3203.8

High-Piled Storage of Lithium-ion Batteries

3205.5

Aisle Maintenance in High-Piled Storage

3209.4, 3209.4.1 (NEW), 3209.4.2 (NEW)

Shutdown of Automated Rack Storage

3303.3, 3303.3.1

Daily Fire Safety Inspection

3303.5

Fire Safety for Types IV-A, IV-B and IV-C Construction

3305.5

Fire Watch

3305.9

Separation of Construction Areas

3313

Water Supply During Construction

3805.2.1, 3805.2.2, 3805.4, TABLE 3805.4

Restricted Materials in College Labs

3904.2, 3904.2.1 (NEW), 3904.2.2 (NEW)

Extraction Equipment

CHAPTER 40 (NEW), 903.2.4.2 (NEW), 903.2.9.3 (NEW), IBC 307.1.1

Storage of Distilled Spirits and Wines

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TABLE 2203.1 Critical Depth Layer

Type of Dust	Critical Depth Layer (inches)
Wood Flour	1/8
All Other Dusts	1/32

Table 2203.1 provides the critical depth layer for the accumulation of combustible dust on surfaces. Depths greater than shown may provide an adequate quantity of dust which can result in a dust explosion.

CHANGE TYPE: Modification

CHANGE SUMMARY: The chapter is revised to include criteria for mitigating the accumulation of combustible dust and control of ignition sources, and provide guidance for fire code inspector.

2021 CODE TEXT: **NOTE:** Due to the length of the code change it cannot be included in its entirety. An abbreviated outline of Chapter 22 is shown.

SECTION 2201 GENERAL

2201.1 Scope.

2201.2 Permits.



The depth of the dust layer on horizontal surfaces would be measured to determine if the critical depth layer is exceeded.

Chapter 22

Combustible Dust-Producing Operations

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SECTION 2202 DEFINITIONS

2202.1 Definitions.

SECTION 2203 DUST EXPLOSION PREVENTION

2203.1 Critical depth layer.

Table 2203.1 Critical Depth Layer

2203.2 Dust-producing and dust handling equipment.

2203.3 Dust collection and conveying systems.

2203.4 Sources of ignition.

2203.5 Housekeeping.

2203.6 Standard operational procedures.

2203.7 Emergency response plan.

2203.8 Training.

SECTION 2204 DUST EXPLOSION SCREENING TESTS

2204.1 Combustibility and explosivity tests.

2204.2 Samples.

SECTION 2205 STANDARDS

2205.1 Specific hazards standards.

2205.1.1 Dust hazard analysis.

CHANGE SIGNIFICANCE: Combustible dust presents a hazard and continues to result in incidents often with a catastrophic result. This chapter was revised in the 2018 *International Fire Code* (IFC) and is again revised in the 2021 edition. Several National Fire Protection Association (NFPA) standards are referenced for unique dust hazards. To aid the inspector who typically cannot travel with all of the referenced standards, the chapter has been completely revised. The chapter still references the NFPA standards, but additional guidance is provided for the fire code official and inspector.

These revisions provide additional guidelines on methods to mitigate dust accumulation, handle dust collection and removal and control sources of ignition. Provisions for housekeeping, employee training and operational procedures are also added.

The chapter retains the provision to require a dust hazard analysis for both new and existing facilities in Section 2205.1.1.

Section 2201.1 contains exceptions where this chapter does not apply. In general, this chapter applies to facilities that generate combustible dust, or handle combustible dust in a manner where the release of dust into the atmosphere is anticipated. Facilities that may simply store or display combustible dust are excluded, such as retail or storage facilities. Consumer materials in Groups B, M and R occupancies are also excluded.

Identification of a dust explosion hazard is the single most critical component in providing adequate mitigation. Section 2203.1 and Table 2203.1 have been added to guide the code user in making this determination and should be used at every inspection. This method is based on the depth of combustible dust. When the critical depth layer in Table 2203.1 is exceeded, there is a possibility enough dust is present for a dust

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explosion to occur. While this is a simplified approach, it gives the inspector a quick and easy method for making a determination. Section 2203.1 also allows for a more complicated analysis by adjusting the critical layer depth based on specific NFPA standard criteria or a dust hazard analysis as specified in Section 2205.1.

Methods to limit the depth of the dust layer include dust collection and proper housekeeping methods, both of which have revised and include expanded provisions.

Ignition sources must also be controlled. The revised chapter includes provisions for:

- limitations on open flames.
- bonding and grounding.
- smoking.
- classified electrical.
- fuel-fired equipment.
- hot surfaces and equipment.

The dust collection system must comply with the *International Mechanical Code* (IMC) and provide cleanouts to access all parts of a conveying system for cleaning and inspection. Lack of cleanouts was one of issues that resulted in the explosion in the Imperial Sugar Company, Port Wentworth, GA.

Basic housekeeping is required to limit the accumulation of dust. Section 2203.5 addresses housekeeping and cleaning. Three options are provided as a method to remove accumulated dust. Utilizing pressurized air is initially prohibited as one of these methods. The new exception is added to allow the use of pressurized air, but only after the other identified methods have been completed. Vacuuming cannot always reach into nooks and crevices on equipment. Therefore, this exception allows the use of compressed air after the majority of the dust has been removed by one of the other methods. These procedures are found in the referenced NFPA standards.

Section 2203.6 requires inspection, maintenance and testing of the components which provide hazard mitigation in the facility. Standard operational procedures provide guidance for maintenance and safe operations.

An emergency response plan is required to address prevention of, preparation for and response to a dust explosion. Section 2203.8 specifies that the employees must be trained upon hire and annually thereafter on the housekeeping requirements, the emergency response plan and standard operating procedures.

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2308.1, 2308.2, 2308.2.3, 2308.2.4

CNG Vehicle Fueling

CHANGE TYPE: Addition

CHANGE SUMMARY: Vehicle fueling with compressed natural gas (CNG), previously allowed at only residential occupancies, is now allowed at other occupancies.

2021 CODE TEXT: **2308.1 General.** Motor fuel-dispensing facilities for compressed natural gas (CNG) fuel shall be in accordance with this section, ~~and~~ Chapter 53 and Section 413 of the *International Fuel Gas Code*.

2308.2 Approvals. Storage vessels and equipment used for the storage, compression or dispensing of CNG shall be *approved* or *listed* in accordance with Sections 2308.2.1 ~~and 2308.2.2~~ through 2308.2.4.

2308.2.3 Residential fueling appliance (RFA). Residential fueling appliances shall be listed and installed in accordance with installation requirements of CSA/ANSI NGV 5.1, manufacturer installation instructions and Section 413 of the *International Fuel Gas Code*. The capacity of an RFA shall not exceed 5 standard cubic feet per minute (0.14 m^3/min) of natural gas.

2308.2.4 Vehicle fueling appliance (VFA). Non-residential fueling appliances shall be listed and installed in accordance with installation requirements of CSA/ANSI NGV 5.2, manufacturer installation instructions and requirements of Section 413 of the *International Fuel Gas Code* for VFAs. The capacity of VFA shall not exceed 10 standard cubic feet per minute (0.28 m^3/min) of natural gas.



Photo courtesy of Tatomm/iStock / Getty Images Plus/Getty Images

Listed residential fueling appliances for compressed natural gas allow the homeowner to refuel at home.

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CHANGE SIGNIFICANCE: The 2018 I-Codes included the concept of refueling CNG-fueled vehicles at home. This code change creates two new terms: (1) "residential fueling appliance" (RFA) and (2) "vehicle fueling appliance" (VFA). Both of these devices are required to be listed to CSA/ANSI NGV 5.1 and CSA/ANSI NGV 5.2, respectively. NGV 5.1 covers installation in residential occupancies and NGV 5.2 covers installation in other than residential occupancies. For example, the installation of a vehicle fueling appliance at a business or retail occupancy is allowed. This change will allow the installation of vehicle fueling appliances at a warehouse facility for refueling forklifts and other CNG-fueled equipment.

The *International Fuel Gas Code* (IFGC) is also revised with comparable requirements in Sections 413.2.3 and 413.2.4. The installation requirements are removed from the IFGC and replaced with reference to installation in accordance with the listing and manufacturer's instructions. The requirements in the 2018 IFGC are now found in the listing and the manufacturer's instructions.

The input flow rate is limited for each of the appliances: RFA is limited to 5 cfm and VFA is limited to 10 cfm. However, if the VFA is installed indoors, the input is limited to 5 cfm. Where VFAs are installed indoors, NFPA 52 *Vehicular Natural Gas Fuel Systems Code* requires that a gas detector be installed.

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2311.8

Repair of Lighter-than-Air Fueled Vehicles

CHANGE TYPE: Clarification

CHANGE SUMMARY: The requirements for repair of lighter-than-air fueled vehicles are clarified and expanded to ensure safe operations in repair garages.

2021 CODE TEXT: **2311.8 Repair garages for vehicles fueled by lighter-than-air fuels.** The room, motor vehicle repair booth or motor vehicle repair space containing repair garage activities for the conversion or repair of vehicles that use CNG, LNG, hydrogen or other lighter-than-air motor fuels shall be in accordance with Sections 2311.8 through 2311.8.11 in addition to the other requirements of Section 2311. Repair garages for the repair of vehicles that use hydrogen fuel shall be in accordance with this code and NFPA 2.

Exceptions:

1. Repair garages where work is conducted only on vehicles ~~that~~ where the motor vehicle fuel tank and system ~~have been~~ defueled and ~~their systems~~ the motor vehicle fuel tank has been purged with nitrogen gas, and where standard operating procedures to document and maintain the fueling status throughout repair operations are approved.
2. Repair garages where work is not performed on the fuel system and is limited to exchange of parts and maintenance not requiring open flame or welding on the CNG-, LNG-, hydrogen- or other lighter-than-air- fueled motor vehicle. Movement of a subassembly upon which the motor vehicle fuel tank remains mounted to allow access to other parts of the vehicle that are not a portion of the fuel system shall be permitted.

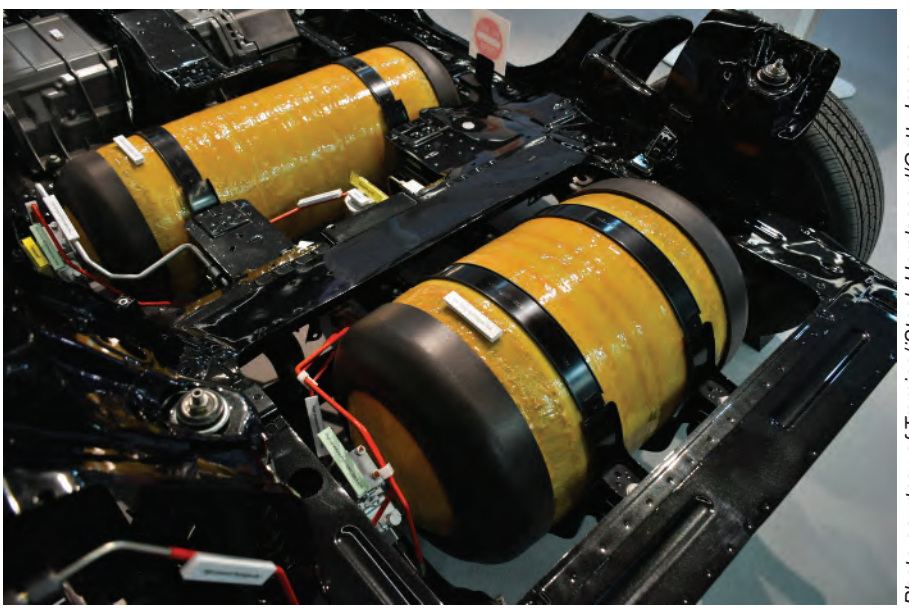


Photo courtesy of Tramino/iStock Unreleased/Getty Images

Where work is performed on the fuel system of lighter-than-air fueled vehicles, the repair garage must comply with the requirements in Section 2311.8.

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3. Repair garages for hydrogen-fueled vehicles where work is not performed on the ~~hydrogen storage~~ motor vehicle fuel tank and is limited to the exchange of parts and maintenance not requiring open flame or welding on the hydrogen-fueled vehicle. During the work, the entire hydrogen fuel system shall contain less than ~~200~~ 400 cubic feet (~~5.6~~ 11.3 m^3) of hydrogen.
4. Repair garages for natural-gas-fueled vehicles where work is not being performed on the motor vehicle fuel ~~storage~~ tank, and is limited to the exchange of parts and maintenance not requiring open flame or welding on the natural-gas-fueled vehicle. During the work, the natural gas, in the motor vehicle fuel tank shall contain a pressure of not more than 250 psi at 70°F (1724 kPa at 21°C).

CHANGE SIGNIFICANCE: Vehicles fuels that are lighter-than-air are becoming more commonplace. With vehicle manufacturers using compressed natural gas, liquefied natural gas and now hydrogen, these lighter-than-air fuels create a different hazard than the traditional gasoline, diesel and LP-gas fuels. Section 2311.8 deals with repair facilities for lighter-than-air fuels and the exceptions have been revised and clarified.

Exception 1 is revised to clarify that only the fuel tank must be purged with nitrogen rather than the entire fuel system. The small diameter fuel line running from the motor fuel tank to the engine compartment contains a minimal amount of gaseous fuel that does not pose a risk to the repair facility. The pressure in the fuel line is reduced during the defueling process which also removes the majority of the gas, making nitrogen purging of this portion of the system unnecessary.

Exception 2 is revised because it is common that a subassembly is required to be removed to access the part needing repair or replacement. At times, this process involves removing the subassembly the motor fuel tank is mounted to. The added language clarifies that movement of the subassembly containing the motor fuel tank is allowed provided the work is limited to the exchange of parts and no use of open flame or welding. The tank remains firmly mounted to its mounting chassis and is not free to drop, roll or otherwise move during this process and as such does not present any additional safety concerns.

Exception 3 allows work on the fuel system, except for the hydrogen storage tank, without having to comply with this section. This exception is revised to increase the allowable amount of hydrogen in the motor vehicle fuel tank from 200 cubic feet to 400 cubic feet. Although each hydrogen passenger vehicle is different, typically their storage containers hold between 5,000 to 50,000 cubic feet (NTP) of hydrogen at high pressure (5,000 psi to 10,000 psi). However, the hydrogen leaving the storage container is regulated to a lower pressure, typically to less than 250 psi.

Any release of hazardous material can pose a problem. In the event that the fuel storage container is opened during repairs and all of the hydrogen is allowed to escape, this proposal requires that the entire fuel system be defueled to less than 400 cubic feet (NTP). This is 40 percent of the Maximum Allowable Quantity per control area listed in Table 5003.1.1(1). With more and more hydrogen vehicles on the road, there is a need to be able to work on the low-pressure side of the

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fuel system at repair garages without posing a hazard. This revision allows for this work as long as the quantity of hydrogen is less than the allowable quantity limitations for flammable gas.

The term "motor vehicle fuel tank" is added as a new definition to clarify the difference between a fuel tank in a car and other containers, vessels or tanks on a vehicle. This new term is revised throughout this section.

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2404.3.3.6
Size of Spray Booths

CHANGE TYPE: Modification

CHANGE SUMMARY: Spray booths are no longer restricted to a maximum size of 1,500 square feet.

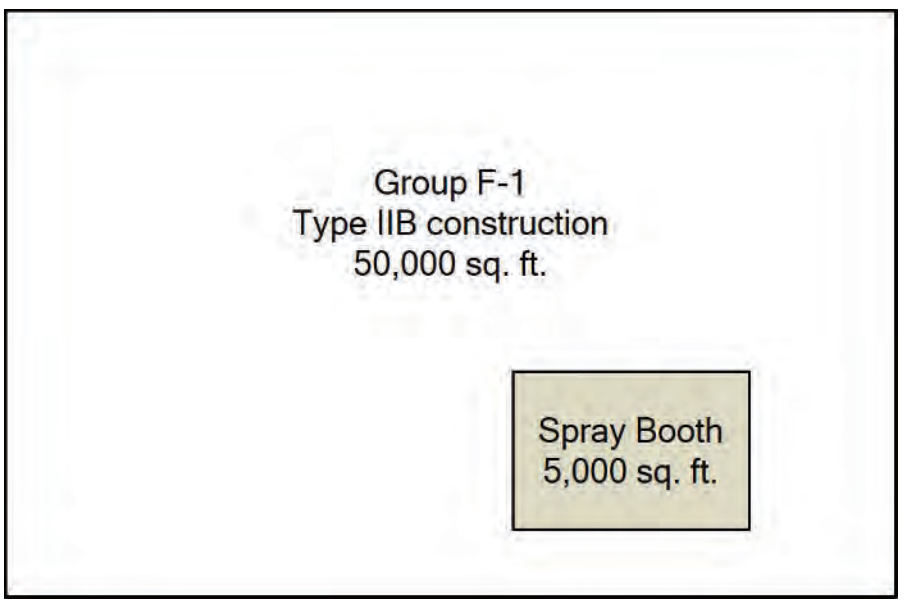
2021 CODE TEXT: **2404.3.3.6 Size.** The aggregate area of spray booths in a building shall not exceed the lesser of 10 percent of the area of any floor of a building or the basic area allowed for a Group H-2 occupancy without area increases, as set forth in the International Building Code. ~~The area of an individual spray booth in a building shall not exceed the lesser of the aggregate size limit or 1,500 square feet (139 m²).~~

Exception: One individual booth not exceeding 500 square feet (46 m²).

CHANGE SIGNIFICANCE: A spray booth is considered a piece of equipment by both the *International Fire Code* (IFC) and *International Building Code* (IBC). Regardless of the size of a spray booth, it must meet ventilation and construction requirements, and be provided with an automatic sprinkler system or fire-extinguishing system. The revision eliminates the restriction that limited a single spray booth to a maximum of 1,500 square feet.

The spray operation still creates a hazard and as the size of the spray booth increases, the capacity of the ventilation system increases. The hazard does not necessarily increase, but the increase in spray booth size allows larger objects to be accommodated within a spray booth.

Spray booths, regardless of size, must meet the requirements of Chapter 24. The spray booth design and construction must also meet NFPA 33



IBC Table 506.2 limits the size of Type IIB construction for a Group H-2 occupancy to 7,000 square feet, so 10 percent of the building area becomes the limiting factor for this spray booth.

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"Standard for Spray Application Using Flammable or Combustible Materials" which does not have a size limitation. A single spray booth, and the aggregate area of spray booths, are still limited in size by two other criteria:

1. Maximum of 10 percent of the floor area of the building.
2. Cannot exceed the basic allowable area for a Group H-2 occupancy in IBC Table 506.2.

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CHANGE TYPE: Modification

CHANGE SUMMARY: The quantity of water-reactive Class 3 solid materials in a fabrication area has been increased with a new limit on maximum quantity per tool.

2021 CODE TEXT: **NOTE:** Only a portion of Table 2704.2.2.1 is shown. For the remainder of the table, see the 2021 IFC.

Table 2704.2.2.1

Water-Reactive Solids in Semiconductor Fabs

TABLE 2704.2.2.1 Quantity Limits for Hazardous Materials in A Single Fabrication Area in Group H-5 [a]

HAZARD CATEGORY	SOLIDS (pounds/square foot)	LIQUIDS (gallons/square foot)	GAS (cubic feet @ NTP/square foot)
PHYSICAL-HAZARD MATERIALS			
Water reactive			
Class 3	~~Note b~~ 0.01[f]	0.00125	Not Applicable
Class 2	0.25	0.025	
Class 1	Not Limited	Not Limited	

For SI: 1 pound per square foot = 4.882 kg/m², 1 gallon per square foot = 40.7 L/m², 1 cubic foot @ NTP/square foot = 0.305 m³ @ NTP/m², 1 cubic foot = 0.02832 m³.

a. Hazardous materials within piping shall not be included in the calculated quantities.
b. Quantity of hazardous materials in a single fabrication area shall not exceed the maximum allowable quantities per control area in Tables 5003.1.1(1) and 5003.1.1(2).
c. Densely packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.
d. The aggregate quantity of flammable, pyrophoric, toxic and highly toxic gases shall not exceed the greater of 0.2 cubic feet at NTP/square foot or 9,000 cubic feet at NTP.
e. The aggregate quantity of pyrophoric gases in the building shall not exceed the amounts set forth in Table 5003.8.2.
f. Quantity of Class 3 water-reactive solids in a single tool shall not exceed 1 pound.

CHANGE SIGNIFICANCE: Technological advances continue to be made in the semiconductor industry. An important and widespread process now being used is Metal Organic Chemical Vapor Deposition (MOCVD). This technology deposits multiple thin films on a semiconductor wafer using a metal-organic vapor. The tools that employ this technology have on-board ampoules of solid metal organics (e.g., trimethylaluminum, trimethylgallium) that are pyrophoric and water-reactive Class 3.

This revision increases the total quantity of water-reactive Class 3 solids allowed in a single semiconductor fabrication area from 5 pounds [from Table 5003.1(1)] to 0.01 pound per square foot. An additional limit is provided in Footnote f. The maximum quantity of water-reactive Class 3 solid materials on board a single tool is 1 pound.

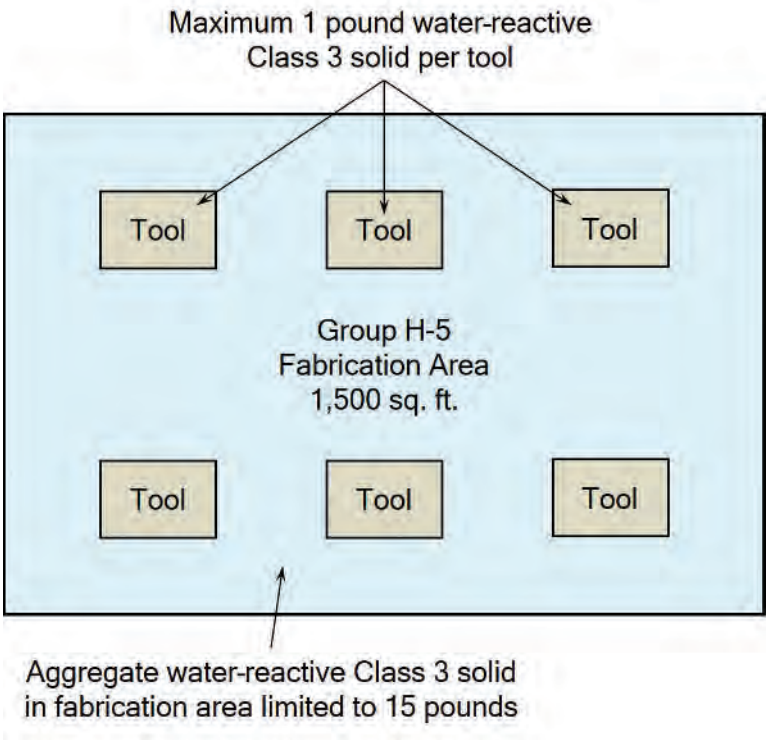
These revisions result in an overall increase in a Group H5 semiconductor fabrication area. The increase aligns with the quantity currently allowed for water-reactive Class 3 liquids in a single fabrication area.

The MOCVD process is considered a use-closed system utilizing sealed ampoules or "bubblers" to prevent direct contact with water. This limits the exposure and potential hazard of the water-reactive Class 3 materials.

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The quantity of water-reactive Class 3 solid materials is limited at each tool and the aggregate is limited in each fabrication area.

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2808.3, 2808.3.1, 2808.4

Sizes of Piles and Stacks

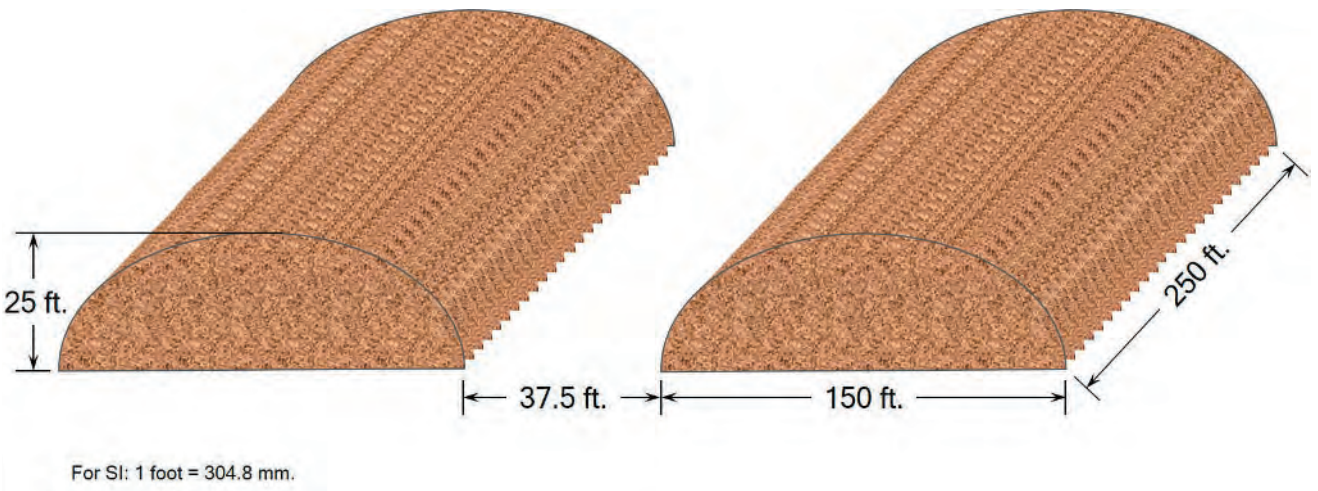
CHANGE TYPE: Modification

CHANGE SUMMARY: Requirements for a fire protection plan are expanded including an increase in the separation distance between piles or stacks.

2021 CODE TEXT: **2808.3 Size of piles or stacks.** Piles shall not exceed 25 feet (7620 mm) in height, 150 feet (45 720 mm) in width and 250 feet (76 200 mm) in length.

Exception: ~~The *fire code official* is authorized to allow the pile size to be increased where a fire protection plan is provided for approval that includes, but is not limited to, the following:~~

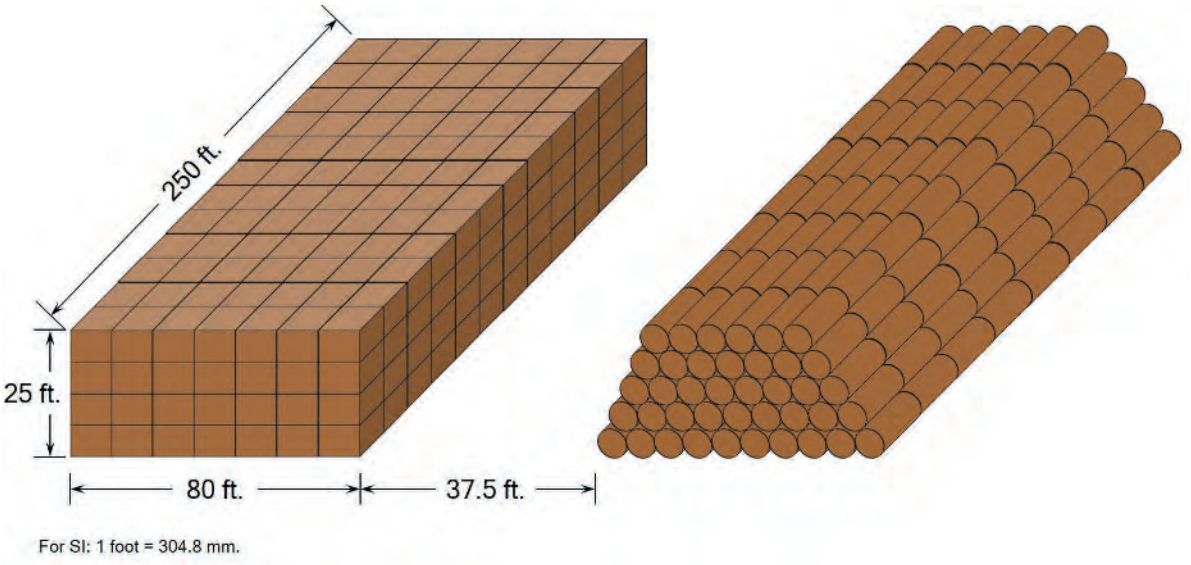
1. ~~Storage yard areas and materials-handling equipment selection, design and arrangement shall be based on sound fire prevention and protection principles.~~
2. ~~Factors that lead to spontaneous heating shall be identified in the plan, and control of the various factors shall be identified and implemented, including provisions for monitoring the internal condition of the pile.~~
3. ~~The plan shall include means for early fire detection and reporting to the public fire department; and facilities needed by the fire department for fire extinguishment including a water supply and fire hydrants.~~
4. ~~Fire apparatus access roads around the piles and access roads to the top of the piles shall be established, identified and maintained.~~
5. ~~Regular yard inspections by trained personnel shall be included as part of an effective fire prevention maintenance program.~~



These piles of product are limited to 150 feet wide by 25 feet high unless an approved fire protection plan is provided.

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This stacked product is limited to 80 feet wide by 25 feet high unless an approved fire protection plan is provided. The separation of piles is a minimum of 1½ times the height of storage.

~~Additional fire protection called for in the plan shall be provided and shall be installed in accordance with this code. The increase of the pile size shall be based on the capabilities of the installed *fire protection systems* and features.~~ Stackable products shall not be stacked in excess of 25 feet in height, 80 feet in width and 250 feet in length.

2808.3.1 Increase in pile or stack size. Piles or stackable products are permitted to be increased beyond the dimensions in Section 2808.3 provided a written fire protection plan is approved by the fire code official. The fire protection plan shall include, but not be limited to, the following:

1. Contact information for after-hours response by facility personnel.
2. Storage yard areas and material-handling equipment selection, pile design and arrangement shall be based on sound safety and fire protection principles.
3. Fire apparatus access roads around the piles or stacks and access roads to the top of piles, if applicable, shall be established, identified and maintained.
4. The potential for spontaneous heating shall be evaluated and provisions made to control the temperature of the piles. Methods for monitoring the internal temperature of the pile shall be provided.
5. Routine yard inspections shall be conducted by trained personnel.
6. A means for early fire detection and reporting to the public fire department shall be provided.
7. Facilities and equipment needed by the fire department for fire extinguishment shall be provided, including a water supply in compliance with Section 507 and heavy equipment necessary to move material.

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8. A de-inventory plan shall be utilized to remove alternating piles or stacked products in a manner to increase the separation distances between the remaining piles or stacks.
9. The increased pile size shall be based on the capabilities of the installed fire protection systems and features.
10. A controlled burn area shall be provided on the site for smoldering or damaged product.

2808.4 Pile separation. Piles or stacked product shall be separated from buildings, property lines and adjacent piles ~~by *approved* fire apparatus access roads~~ or stacks by a distance of not less than 1½ times the height of the pile or stack. The distance between rows shall be a minimum of 30 feet (9144 mm). Approved fire apparatus access roads shall be provided within the separation space in accordance with Section 503.

CHANGE SIGNIFICANCE: When these sections were added to the 2018 *International Fire Code* (IFC), the difference between piles and stacks was not clearly defined. This created confusion and varying interpretations on application of these requirements. These terms still are not defined, but the provisions are revised to provide a clear picture of application. As indicated in Section 2808.4, the product is either in a "pile" or it is a "stackable product." The inclusion of this terminology provides guidance on application of the provisions for "stacks." As a stackable product, one can envision a bale or packaged unit, versus a pile of loose material.

Restrictions are established for the maximum size of piles and stacks. When the piles are made low and narrow, fire extinguishment is enhanced and fire fighter safety improved. When the piles are extremely high and wide, fire extinguishment is hampered and arrangements must be made for fire-fighting operations. This section provides tools and guidance for fire code officials when proposals to increase pile size are submitted. The fire code official must realize the storage configuration is transitional with quantities varying based on when the product is harvested. For example, biomass fuels are likely to have larger storage piles or stacks in the fall and winter with declining inventory throughout the rest of the year as product is used.

Section 2808.3.1 is added to expand on the requirements for the fire protection plan allowing larger pile or stack sizes. Item 7 includes equipment for moving product akin to creating a fire break in a wildland fire. Item 8 requires a de-inventory plan. This portion of the plan would identify more of a leapfrog approach to utilizing the material. For example, leaving every other row or stack will increase the separation distance between remaining stacks reducing the possible fire spread from one row to another. Item 10 is added to require an area where the burning product can be placed and spread out to obtain extinguishment.

To slow the spread of fire from pile to pile, as well as to provide the fire department with tactical access to all parts of the pile storage area, piles must be subdivided by fire apparatus access roads at least 20 feet in width at the base of the piles. Section 2808.4 is revised to specify that the separation between rows of piles or stacks is a minimum of 30 feet or 1½ times the stack height, whichever is greater. If the size of the piles or stacks are allowed to increase as provided in Section 2808.3.1, the separation distance between piles also increases to maintain 1½ times the height.

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Large scale testing performed by Underwriter's Laboratories showed large sections of bales falling nearly 20 feet to the ground when fire burnt through the bale straps. The separation between stacks establishes a collapse zone similar to building collapse zones for apparatus parking. Distance separation is based on fire fighter safety and equipment operation.

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CHANGE TYPE: Addition

CHANGE SUMMARY: High-piled storage of lithium-ion batteries is considered a high-hazard commodity.

2021 CODE TEXT: **NOTE:** Only a portion of Table 3203.8 is shown. To review the remainder of the table, see the 2021 IFC.

Table 3203.8

High-Piled Storage of Lithium-Ion Batteries

TABLE 3203.8 Examples of Commodity Classification

PRODUCT CATEGORY	PRODUCT	CLASSIFICATION
Batteries	Dry cells (excludes lithium, lithium-ion and other similar exotic metals or combustible electrolyte); without blister packing (if blister packed, refer to the commodity classification definitions)	Class I
	Dry cells (nonlithium or similar exotic metals); in blister packing; cartoned	Class II
	Vehicle; any size (for example, automobile or truck); empty plastic casing	High-hazard (Group A unexpanded)
	Vehicle; large (in other words, truck or larger); dry or wet cells (excludes lithium-ion and other cells containing combustible electrolytes)	High-hazard (Group A unexpanded)
	Vehicle; small (for example, automobile); wet cells (excludes lithium-ion and other cells containing combustible electrolytes)	Class I
	Lithium-ion	High-hazard

CHANGE SIGNIFICANCE: Lithium-ion batteries will burn vigorously with a high heat release rate. Initial laboratory testing has indicated they will present a high-challenge fire in storage arrangements. Presently the code lacks guidance on the protection levels necessary for the storage of this product.



Photo courtesy of Coprid/iStock / Getty Images Plus/ Getty Images

Lithium-ion batteries present a high fire hazard.

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The National Fire Protection Research Foundation and FM Global have conducted several fire tests with lithium-ion batteries. The 2019 edition of NFPA 13 does not include any specific criteria for protection of lithium-ion batteries. By classifying lithium-ion batteries as a high-hazard commodity, the user now has a commodity classification to use when applying Table 3206.2 for general fire protection and life safety systems.

By classifying lithium-ion batteries as high-hazard, it also allows the code official to regulate lithium-ion battery storage as high-piled storage when the storage height exceeds 6 feet.

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3205.5

Aisle Maintenance in High-Piled Storage

CHANGE TYPE: Modification

CHANGE SUMMARY: Limited displays are allowed within aisles if the sprinkler system meets the design criteria and egress is still available.

2021 CODE TEXT: **3205.5 Aisle maintenance.** When restocking is not being conducted, aisles shall be kept clear of storage, waste material and debris. Fire department access doors, aisles and exit doors shall not be obstructed. During restocking operations using manual stocking methods, a minimum unobstructed aisle width of 24 inches (610 mm) shall be maintained in 48-inch (1219 mm) or smaller aisles, and a minimum unobstructed aisle width of one-half of the required aisle width shall be maintained in aisles greater than 48 inches (1219 mm). During mechanical stocking operations, a minimum unobstructed aisle width of 44 inches (1118 mm) shall be maintained in accordance with Section 3206.10.

> **Exception:** In high-piled single- and double-row rack storage of combustible materials protected by automatic sprinkler systems designed and installed in accordance with the requirements of NFPA 13 governing the use of K=25.2 (360) sprinklers, displays and wing stacks not exceeding 48-inches (1219 mm) in height provided they do not obstruct or reduce the clear width of the aisle to less than 48-inches (1219 mm).

CHANGE SIGNIFICANCE: This section first states that aisles shall be maintained clear and unobstructed. The new exception allows for small displays to be located within the aisle provided clear, unobstructed egress with a minimum width of 48 inches is maintained.



Limited displays in the aisles cannot exceed 48 inches in height and must not obstruct a minimum of 48-inch egress path.

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The new exception recognizes Section 21.9.1 in the 2019 edition of NFPA 13 "Standard for the Installation of Sprinkler Systems." The criteria in NFPA 13 allow for storage or display in the aisle between racks in retail facilities. The K-25.2 sprinkler must be an extended coverage sprinkler listed for storage occupancies.

The exception does not address short-term pallets within the aisles as part of restocking operations. Restocking is covered in the main body of this section. The exception is specific to display and storage, and can be long term. Since it is considered long term, the height is limited to 48 inches and the sprinkler system must meet specific design criteria. Typical fire sprinkler system design requires that the delivered density from the sprinkler system meet one specific design point; however, in this case, the sprinkler system must meet two separate design points:

1. 0.60 gpm per square foot over 2,000 square feet.
2. 0.70 gpm per square foot from the four most demanding sprinklers.

Extensive large-scale fire testing was conducted that demonstrates such displays do not compromise the effectiveness of sprinkler systems to control or extinguish fires in high-piled combustible storage when sprinkler systems meet or exceed the design criteria.

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3209.4, 3209.4.1 (New), 3209.4.2 (New)

Shutdown of Automated Rack Storage

CHANGE TYPE: Modification

CHANGE SUMMARY: Automatic shutdown of automated rack storage is required when the high-piled storage area exceeds 500 square feet.

2021 CODE TEXT: **3209.4 Automated rack storage.** High-piled storage areas with automated rack storage shall be provided with a manually activated emergency shutdown switch ~~for use by emergency personnel. The switch shall be clearly identified and shall be in a location approved by the fire code official~~ and automatic shutdown in accordance with Sections 3209.4.1 and 3209.4.2.

3209.4.1 Manual activated shutdown. A manually activated switch shall be provided to initiate the approved automatic shutdown process. The switch shall be clearly identified and shall be in a location approved by the fire code official.

3209.4.2 Automatic shutdown. Automatic shutdown shall be required for high-piled combustible storage areas greater than 500 square feet (46 m²). The approved automatic shutdown process shall commence upon any of the following events:

1. Water flow is detected in the automatic sprinkler system, if present.
2. Activation of the fire detection system, if present.

CHANGE SIGNIFICANCE: Automated storage systems are commonly used in many different types of facilities and with a multitude of various products. It is important that the automated process shutdown when a fire occurs. Section 3209.4 requires emergency shutdown in the 2018 *International Fire Code* (IFC). These revisions expand those requirements and add guidance for the system operation.

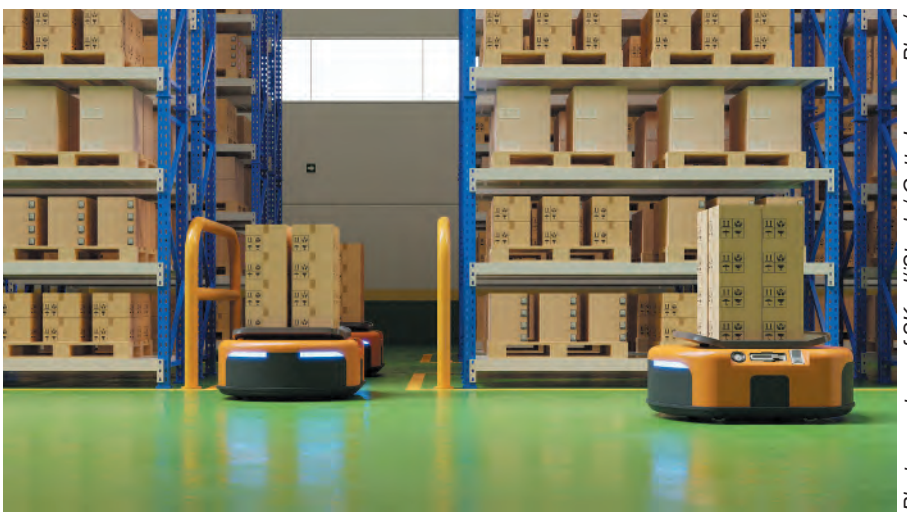


Photo courtesy of SKapl/iStock / Getty Images Plus/ Getty Images

Automated product handling in a rack storage warehouse.

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Section 3209.4 is revised to specify shutdown is required for automated rack storage systems. The subsequent sections then determine whether manual or automatic shutdown is required.

- Section 3209.4.1 requires a manual shutdown switch for all automated rack storage systems.
- Section 3209.4.2 requires an automatic shutdown where the automated rack storage system exceeds 500 square feet. Note that the manual shutdown switch is still required in addition to the automatic activation.

Both shutdown operations refer to an "approved automatic shutdown process." There are systems where a phased shutdown is appropriate rather than an immediate cease of operations. For example, assume a large facility with automated pallet movers and five fire sprinkler system zones. Fire sprinklers operate in Zone 1 and the water flow switch activates. The shutdown process could consist of:

1. automated movers in Zone 1 that are not carrying a load move out of the storage area and return to their home base. This allows for unobstructed aisles.
2. automated movers in Zone 1 carrying a load travel to the closest area out of the storage aisles. Once out of the storage area, the pallet mover stops. Again, the pallet mover does not obstruct the aisle.
3. automated movers in Zones 2 through 5 complete their task and then return to home base. This allows those aisles to be unobstructed and empty of product loads, rather than just stopping wherever they are located.

The shutdown process would be specifically tailored to each facility, but must meet the approval of the fire code official. The approved shutdown process would be triggered by either the manual switch or the automatic shutdown.

The automated shutdown is to be initiated by either operation of the automatic sprinkler system or the fire detection system. Table 3206.2 will require either sprinklers or detection when the high-piled combustible storage area exceeds 500 square feet.

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3303.3, 3303.3.1

Daily Fire Safety Inspection

CHANGE TYPE: Addition

CHANGE SUMMARY: New provisions for buildings under construction require daily fire safety inspections by the site safety director.

2021 CODE TEXT: SECTION ~~3308~~ 3303 OWNER'S RESPONSIBILITY FOR FIRE PROTECTION

3303.3 Daily fire safety inspection. The site safety director shall be responsible for completion of a daily fire safety inspection at the project site. Each day, all building and outdoor areas shall be inspected to ensure compliance with the inspection list in this section. The results of each inspection shall be documented and maintained on-site until a certificate of occupancy has been issued. Documentation shall be immediately available on-site for presentation to the fire code official upon request.

1. Any contractors entering the site to perform hot work each day have been instructed in hot work safety requirements in Chapter 35 and hot work is only performed in areas approved by the site safety director.
2. Temporary heating equipment is maintained away from combustible materials in accordance with the equipment manufacturer's instructions.
3. Combustible debris, rubbish and waste material is removed from the building in areas where work is not being performed.
4. Temporary wiring does not have exposed conductors.
5. Flammable liquids and other hazardous materials are stored in locations that have been approved by the site safety director when not involved in work that is being performed.



Daily fire safety inspections are required to address hazards that exist during building construction.

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6. Fire apparatus access roads required by Section 3311 are maintained clear of obstructions that reduce the width of the usable roadway to less than 20 feet.
7. Fire hydrants are clearly visible from access roads and are not obstructed.
8. The location of fire department connections to standpipe and in-service sprinkler systems are clearly identifiable from the access road and such connections are not obstructed.
9. Standpipe systems are in service and continuous to the highest work floor, as specified in Section 3313.1.
10. Portable fire extinguishers are available in locations required by Section 3316 and 3318.3.

3303.3.1 Violations. Failure to properly conduct, document and maintain documentation required by this section shall constitute an unlawful act in accordance with Section 112.1 and shall result in the issuance of a notice of violation to the site safety director in accordance with Section 112.3. Upon the third offense, the fire code official is authorized to issue a stop work order in accordance with Section 113, and work shall not resume until satisfactory assurances of future compliance have been presented to and approved by the fire code official.

CHANGE SIGNIFICANCE: The number of fires during building construction have increased in recent years. These fires are normally quite destructive. Combustible framing is not yet protected by sheetrock and fire spreads quickly. While many of these fires are considered accidental, they are often the result of carelessness and failing to follow basic fire safety practices. The total number of construction fires may represent a relatively small percentage of the overall population of buildings under construction, but the consequences of these fires severely impact nearby buildings and neighborhoods with increasing frequency and increasing levels of damage.

IFC 3303.1 states in part "The owner or owner's authorized agent shall be responsible for the development, implementation and maintenance of an approved written site safety plan establishing a fire prevention program at the project site applicable throughout all phases of the construction, repair, alteration or demolition work." The owner or the owner's authorized agent is responsible to maintain the on-site safety and is now required to conduct daily fire safety inspections to enhance site fire safety. The person obligated to perform the daily inspections is the site safety director.

The duties and responsibilities of the site safety director have been expanded, including daily inspection of common fire safety hazards and ensuring that contractors working on-site are trained and following operational safety requirements.

This new section is found in the *International Fire Code* (IFC) and *International Building Code* (IBC). Provisions specify that the daily inspections are documented and available for review until the Certificate of Occupancy is issued. Fire and building officials can issue a "stop work"

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order if daily self-inspections are not completed and documented. The site safety plan and the ability to stop work in Section 3303.3.1 give code officials needed tools to gain compliance.

This code provision is intended to serve as an accountability measure to ensure that there is motivation to adhere to basic fire safety requirements. By requiring daily inspections and documentation, any fire or building official can request to see documentation of daily inspections when at the site for any reason, and a clear enforcement path is specified when noncompliance is encountered.

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3303.5

Fire Safety for Types IV-A, IV-B and IV-C Construction

CHANGE TYPE: Addition

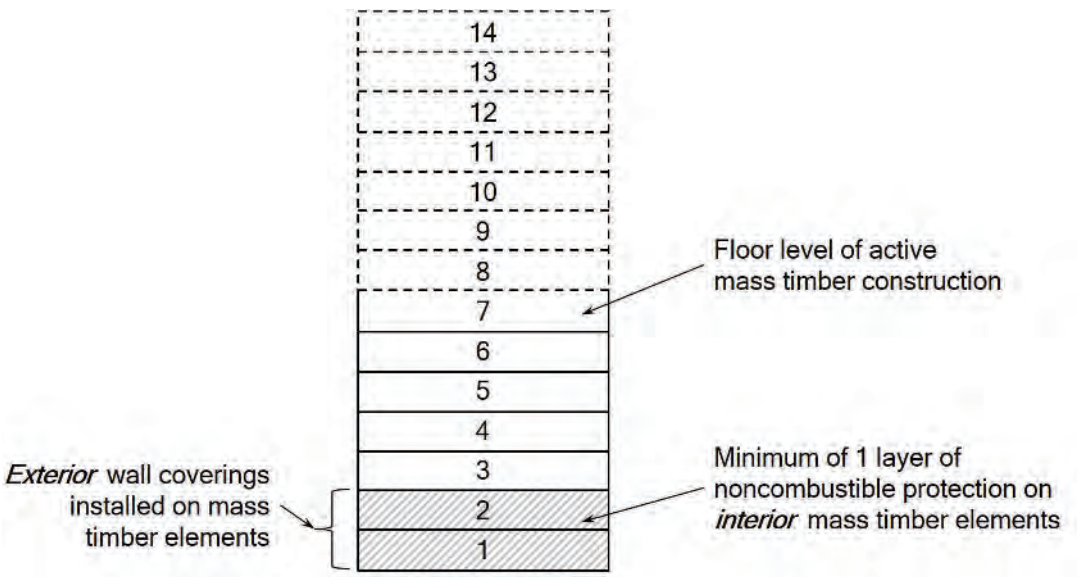
CHANGE SUMMARY: Passive fire safety requirements added during construction of buildings of construction Types IV-A, IV-B and IV-C.

2021 CODE TEXT: **3303.5 Fire safety requirements for buildings of Types IV-A, IV-B and IV-C construction.** Buildings of Types IV-A, IV-B and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3314.
2. A water supply for fire department operations, as approved by the fire code official and the fire chief.
3. Where building construction exceeds six stories above grade plane and noncombustible protection is required by Section 602.4 of the *International Building Code*, at least one layer of noncombustible protection shall be installed on all building elements on floor levels, including mezzanines, more than four levels below active mass timber construction before additional floor levels can be erected.

   Exception: Shafts and vertical exit enclosures shall not be considered a part of the active mass timber construction.
4. Where building construction exceeds six stories above grade plane, required exterior wall coverings shall be installed on all floor levels, including mezzanines, more than four levels below active mass timber construction before erecting additional floor level can be erected.

   Exception: Shafts and vertical exit enclosures shall not be considered a part of the active mass timber construction.



Exposed mass timber on the first and second floors need to be protected before mass timber construction can occur on the seventh floor since the building will exceed six stories.

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CHANGE SIGNIFICANCE: Over the past several years there have been several significant fires in buildings under construction. A document from NFPA, "Fires in Structures Under Construction or Renovation" dated February 2020, reported that fire departments responded to an estimated average of 3,840 fires in structures under construction per year in 2013 through 2017. These fires caused an average of four civilian deaths, 49 civilian injuries and $304 million in direct property damage annually. Many of these fires occurred in large structures composed of light-frame wood members prior to the installation of any active and passive fire protection systems. Although mass timber has inherent fire-resistance value and structural integrity due to the mass of the wood elements, the potential risk of fire in combustible construction must be considered.

A specified degree of hazard reduction, provided by both fire protection systems and fire-resistive features, must now be provided for tall mass timber buildings during construction. These new provisions addressing buildings under construction are applicable to structures of Type IV-A, IV-B and IV-C construction. These are new construction classification types used to identify mass timber construction. Mass timber is defined as structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction. See Significant Changes to 2021 *International Building Code* (IBC) for additional information on Type IV-A, IV-B and IV-C construction.

These new construction types allow increased heights and areas for mass timber buildings. During construction, these new provisions require protection of the exposed wood for both interior and exterior portions of the building. This will help ensure that the lower portions of the combustible structure have an increased level of protection as greater heights are reached. As such, the likelihood of catastrophic structural failure during a fire and adverse impact to surrounding structures is reduced, a benefit to responding fire fighters.

Items 1 and 2 require the installation of standpipe system and water supply as the construction progresses. This is the same as for any construction. Note that the requirements for water supply have been revised in the 2021 *International Fire Code* (IFC). See Significant Change for IFC Section 3313.

Mass timber construction typically proceeds with limited amounts of stored combustible material on site. Mass timber components are generally installed as they arrive at the site. This is very different from conventional construction processes. Thus, there may be fewer site hazards than on a typical construction site utilizing combustible materials. Protection of the installed components must occur before the project moves above a certain specified numbers of levels. The number of exposed levels cannot exceed four.

Items 3 and 4 require the installation of noncombustible protection over the exposed wood construction. A new definition was added to the IBC as follows:

> **Noncombustible Protection (for Mass Timber).** Noncombustible material, in accordance with Section 703.6, designed to increase the fire-resistance rating and delay the combustion of mass timber.

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Fire-resistive requirements include installation of all or part of the permanently-required noncombustible protection during construction. This requirement is initiated when active construction exceeds six stories. The six-story trigger is derived from the maximum allowance permitted in IBC Table 504.4 for the number of stories permitted in buildings of Type IV-HT construction. After reaching the initial point at which fire-resistive protection is required, noncombustible protection is required to be added in a manner to limit the number of stories of exposed mass timber elements to four levels below the level of active construction. Item 3 refers to IBC Section 602.4, which states that for Type IV-C construction, interior elements can be fully exposed. As such, the interior of the building does not need to be protected, but the exterior fire protection in Item 4 is still required.

Looking at figure on page 160, exposed mass timber on the interior and exterior of floors one and two must be protected before mass timber construction can occur on the seventh floor. Exceptions to this requirement are:

- Type IV-C construction does not require interior elements to be protected.
- Shafts and vertical exit enclosures are not considered as part of the active construction.

As construction progresses upward, each successive level would be provided with protection of the mass timber components. In this manner, there are never more than four levels of exposed mass timber during the construction process. This again excludes Type IV-C construction since interior elements can be unprotected.

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3305.5
Fire Watch

CHANGE TYPE: Modification

CHANGE SUMMARY: Requirements are added for fire watch during non-working hours at building construction sites.

2021 CODE TEXT: ~~**3304.5**~~ **3305.5 Fire watch.** Where required by the fire code official or the ~~prefire~~ site safety plan established in accordance with Section ~~3308.3~~3303.1, a fire watch shall be provided for building demolition and for building construction ~~that is hazardous in nature, such as temporary heating or hot work~~.

~~**3304.5.1**~~ **3305.5.1 Fire watch during construction.** ~~Where required by the fire code official, a~~ A fire watch shall be provided during nonworking hours for new construction that exceeds 40 feet (12 192 mm) in height above the lowest adjacent grade at any point along the building perimeter, any new multistory construction with an aggregate area exceeding 50,000 square feet per story or as required by the fire code official.

~~**3304.5.2**~~ **3305.5.2 Fire watch personnel.** ~~Trained personnel shall be provided to serve as an on-site fire watch. Fire watch personnel shall be provided with not fewer than one approved means for notification of the fire department, and the sole duty of such personnel shall be to perform constant patrols and watch for the occurrence of fire. The combination of fire watch duties and site security duties is acceptable. Fire watch personnel shall be trained in the use of portable fire extinguishers.~~ Fire watch personnel shall be provided in accordance with this section.



Fire watch is required for new construction exceeding 40 feet above the lowest adjacent grade.

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3305.5.2.1 Duties. The primary duty of fire watch personnel shall be to perform constant patrols and watch for the occurrence of fire. The combination of fire watch duties and site security duties is acceptable.

3305.5.2.2 Training. Personnel shall be trained to serve as on-site fire watch. Training shall include the use of portable fire extinguishers. Fire extinguishers and fire reporting shall be in accordance with Section 3310.

3305.5.2.3 Means of notification. Fire watch personnel shall be provided with not fewer than one approved means for notifying the fire department.

~~**3304.5.3**~~ **3305.5.3 Fire watch location and records.** The fire watch shall include areas specified by the ~~prefire~~ site safety plan established in accordance with Section ~~3308.3~~3303. ~~The fire watch personnel shall keep a record of all time periods of duty, including a log entry each time the site was patrolled and each time a structure under construction was entered and inspected. The records and log entries shall be made available for review by the fire code official upon request.~~

3305.5.4 Fire Watch Records. Fire watch personnel shall keep a record of all time periods of duty, including the log entry each time the site was patrolled, and each time a structure was entered and inspected. Records shall be made available for review by the fire code official upon request.

CHANGE SIGNIFICANCE: Fire departments across the United States are being stretched beyond their limits and communities are negatively impacted by fires during construction or remodel. Virtually every national organization with a stake in this issue is wrestling with solutions. Part of the solution is to provide fire watch when construction personnel are not on-site. These revisions to fire watch requirements refined the requirements for fire watch.

Section 3305.5 covers construction and demolition. This section states that fire watch shall be provided when the site safety plan deems it necessary or when required by the fire code official.

Section 3305.5.1 only covers new construction and requires fire watch when the building reaches 40 feet in height or where construction of a multiple-story building exceeds 50,000 square feet per floor. Both the height of the building and the size of the building impact the magnitude of a fire. These buildings are large enough to create a significant loss to a community, endanger firefighters and consume resources of emergency personnel if the building burns. The fire code official still has the authority to require fire watch for construction projects where the building does not meet either of the criteria.

The personnel performing fire watch must be trained and are required to be on constant patrol during the fire watch period. Fire watch personnel must have at least one method of contacting the fire department. A written log of fire watch operations is required. This log must be available for review by the code official.

These revisions, along with the new requirements for the site safety director (see Significant Change to Section 3303.3), are designed to increase the level of safety and limit the number of fires at buildings under construction.

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3305.9

Separation of Construction Areas

CHANGE TYPE: Addition

CHANGE SUMMARY: In Type I and II buildings, barriers installed to separate construction areas from the remainder of a building must be noncombustible, flame retardant or have a limited heat release rate.

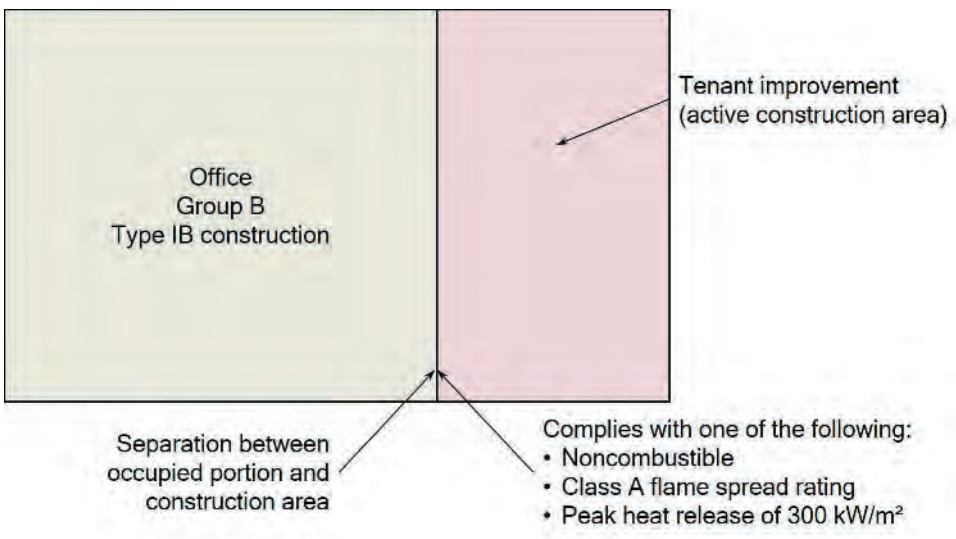
2021 CODE TEXT: **3305.9 Separations between construction areas.** Separations used in Type I and Type II construction to separate construction areas from occupied portions of the building, shall be constructed of materials that comply with one of the following:

1. Non-combustible materials.
2. Materials that exhibit a flame spread index not exceeding 25 when tested in accordance with ASTM E84 or UL 723.
3. Materials exhibiting a heat peak release rate not exceeding 300kW/m² when tested in accordance with ASTM E1354 at an incident heat flux of 50 kW/m² in the horizontal orientation on specimens at the thickness intended for use.

CHANGE SIGNIFICANCE: Existing building are often remodeled, altered or expanded. When such a remodel or expansion occurs some type of vapor and dust barrier is provided to separate the construction zone from the remainder of the building. It can often be seen that lightweight plastic film is used to provide this separation.

Plastic film is available in fire retardant configurations, however this is more expensive than the material that is not fire-retardant. The combustible barrier is providing a separation between the occupied area and the area where higher hazards exist because of the construction process.

This new section requires that the barrier separating the construction zone from the remainder of the building meet a minimum level of fire resistance. In Type I and II buildings, the barrier must be noncombustible,



Where a separation is provided between construction areas and occupied areas it must meet minimum flammability requirements in Type I or II buildings.

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or it must meet the flame spread requirements. The material can have a Class A flame spread rating or demonstrate that when it burns, it produces limited amounts of heat.

Based on these requirements, the barrier will present no more of a hazard than typical decorations or wall coverings. Flame retardant plastic sheeting is available if that is the method selected to provide the barrier.

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3313

Water Supply During Construction

CHANGE TYPE: Addition

CHANGE SUMMARY: New requirements for minimum water supply during construction specify minimum fire flow and distance from the structure.

2021 CODE TEXT:

SECTION ~~3312~~ 3313 WATER SUPPLY FOR FIRE PROTECTION

~~3312.1~~ 3313.1 When required. An approved water supply for fire protection, either temporary or permanent, shall be made available as soon as combustible building material arrives on the site, on commencement of vertical combustible construction and on installation of a standpipe system in buildings under construction, in accordance with Sections 3313.2 through 3313.5.



Water supply is not required during construction of the lower portion of this building since it is Type I construction, but when combustible building materials arrive on site for the upper floors, water supply is required.

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Exception: The fire code official is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

3313.2 Combustible building materials. When combustible building materials of the building under construction are delivered to a site, a minimum fire flow of 500 gallons per minute (gpm) (1893 L/min) shall be provided. The fire hydrant used to provide this fire flow supply shall be within 500 feet (152 m) of the combustible building materials, as measured along an approved fire apparatus access lane. Where the site configuration is such that one fire hydrant cannot be located within 500 feet (152 m) of all combustible building materials, additional fire hydrants shall be required to provide coverage in accordance with this section.

3313.3 Vertical construction of Types III, IV and V construction. Prior to commencement of vertical construction of Type III, IV or V buildings that utilize any combustible building materials, the fire flow required by Sections 3313.3.1 through 3313.3.3 shall be provided, accompanied by fire hydrants in sufficient quantity to deliver the required fire flow and proper coverage.

3313.3.1 Fire separation up to 30 feet. Where a building of Type III, IV or V construction has a fire separation distance of less than 30 feet (914 mm) from property lot lines, and an adjacent property has an existing structure or otherwise can be built on, the water supply shall provide either a minimum of 500 gallons per minute (1893 L/min) or the entire fire flow required for the building when constructed, whichever is greater.

3313.3.2 Fire separation of 30 feet up to 60 feet. Where a building of Type III, IV or V construction has a fire separation distance of 30 feet up to 60 feet from property lot lines, and an adjacent property has an existing structure or otherwise can be built on, the water supply shall provide a minimum of 500 gallons per minute (1893 L/min) or 50 percent of the fire flow required for the building when constructed, whichever is greater.

3313.3.3 Fire separation of 60 feet or greater. Where a building of Type III, IV or V construction has a fire separation of 60 feet (18 288 mm) or greater from a property lot line, a water supply of 500 gallons per minute (1893 L/min) shall be provided.

3313.4 Vertical construction, Type I and II construction. If combustible building materials are delivered to the construction site, water supply in accordance with Section 3313.2 shall be provided. Additional water supply for fire flow is not required prior to commencing vertical construction of Type I and II buildings.

3313.5 Standpipe supply. Regardless of the presence of combustible building materials, the construction type or the fire separation distance, where a standpipe is required in accordance with Section 3314, a water supply providing a minimum flow of 500 gallons per minute

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(1893 L/min) shall be provided. The fire hydrant used for this water supply shall be located within 100 feet (3048 mm) of the fire department connection supplying the standpipe.

CHANGE SIGNIFICANCE: Construction fires continue to present a problem. Fires during construction have predominately affected combustible construction Types III, IV and V. One of the issues with construction is that water supply infrastructure is not always completed prior to vertical construction of the building. The lack of a reliable and sufficient water supply has resulted in many of these fires causing more damage than may otherwise have occurred. The fire service cannot fight a fire of any significant size without a reliable water supply. These changes provide minimum criteria for the water supply available during construction.

The changes affect the timing of providing fire flow. Section 3313.1 requires that the water supply be provided upon delivery of combustible building materials at the site, commencement of vertical combustible construction or installation of a standpipe system. Further guidance for each of these three thresholds is provided in Sections 3313.2 through 3313.5. The timing for providing water supply is based on arrival of combustible building components, and is not intended to apply to wood for concrete framing or construction trailers, for example.

Section 3313.2 requires the water supply to be within 500 feet of the combustibles. This is a relaxed requirement from Section 507, which requires 400 feet. This spacing does not override Section 507, but this spacing only applies during construction. As stated in Section 3313.1, the provided water supply can be the permanent water supply or water supply can be provided by a temporary means.

Note that this section along with the subsequent sections refer to a "fire hydrant," rather than a general term of water supply. It would be appropriate to interpret this as the method of water supply. While fire hydrants are often provided as the source of water for fire fighting, they are not the only method allowed in Section 507.2.

Sections 3313.3 through 3313.3.3 address the issue of vertical construction for Type III, IV and V construction. Water supply must be provided prior to the construction going vertical. The subsections divide the water supply requirement into three categories based on the fire separation distance to a property line. The volume of water is dependent on this separation. As the separation increases, the required water supply is reduced.

Section 3313.4 addresses Types I and II construction. Water supply is not required during construction, unless combustible building materials arrive on site. The requirement for water supply upon vertical construction does not apply. Note that these provisions require water supply when combustible building materials are used. This was intentionally worded to address combustible "building" materials so that water supply is not required for construction trailers, combustible concrete forms, etc. It is intended that water supply is provided when the building construction itself presents the fire hazard, not merely the presence of anything that is combustible.

Section 3313.5 states that for buildings with a standpipe, when the standpipe is installed a water supply must be available. Section 3314.1 requires a standpipe to be provided when construction exceeds 40 feet in height. When the standpipe is provided, water supply is needed to utilize the standpipe. The spacing requirement is different for standpipes. The water supply must be within 100 feet of the fire department connection for the standpipe.

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3805.2.1, 3805.2.2, 3805.4, Table 3805.4

Restricted Materials in College Labs

CHANGE TYPE: Clarification

CHANGE SUMMARY: The limitation on use and storage of oxidizer Class 4 and pyrophoric materials is reinforced and Table 3805.4 is correlated with the text.

2021 CODE TEXT: **3805.2.1 Restricted materials storage.** Where approved by the fire code official, storage of the following hazardous materials prohibited by Table 5003.1.1(1) in buildings not equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 shall be allowed within a laboratory control area at 25 percent of Table 5003.1.1(1) limits for a building equipped throughout with an automatic sprinkler system.

1. ~~Pyrophorics~~ Class 4 Oxidizers.
2. ~~Class 4 Oxidizers~~ Pyrophorics.

The percentage of the maximum allowable quantity per control shown in Table 3805.4 shall be applied to 25 percent of Table 5003.1.1(1) limits for Class 4 Oxidizers or pyrophoric materials.

Additional quantity increases shall be prohibited, and such materials shall be stored in accordance with all of the following:

1. Containers shall be completely sealed and stored in accordance with the manufacturers' recommendations.
2. Storage shall be within approved hazardous material storage cabinets in accordance with Section 5003.8.7, or shall be located in an inert atmosphere glove box in accordance with NFPA 45, Section 7.11.
3. The storage cabinet or glove box shall not contain any storage of incompatible materials.



College and university labs are limited in the quantities of pyrophoric and oxidizer Class 4 materials.

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3805.2.2 Restricted materials use. Where approved by the fire code official, use of the following hazardous materials prohibited by Table 5003.1.1(1) in buildings not equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, shall be allowed within a laboratory control area at 25 percent of Table 5003.1.1(1) limits for buildings equipped throughout with an automatic sprinkler system.

1. ~~Pyrophorics~~ Class 4 Oxidizers.
2. ~~Class 4 Oxidizers~~ Pyrophorics.

The percentage of the maximum allowable quantity per control area shown in Table 3805.4 shall be applied to 25 percent of Table 5003.1.1(1) limits for Class 4 Oxidizers or pyrophoric materials.

Additional quantity increases shall be prohibited, and such materials shall be stored in accordance with all of the following:

1. Use shall be within an approved chemical fume hood listed in accordance with UL 1805, or in an inert atmosphere glove box in accordance with NFPA 45, Section 7.11, or other approved equipment designed for the specific hazard of the material.
2. Combustible materials shall be kept not less than 2 feet (610 mm) away from the work area, except for those items directly related to the research.
3. A portable fire extinguisher appropriate for the specific material shall be provided within 20 feet (6096 mm) of the use in accordance with Section 906.

3805.4 Percentage of maximum allowable quantity per control area. The percentage of maximum allowable quantities per control area of hazardous materials shall ~~be permitted to be increased in accordance~~ comply with Table 3805.4.

TABLE 3805.4 Design and Number of Control Areas in Existing Nonsprinklered Laboratories

Floor Level		Percentage of the Maximum Allowable Quantity per Lab Suite[a,e]	Number of Control Areas per Floor	Fire-resistance Rating for Fire Barriers in Hours[b,c,d]
Above grade plane	Higher than 5	10	1	2[c]
	7-9	25	2	2[c]
	4-6	75	2	2[c]
	3	100	2	1
	1-2		4	1
Below grade plane	1	75	3	1
	2	Not Allowed	2	1
	Lower than 2		Not Allowed	Not Allowed

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 5003.1.1(1) and 5003.1.1(2), excluding all increases allowed in the footnotes to those tables.
b. Fire barriers shall include walls, floors and ceilings necessary to provide separation from other portions of the building.
c. Vertical fire barriers separating control areas from other spaces on the same floor are permitted to be 1-hour rated.
d. See *International Building Code* Section 414.2.4 for additional requirements.
e. The percentage of the maximum allowable quantity per control shown in Table 3805.4 shall be applied to 25 percent of Table 5003.1.1(1) limits for Class 4 Oxidizers or pyrophoric materials.

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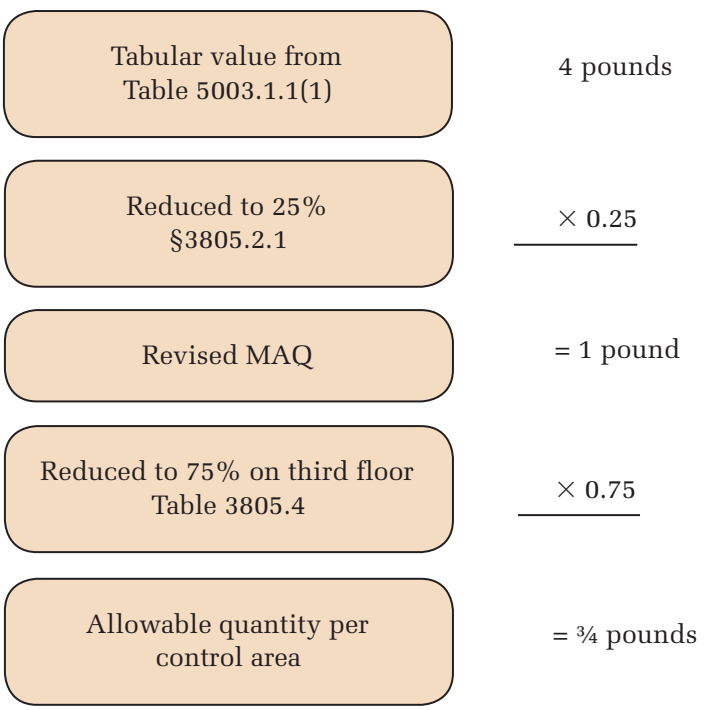
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CHANGE SIGNIFICANCE: The basic concept that allows hazardous materials in higher education laboratories is that the increased quantities are mitigated by the increased supervision and controls provided at the college and universities. Pyrophoric materials and oxidizer Class 4 materials can be quite hazardous, and as such are only allowed in limited quantities.

While the limitation to only 25 percent of the maximum allowable quantity per control area (MAQ) in Table 5003.1(1) is in the 2018 *International Fire Code* (IFC), it is not easily located or correlated with Table 3805.4. These revisions are intended to provide that correlation to ensure that quantities of pyrophoric materials and oxidizer Class 4 materials are limited. These limitations are critical since the sections deal with storage and use in nonsprinklered buildings.

Footnote e is added to Table 3805.4 to correlate with the text added in Sections 3805.2.1 and 3805.2.2. The footnote and the new text state that pyrophoric materials can be stored and used in nonsprinklered higher education laboratories, even though Table 5003.1.1(1) prohibits their storage and use in nonsprinklered buildings. The allowable quantity is based on 25 percent of the MAQ for a sprinklered building in Table 5003.1.1(1).

For example, Section 3805.2.1 states that pyrophoric materials can be used in nonsprinklered higher education labs, but quantities are limited to 25 percent of Table 5003.1.1(1). Table 5003.1.1(1) shows storage of solid pyrophoric with an MAQ of 4 pounds. The third paragraph in Section 3805.2 and Footnote a in Table 3805.4 both indicate that the tabular value is used excluding possible increases. Section 3805.2.1 states that 25 percent of the MAQ is allowed, so 1 pound of pyrophoric solids is allowed. The new paragraph in Section 3805.2.1 states that the percentage of MAQ based on floor level is then applied to 1 pound. Therefore, since a higher education lab on the third floor can have 75 percent of the MAQ, that lab is allowed .75 pounds of solid pyrophoric materials. See calculation below.



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After the quantities have been adjusted as shown for a control area on the third floor, the solid pyrophoric materials must be stored in a hazardous materials cabinet or an inert atmosphere glove box. There is no increase provided for storage in the cabinet.

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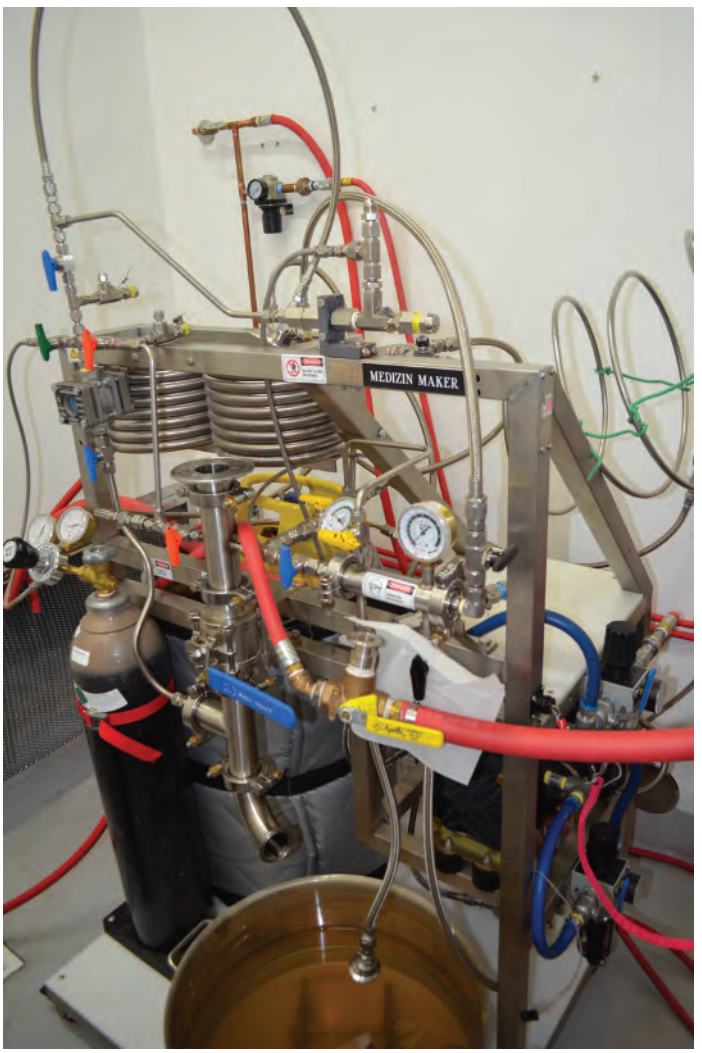
3904.2, 3904.2.1 (New), 3904.2.2 (New)

Extraction Equipment

CHANGE TYPE: Modification

CHANGE SUMMARY: A new UL standard is available for listed extraction equipment.

2021 CODE TEXT: **3904.2 Systems and equipment.** Systems or equipment used for the extraction of oils from plant material shall ~~be listed or approved for the specific use. If the system used for extraction of oils and products from plant material is not listed, the system shall be reviewed by a registered design professional. The registered design professional shall review and consider any information provided by the system's designer or manufacturer. For systems and equipment not listed for the specific use, a technical report in accordance with Section 3904.3 shall be prepared and submitted to the fire code official for review and approval. The firm or individual preparing the technical report shall be approved by the fire code official prior to performing the analysis~~ comply with either Section 3904.2.1 or 3904.2.2.



This plant oil extraction unit was not listed so a technical report was required to evaluate the safe operation of the equipment.

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3904.2.1 Listings. Systems or equipment used for the extraction of oils from plant material shall be listed and labeled in accordance with UL 1389 and installed in accordance with the listing and the manufacturer's installation instructions.

3904.2.2 Approvals. Systems or equipment used for the extraction of oils from plant material shall be approved for the specific use. The system shall be reviewed by a registered design professional. The registered design professional shall review and consider any information provided by the system's designer or manufacturer. A technical report in accordance with Section 3904.2.2.1 shall be prepared and submitted to the fire code official for review and approval. The firm or individual preparing the technical report shall be approved by the fire code official prior to performing the analysis.

~~**3904.3**~~ **3904.2.2.1 Technical report.** A technical report, reviewed and approved by the fire code official as required by Section ~~3904.2~~ 3904.2.2, is required prior to the equipment being located or installed at the facility. The report shall be prepared by a registered design professional or other professional approved by the fire code official.

CHANGE SIGNIFICANCE: The 2018 *International Fire Code* (IFC) requires plant oil extraction equipment to be either listed or approved. If the equipment is not listed, approval is based on a registered design professional preparing a technical report on the equipment, followed up by a site inspection to ensure the equipment was installed per plans.

At the time of publication of the 2018 IFC, a testing standard was under development, but not yet available. In 2019, Underwriter's Laboratories published UL 1389 "Standard for Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations." This standard is designed specifically to evaluate and list plant oil extraction systems using flammable solvents consisting of LPG, butane, propane solvents, ethanol or pentane and non-flammable solvent of carbon dioxide (CO_2). The standard includes evaluation of the preparatory equipment for preparing the plant material for extraction of the oil, such as trimming, deseeding and drying/curing; the extraction booths or pods, for enclosing/protecting plant oil extraction equipment; and post-processing equipment, for finalizing the plant oil extraction process such as vacuum ovens, rotary evaporators and solvent recovery pumps.

The code does not mandate that equipment is listed. The option is still available for the applicant to provide a technical report by a registered design professional. The technical criteria were separated from the listing criteria to clarify that a technical report is not required if the equipment is listed. Essentially, the listing is equivalent to a technical report.

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Chapter 40 (New), 903.2.4.2 (New), 903.2.9.3 (New), IBC 307.1.1

Storage of Distilled Spirits and Wines

CHANGE TYPE: Addition

CHANGE SUMMARY: Provisions have been added to the code to address storage of distilled spirits and wines in barrels and casks.

2021 CODE TEXT: **NOTE:** Due to the extent of the code text, an outline of the chapter is shown below. For the full text, see the 2021 *International Fire Code*.

Chapter 40
Storage of Distilled Spirits and Wines

4001 GENERAL
4001.1 GENERAL
4001.1.1 Nonapplicability.
4002 DEFINITIONS
4002.1 Terms defined in Chapter 2.
4003 PRECAUTIONS AGAINST FIRE
4003.1 Spill Control.
4003.2 Ventilation.
4003.3 Sources of ignition.
4003.3.1 Smoking.
4003.3.2 Open Flame.
4003.3.3 Industrial trucks.
4003.3.4 Electrical.
4003.4 Lightning.
4004 STORAGE
4004.1 Storage.
4004.2 Empty containers.
4004.3 Basement storage.



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Storage of distilled spirits and wines is now regulated by Chapter 40.

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4004.4 Bulk beverage storage areas.
4005 FIRE PROTECTION
4005.1 Automatic sprinkler system.
4005.2 Portable Fire Extinguishers.
4006 SIGNAGE
4006.1 Hazard identification signs.
4006.1.1 Maintenance and style.

903.2.4.2 Group F-1 Distilled Spirits. An automatic sprinkler system shall be provided throughout a Group F-1 fire area used for the manufacture of distilled spirits.

903.2.9.3 Group S-1 Distilled spirits or wine. An automatic sprinkler system shall be provided throughout a Group S-1 fire area used for the bulk storage of distilled spirits or wine.

IBC 307.1.1 Uses other than Group H. An occupancy that stores, uses or handles hazardous materials as described in one or more of the following items shall not be classified as Group H, but shall be classified as the occupancy that it most nearly resembles.

1. through 17. *(No change to text.)*
18. Distilling or brewing of beverages conforming to the requirements of the *International Fire Code*.
19. The storage of beer, distilled spirits and wines in barrels and casks conforming to the requirements of the *International Fire Code*.

CHANGE SIGNIFICANCE: Due to changes over several code change cycles, there is an inconsistency between the *International Building Code* (IBC) and the *International Fire Code* (IFC) regarding occupancy classification and safety requirements when dealing with distilled spirits and wines. This code change is designed to coordinate the codes when addressing this operation. Distilled spirits have properties consistent with flammable liquids and proper safeguards must be provided for the occupancies housing such liquids.

The IBC classifies the manufacturing of beverages with over 16 percent alcohol as Group F-1 and the manufacturing of beverages with 16 percent alcohol or less as Group F-2. New changes have occurred to classify the storage of beverages with more than 16 percent alcohol as Group S-1 and the storage of beverages with not more than 16 percent alcohol as Group S-2.

The IFC exempts the storage of distilled spirits and wines from regulation under the hazardous material provisions in Chapter 50 and the flammable and combustible liquid provisions in Chapter 57. Changes occurred in the IBC to include these same exemptions so that the storage facilities will not be classified as Group H. In the correlating of these provisions, the stipulation of storage in wooden barrels was removed, so this exemption applies to storage in barrels or casks of any material.

This set of changes specifies the classification for storage facilities based on the alcohol content of distilled spirits and wine. The Distilled Spirits Council of the United States (DISCUS) has developed the "Recommended Fire Protection Practices for Distilled Spirits Beverage Facilities"

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containing requirements for sprinkler protection, ventilation and secondary containment. While not referenced in the IFC, those guidelines were consulted in developing the new Chapter 40.

A companion revision occurred by adding Exception 18 to IBC Section 307.1.1 which states that distillation and brewing of beverages is not classified as a Group H occupancy provided the process complies with the IFC. This new exception means that distilleries are not classified as Group H when they comply with the flammable and combustible liquid requirements and other hazard requirements. No new requirements were added to the code to specifically address the distillation process other than Section 903.2.4.2 requiring a fire sprinkler system in the fire area where distillation occurs. New storage requirements are found in Chapter 40.

Note that Chapter 40 addresses the **storage** of distilled spirits and wines when stored in barrels and casks. This new chapter does not deal with the distillation process, however, storage at the distillation facility would fall under Chapter 40. The requirements applicable to storage include:

- Ventilation – continuous mechanical ventilation providing an exhaust rate of 1 cubic foot per minute per square foot of soli floor area; or ventilation controlled by monitoring the lower flammable limit (LFL) and maintaining the LFL at or below 25 percent.
- Smoking is not allowed.
- Open flame devices and high-temperature devices may only be used if listed.
- Powered industrial trucks must be listed when used in a hazardous (classified) location.
- Storage facilities with barrel storage need to comply with NFPA 780 for lightning protection.
- Empty barrels and casks are treated no differently from full containers.
- Distilled spirits classified as Class I liquids (flash point below 100°F) are limited when stored in basements. The aggregate quantity cannot exceed the maximum allowable quantity per control area for use-open systems. For Class I liquids, this would limit the quantity to 30 gallons, or 60 gallons if sprinklered.
- Other combustible materials not related to the beverage storage shall not be located in the same storage area as the distilled spirits and wines.
- An automatic sprinkler system is required for storage of distilled spirits and wines. See Commentary for Section 903.2.4.2 “Distilled Spirits” for additional information and requirements.

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PART 5

Hazardous Materials

Chapters 50 through 67



- **Chapter 50** Hazardous Materials—General Provisions
- **Chapter 51** Aerosols No changes addressed
- **Chapter 52** (Reserved)
- **Chapter 53** Compressed Gases No changes addressed
- **Chapter 54** Corrosive Materials No changes addressed
- **Chapter 55** Cryogenic Fluids No changes addressed
- **Chapter 56** Explosives and Fireworks
- **Chapter 57** Flammable and Combustible Liquids
- **Chapter 58** Flammable Gases and Flammable Cryogenic Fluids No changes addressed
- **Chapter 59** Flammable Solids No changes addressed
- **Chapter 60** Highly Toxic and Toxic Materials No changes addressed
- **Chapter 61** Liquefied Petroleum Gases No changes addressed
- **Chapter 62** Organic Peroxides No changes addressed
- **Chapter 63** Oxidizers, Oxidizing Gases and Oxidizing Cryogenic Fluids
- **Chapter 64** Pyrophoric Materials No changes addressed
- **Chapter 65** Pyroxylin (Cellulose Nitrate) Plastics No changes addressed
- **Chapter 66** Unstable (Reactive) Materials No changes addressed
- **Chapter 67** Water-Reactive Solids and Liquids No changes addressed
- **Chapters 68 through 79** (Reserved)

Chapters 50 through 67 contain requirements for the safe storage, use, handling and dispensing of hazardous materials. The Chemical Abstract Service, a part of the American Chemical Council, has identified over 175 million organic and inorganic substances. The *International Fire Code* (IFC) does not regulate all of these chemicals. Instead, the IFC focuses on chemicals or chemical mixtures that pose physical or health hazards. Physical hazard materials can detonate, deflagrate, burn or accelerate burning. Health hazard materials can incapacitate, injure or cause death after only a single exposure. Chapters 68 through 79 are reserved and serve as place holders for future code provisions when new hazardous materials are identified as requiring regulation by the IFC. ■

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5001.1, 5701.2, 202

Hazardous Material Exemptions

5003.8.3.3

Number of Control Areas

TABLE 5003.11.1

Toxic Solids in Retail Occupancies

5003.12, 5004.14 (NEW), 5005.3.3, 5005.4.3

Outdoor Control Areas

5601.1.3

Retail of Consumer Use Fireworks

5606.1, 5606.6

Ammunition Reloading in Commercial Operations

5707.1, 5707.2, 5707.2.1, 5707.2.2

On-Demand Mobile Fueling

6303.1.4, TABLE 6303.1.4, TABLE 6304.1.5(1), TABLE 6304.1.5(2)

Storage of Oxidizers



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5001.1, 5701.2, 202

Hazardous Material Exemptions

CHANGE TYPE: Modification

CHANGE SUMMARY: Exceptions to Chapters 50 and 57 are correlated to eliminate confusion and misapplication.

2021 CODE TEXT: **5001.1 Scope.** Prevention, control and mitigation of dangerous conditions related to storage, dispensing, use and handling of hazardous materials shall be in accordance with this chapter.

This chapter shall apply to all hazardous materials, including those materials regulated elsewhere in this code, except that where specific requirements are provided in other chapters, those specific requirements shall apply in accordance with the applicable chapter. Where a material has multiple hazards, all hazards shall be addressed.

Exceptions:

1. In retail or wholesale sales occupancies, ~~the quantities of~~ medicines, foodstuff, ~~or consumer products and~~ cosmetics and commercial or institutional products containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable ~~shall not be limited~~, provided that such materials are packaged in individual containers not exceeding 1.3 gallons (5 L).
2. ~~Quantities of alcoholic~~ Alcoholic beverages in retail or wholesale sales occupancies ~~shall not be limited providing~~ provided that the liquids are packaged in individual containers not exceeding 1.3 gallons (5 L).
3. through 9. *(No change to text.)*
10. The storage of beer, distilled spirits and wines in ~~wooden~~ barrels and casks.



Some paint products have a flash point, but no fire point and are therefore not regulated as hazardous materials. Other products, like the paint thinner and acetone, have a fire point and are classified as flammable or combustible liquids and a hazardous material.

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11. *(No change to text.)*
12. Specific provisions for flammable liquids in motor fuel-dispensing facilities, repair garages, airports and marinas in Chapter 23.
13. Storage and use of fuel oil in tanks and containers connected to oil-burning equipment. Such storage and use shall be in accordance with Section 603. For abandonment of fuel oil tanks, Chapter 57 applies.
14. Storage and display of aerosol products complying with Chapter 51.
15. Storage and use of flammable or combustible liquids that do not have a fire point when tested in accordance with ASTM D92, not otherwise regulated by this code.
16. Flammable or combustible liquids with a flash point greater than 95°F (35°C) in a water-miscible solution or dispersion with a water and inert (noncombustible) solids content of more than 80 percent by weight, which do not sustain combustion, not otherwise regulated by this code.
17. Commercial cooking oil storage tank systems located within a building and designed and installed in accordance with Section 607 and NFPA 30.

5701.2 Nonapplicability. This chapter shall not apply to liquids as otherwise provided in other laws or regulations or chapters of this code, including:

1. through 9. *(No change to text.)*
10. The storage of beer, distilled spirits and wines in ~~wooden~~ barrels and casks.
11. *(No change to text.)*
12. Application and release of pesticide and agricultural products and materials intended for use in weed abatement, erosion control, soil amendment or similar applications where applied in accordance with the manufacturers' instructions and label directions.
13. The off-site transportation of hazardous materials where in accordance with Department of Transportation (DOTn) regulations.

202 Definitions.

COMBUSTIBLE LIQUID. A liquid having a closed cup flash point at or above 100°F (38°C). Combustible liquids shall be subdivided as follows:

The category of combustible liquids does not include compressed gases or cryogenic fluids, or liquids that do not have a fire point when tested in accordance with ASTM D92.

Class II. Liquids having a closed cup flash point at or above 100°F (38°C) and below 140°F (60°C).

Class IIIA. Liquids having a closed cup flash point at or above 140°F (60°C) and below 200°F (93°C).

Class IIIB. Liquids having closed cup flash points at or above 200°F (93°C).

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FLAMMABLE LIQUID. A liquid having a closed cup flash point below 100°F (38°C). Flammable liquids are further categorized into a group known as Class I liquids. The Class I category is subdivided as follows:

Class IA. Liquids having a flash point below 73°F (23°C) and having a boiling point below 100°F (38°C).

Class IB. Liquids having a flash point below 73°F (23°C) and having a boiling point at or above 100°F (38°C).

Class IC. Liquids having a flash point at or above 73°F (23°C) and below 100°F (38°C).

The category of flammable liquids does not include compressed gases or cryogenic fluids, or liquids that do not have a fire point when tested in accordance with ASTM D92.

CHANGE SIGNIFICANCE: Hazardous materials can be found in nearly all occupancies. Chapter 50 provides general requirements for hazardous materials, and Chapter 57 provides requirements specific to flammable and combustible liquids. Both chapters address hazardous materials, however the exceptions do not correlate. For example, a flammable liquid can be exempted from Chapter 57, but still fall under Chapter 50 because the exception is not carried over to Chapter 50. This code change is designed to correlate the exceptions for both Chapters 50 and 57.

For example, Section 5701.2, Exception 1 in the 2018 *International Fire Code* (IFC) has an exception for flammable liquids at motor fuel dispensing facilities and repair garages provided they comply with Chapter 23. Chapter 50 does not contain an equivalent exception, therefore the confusion arises with regard to Chapter 50—does Chapter 50 apply in addition to Chapter 23? It is the intent that if the flammable liquids comply with Chapter 23, then they should be exempt from both Chapters 50 and 57. Therefore, Exception 12 is added to Section 5001.1 to correlate the requirements in the three chapters. There are sections in Chapter 23 that reference specific requirements in Chapter 50 or Chapter 57, but those are specific references to sections and the remainder of the chapter does not apply. For example, Section 2306.2.1 refers to Chapter 57 for underground tank requirements, and Section 2306.2.3 refers to Chapter 57 for protected above-ground tank requirements.

Exception 10 in Section 5001.1 is revised to include beer into the list of distilled spirits and wines. These products are not treated as hazardous materials when they are in storage. The brewing, distilling and processing of these products may still be classified as handling a hazardous material, but once it is in storage, it is no longer treated as a hazardous material and therefore never becomes a Group H occupancy. The restriction for the storage to be in wooden barrels or casks is also removed. As far as fire load is concerned, the wooden barrel is a greater hazard than stainless steel. So if the wooden barrel is exempted, it only makes sense to exempt all methods of storage.

Exception 7 in Section 5701.2 states that if a liquid has no fire point, it is not considered a flammable or combustible liquid. That exception is now repeated in Chapter 50. If Chapter 57 considers the product to not be a flammable liquid, then Chapter 50 should not include it as a hazardous material. There is a caveat that stipulates the product is "not otherwise regulated by this code." This means that if the product has no fire point,

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then it is not considered to be a flammable liquid and is not regulated by Chapter 50, provided the product has no other characteristics that would classify it as hazardous material, such as corrosive or toxic.

The definitions for flammable liquid and combustible liquid are revised to include the exclusion when liquids have a flash point, but not a fire point. The **fire point** of a liquid is the lowest temperature at which the vapor of that fuel will continue to burn for at least 5 seconds after ignition by an open flame. At the flash point, a lower temperature, a substance will ignite briefly, but the vapors cannot sustain the fire if the liquid does not have a fire point. This is why liquids with no fire point have been excluded from Chapter 57. For example, most beers contain 4 percent to 12 percent ethanol and may have a flashpoint, but in most cases do not have a fire point.

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5003.8.3.3

Number of Control Areas

CHANGE TYPE: Modification

CHANGE SUMMARY: Portions of buildings separated by fire walls can be treated as separate buildings when evaluating control areas.

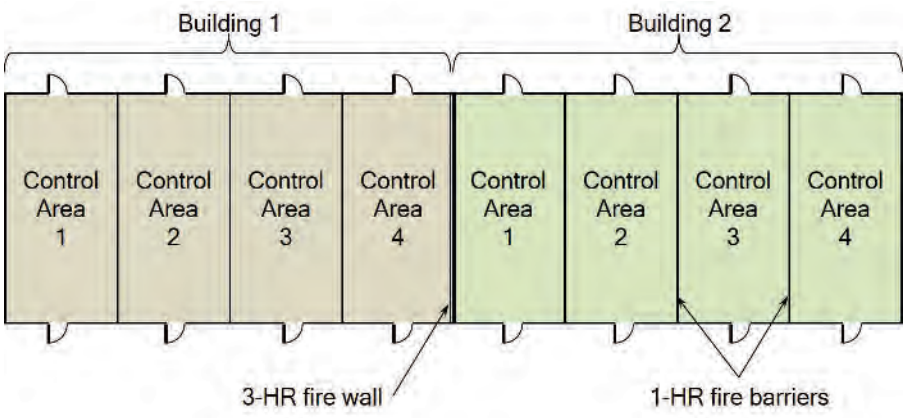
2021 CODE TEXT: **5003.8.3.3 Number.** The maximum number of control areas per floor within a building shall be in accordance with Table 5003.8.3.2. For the purposes of determining the number of control areas within a building, each portion of a building separated by one or more fire walls complying with Section 706 of the *International Building Code* shall be considered a separate building.

CHANGE SIGNIFICANCE: The application of fire walls changed in the 2018 *International Building Code* (IBC). That change no longer allowed portions of a building to be considered separately when separated by a fire wall. Previously the IBC stated that fire walls created separate buildings and the number of control areas in each building was counted independently on each side of a fire wall. The IBC now states that fire walls only create separate buildings for the application of height, area and type of construction requirements. This resulted in an unintended consequence in its application to control areas. Based on the 2018 IBC change, quantities in these control areas now must be aggregated, which has the potential to place many facilities out of compliance. This code change allows a fire wall to create separate buildings when determining the allowable number of control areas in a building.

This revision states that for control area purposes, portions of buildings separated by fire walls can be considered separate buildings. This means that the number of allowed control areas on each side of the fire wall is limited to the number of control areas per floor in Table 5003.8.3.2 in each building.

The end result is that a single-story building can have up to four control areas, then be divided by a fire wall and have up to another four control areas. This occurs often in strip malls. See the figure below.

A companion code change occurred in the IBC to Section 414.2.3.



Portions of a building separated by a fire wall are considered separate buildings which allows the number of control areas on each side of the fire wall to be the maximum allowed per building. Table 5003.8.3.2 allows four control areas per floor on the first floor. Therefore, this single story facility can have a maximum of eight control areas.

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Table 5003.11.1

Toxic Solids in Retail Occupancies

CHANGE TYPE: Modification

CHANGE SUMMARY: The maximum allowable quantity of solid toxic material can be increased in retail and storage facilities if the toxic classification is based solely on the LC_{50}.

2021 CODE TEXT:

TABLE 5003.11.1 Maximum Allowable Quantity Per Indoor and Outdoor Control Area in Group M And S Occupancies – Nonflammable Solids, Nonflammable and Noncombustible Liquids [d,e,f]

Condition		Maximum Allowable Quantity per Control Area	
Material[a]	Class	Solids pounds	Liquids gallons
A. Health Hazard Materials—Nonflammable and Noncombustible Solids and Liquids			
1. Corrosives[b,c]	Not Applicable	9,750	975
2. Highly Toxics	Not Applicable	20[b,c]	2[b,c]
3. Toxics[b,c]	Not Applicable	1,000[k]	100
B. Physical Hazard Materials—Nonflammable and Noncombustible Solids and Liquids			
1. Oxidizers[b,c]	4	Not Allowed	Not Allowed
	3	1,350[g]	135
	2	2,250[h]	225
	1	18,000[i,j]	1,800[i,j]
2. Unstable (Reactives)[b,c]	4	Not Allowed	Not Allowed
	3	550	55
	2	1,150	115
	1	Not Limited	Not Limited
3. Water Reactives	3[b,c]	550	55
	2[b,c]	1,150	115
	1	Not Limited	Not Limited

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 cubic foot = 0.02832 m^3.

a. through j. *(No change.)*

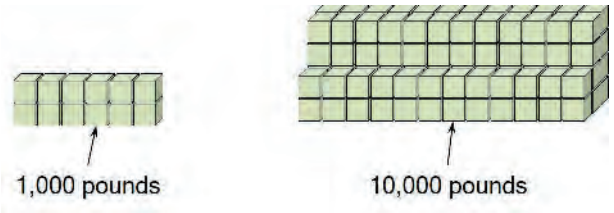
k. Maximum allowable quantity of consumer products shall be increased to 10,000 pounds where individual packages are in the original sealed containers from the manufacturer and the toxic classification is exclusively based on the LC_{50} threshold and no other hazardous materials classifications apply.

CHANGE SIGNIFICANCE: Small businesses often move into warehouse/office suites in light industrial or business complexes without conducting any construction or other activity that would require a review by the fire or building department. These businesses are often discovered through the fire department's business inspection program. During a walk-through, an inspector would not see anything of significance, but may notice the presence of chemicals and would ask for a hazardous materials inventory. For most businesses this would not garner undue concern. But for some businesses this hazardous materials inventory would trigger a hazardous occupancy review that could have a negative impact on the long-term viability of the business.

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The quantity of solid toxic materials receives ten times increase if the only hazard is the LC_{50} based on the inhalation hazard.

As home ownership in the United States has increased, the number of smaller wholesale/distribution centers serving small businesses catering to homeowners has grown. A specific example is lawn care companies. The small wholesale centers serving this group of businesses can be the most affected by a fire department's review of hazardous materials. Many of the lawn chemicals present are classified as toxic based on the LC_{50} threshold. The total amount of toxins present exceeds the maximum allowable quantities, thus reclassifying the space as a Group H-4 occupancy. The requirements generated by this classification cause a business significant hardship, as the types of buildings occupied typically do not have fire sprinkler systems, fire-rated construction or any other typical Group H occupancy requirements.

The cost of complying with the code is normally not considered a reason to not follow code requirements. If a review of the actual risk is conducted, the H-occupancy requirements can be onerous and more than should be necessary.

While these small distribution centers exceed the maximum allowable quantities, the chemicals are normally in unopened original packaging from the manufacturer. The products arrive on pallets wrapped in plastic. The warehouse manager will unwrap the pallets and redistribute the unopened packages to other pallets, creating a loaded pallet to be delivered to a customer. None of the packages are opened. There is no mixing or repackaging occurring, just redistribution of product on outbound pallets. Even if a spill were to occur, a minimal number of packages (or pounds) would be involved. Most likely the spill would be far below the maximum allowable quantity. Spills involving solids, typically in pellet form, do not present a significant inhalation risk.

Further, when evaluating the risk presented by solids in this situation, the reliance of the LC_{50} threshold itself needs be taken into account. The definition for toxic materials is based on acute toxicity values (oral, dermal and inhalation). In this particular situation, the hazard presented by inhalation is the concern (LC_{50}). If the material exceeds the $LC_{50,}$ it is classified as toxic. However, there is discussion in the scientific community as to whether the LC_{50} should be used as a standalone metric for determining the toxicity of a solid substance.

This revision is partially based on the artificial nature of the LC_{50} threshold measurement itself. The process necessary to prepare the sample for the testing does not simulate the expected normal conditions within a typical retail or wholesale building. The solids are required to be highly processed, using high heat and pressure along with mechanical grinding, to create particles sufficiently small enough to be infused deeply

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within the lungs. The dust-sized particles are then fed into a test chamber or through a face mask to the test specimen. These test procedures do not represent a real-world condition for retail operations.

Therefore, this new footnote allows for an increase in quantities for solid toxic materials with three conditions:

1. The packaging is the original sealed containers from the manufacturer. This would mean there is no mixing or product transfer at the retail or storage facility.
2. The product is classified as toxic based solely on the LC_{50}. If the product is also classified as toxic based on ingestion or absorption (LD_{50}), this footnote is not applicable.
3. The product does not have any other hazard category classification. This means that only the LC_{50} places this product into a hazardous material classification.

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5003.12, 5004.14 (New), 5005.3.3, 5005.4.3

Outdoor Control Areas

CHANGE TYPE: Clarification

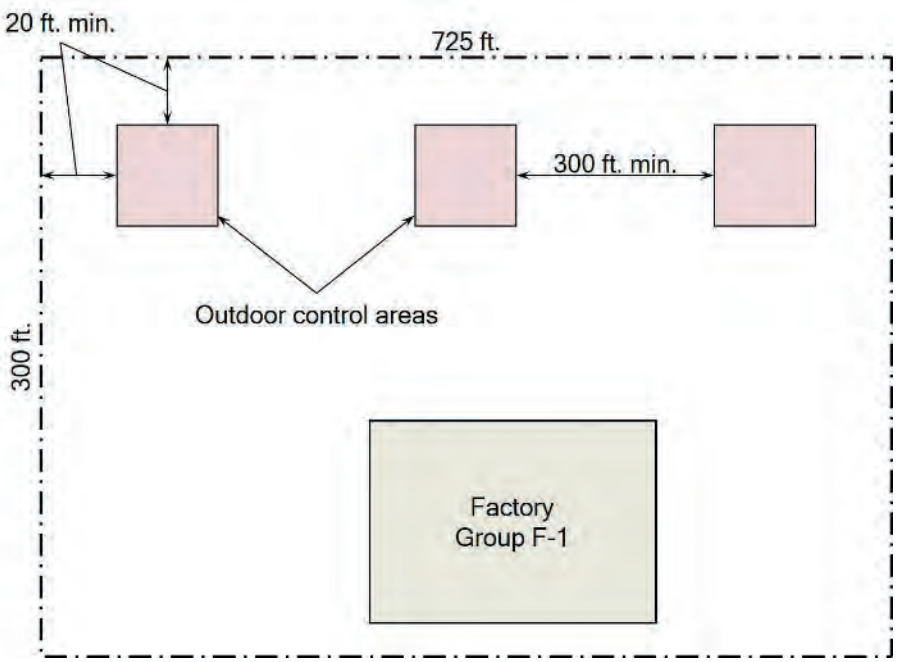
CHANGE SUMMARY: Requirements for outdoor control area for hazardous materials have been correlated and clarified.

2021 CODE TEXT: **5003.12 Outdoor control areas.** Outdoor control areas for hazardous materials ~~in amounts not exceeding the maximum allowable quantity per outdoor control area~~ shall be in accordance with the following general requirements:

1. Outdoor control areas shall be kept free from weeds, debris and common combustible materials not necessary to the storage. The area surrounding an outdoor control area shall be kept clear of such materials for not less than 15 feet (4572 mm).
2. Outdoor control areas shall be located not closer than 20 feet (6096 mm) from a public street, public alley, public way or lot line that can be built on.

Exceptions:

1. For solid and liquid hazardous materials, a 2-hour fire-resistance-rated wall without openings extending not less than 30 inches (762 mm) above and to the sides of the storage area shall be allowed in lieu of such distance.
2. For compressed gas hazardous materials, unless otherwise specified, the minimum required distances shall not apply where fire barriers without openings or penetrations having a



Quantities of hazardous materials in outdoor control areas can exceed the maximum allowable quantity when other code sections or referenced standards contain requirements for outdoor storage and use that are specific to the material.

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minimum fire-resistance rating of 2 hours interrupt the line of sight between the storage and the exposure. The configuration of the fire barrier shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

3. Where a property exceeds 10,000 square feet (929 m²), a group of two outdoor control areas is allowed where approved and where each control area is separated by a minimum distance of 50 feet (15 240 mm).
4. Where a property exceeds 35,000 square feet (3252 m²), additional groups of outdoor control areas are allowed where approved and where each group is separated by a minimum distance of 300 feet (91 440 mm).

5004.14 Outdoor storage location. Outdoor storage areas for hazardous materials shall be located as required by Section 5003.12 except where material specific requirements, including requirements in referenced standards, are provided in other chapters of this code.

5005.3.3 ~~Location~~ Outdoor location. Outdoor dispensing and use areas for hazardous materials shall be located as required ~~for outdoor storage in accordance with Section 5004~~ by Section 5003.12 except where material specific requirements, including requirements in referenced standards, are provided in other chapters of this code.

5005.4.3 ~~Location~~ Outdoor location. Outdoor handling areas for hazardous materials shall be located as required ~~for outdoor storage in accordance with Section 5004~~ by Section 5003.12 except where material specific requirements, including requirements in referenced standards, are provided in other chapters of this code.

CHANGE SIGNIFICANCE: The intent of this proposal is to provide correlation between Sections 5003, 5004 and 5005 as they apply to outdoor storage of hazardous materials.

Upon review of the requirements Section 5003, both quantities not exceeding the maximum allowable quantity (MAQ) and quantities exceeding the MAQ are required to comply with all of Section 5003 General Requirements. As the *International Fire Code* (IFC) is structured, a specific requirement takes precedence over a general requirement, but the general requirements are the starting point.

Section 5003.12 is revised to remove redundant language. The text specifying "amounts not exceeding the maximum allowable quantity per outdoor control area" is removed, because outdoor control areas, by definition, cannot exceed the MAQ. Outdoor control areas are defined as "an outdoor area that contains hazardous materials in amounts not exceeding the maximum allowable quantities of Table 5003.1.1(3) or Table 5003.1.1(4)." Therefore, Section 5003.12 is still limited to storage not exceeding the MAQ.

Section 5004 deals with storage above the MAQ. A new section is added, Section 5004.14, which sends the user back to Section 5003.12 for outdoor storage unless the material specific requirements provide for different outdoor storage arrangements.

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Section 5004.14 includes a reference to other sections of the code and to provisions in applicable standards. Essentially, this reference reinforces Section 102.10, which states that specific requirements override general requirements. For example, Section 5003.12 Item 2 requires a separation of 20 feet from public streets and lot lines. However, Table 5704.4.2, excluding footnotes, for outdoor storage of containers storing Class IB flammable liquids requires 50 feet to lot lines. In this case, the requirement in Table 5704.4.2 applies since it is specific to the situation. Table 5704.4.2 also addresses outdoor storage of Class III combustible liquids and requires 10 feet to lot lines and 5 feet to public streets, excluding footnotes. In this case, even though the requirements in Table 5704.4.2 are less restrictive, they are applicable since they are specific to the situation.

The specific requirements could also be found in a referenced standard, such as NFPA 2 *Hydrogen Technology Code*, which requires a separation of 10 feet to lot lines and public streets for gaseous storage of 20,000 cubic feet of hydrogen.

Sections dealing with the location of outdoor dispensing, use and handling areas now reference Section 5003.12 or other requirements in the code or standards that are specific to the situation.

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5601.1.3

Retail of Consumer Use Fireworks

CHANGE TYPE: Modification

CHANGE SUMMARY: The referenced NFPA standard for fireworks sale and storage is specified as the 2006 edition of NFPA 1124.

2021 CODE TEXT: **5601.1.3 Fireworks.** The possession, manufacture, storage, sale, handling and use of fireworks are prohibited.

Exceptions:

1. Storage and handling of fireworks as allowed in Section 5604.
2. Manufacture, assembly and testing of fireworks as allowed in Section 5605.
3. The use of fireworks for fireworks displays as allowed in Section 5608.
4. The possession, storage, sale, handling and use of specific types of Division 1.4G fireworks where allowed by applicable laws, ordinances and regulations, provided that such fireworks and facilities comply with the 2006 edition of NFPA 1124, CPSC 16 CFR Parts 1500 and 1507, and DOTn 49 CFR Parts 100–185, as applicable for consumer fireworks.

CHANGE SIGNIFICANCE: The charging sentence for this section prohibits sale and use of fireworks. However, many jurisdictions allow the retail sale and use of consumer fireworks. Recognizing the need to regulate these operations in jurisdictions where retail sales are allowed, Exception 4 has referenced the requirements in NFPA 1124 *Code for the Manufacture, Transportation and Storage of Fireworks and Pyrotechnic Articles*.

The most recent edition of NFPA 1124 no longer contains requirements for retail sales and storage of consumer fireworks. This code change therefore specifies the 2006 edition of NFPA 1124 as the referenced document. The 2006 edition provides criteria for retail sales and storage in Chapters 6 and 7 of the standard. In fact, Section 7.3.1.2 of NFPA 1124



Retail sales of fireworks must comply with the 2006 edition of NFPA 1124.

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correlates with Footnote l in *International Fire Code* (IFC) Table 5003.1.1(1) which states to use 25 percent of the product weight to determine the quantity of pyrotechnic composition.

Even though there are two revised editions since the 2006 edition of NFPA 1124, the 2006 edition is the appropriate edition for regulation of storage, use and sale of consumer fireworks in those areas where such use is legal.

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5606.1, 5606.6

Ammunition Reloading in Commercial Operations

CHANGE TYPE: Modification

CHANGE SUMMARY: Requirements for ammunition reloading in commercial operations are added to the code.

2021 CODE TEXT: **5606.1 General.** Indoor storage and display of black powder, smokeless propellants, small arms primers and, small arms ammunition, and commercial reloading shall comply with this section and NFPA 495.

5606.6 Commercial reloading. Commercial reloading of small arms ammunition shall comply with Sections 5606.6.1 through 5606.6.8.

5606.6.1 Electrical. Areas within 3 feet (914 mm) of reloading equipment shall be Class I, Division 2, Group A type.

5606.6.2 Exhaust fans. Squirrel cage blowers shall not be used for exhausting hazardous fumes, vapors or gases. Only nonferrous fan blades shall be used for fans located within the ductwork and through which hazardous materials are exhausted. Motors shall be located outside the duct.

5606.6.3 Work stations. Work stations shall be separated by distance, barrier or other approved alternatives so that fire in one station will not ignite material in another work station.

5606.6.4 Personnel limits. The number of occupants in each process building and in each magazine shall not exceed the number necessary for proper conduct of production operations.



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Safety precautions are necessary to conduct commercial ammunition reloading operations.

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5606.6.5 Approved containers. Smokeless powder shall be kept in its original container.

5606.6.6 Static controls. The work area shall be provided with approved static controls.

5606.6.7 Waste disposal. Approved receptacles with covers shall be provided for each location for disposing of waste material and debris. These waste receptacles shall be emptied and cleaned as often as necessary but not less than once each day or at the end of each shift.

5606.6.8 Safety rules. General safety rules and operating instructions governing the particular operation or process conducted at that location shall be available at each location.

CHANGE SIGNIFICANCE: These new requirements in the code regulate reloading of ammunition in commercial operations. These requirements do not apply to personal reloading operations.

Control of ignition sources is a major concern when handling gunpowder. These new requirements specify that the areas within 3 feet of reloading equipment are either classified (hazardous) locations or have no electrical components. The generation of static electricity at each work area must be controlled. Motors for exhaust fans are to be located outside of the ductwork, and the fan blades must be nonferrous, such as aluminum, copper or brass.

Safety rules and operating instructions must be available. The safety rules should include disposal of waste (see Section 5606.7), storage of smokeless powder in original containers (see Section 5606.5) and use and maintenance of static and grounding equipment (see Section 5606.6).

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5707.1, 5707.2, 5707.2.1, 5707.2.2

On-Demand Mobile Fueling

CHANGE TYPE: Modification

CHANGE SUMMARY: On-demand mobile fueling operations are enhanced and fueling vehicles are now identified as one of three classifications based on the quantity of fuel carried.

2021 CODE TEXT: **5707.1.1 Approval required.** Mobile fueling operations shall not be conducted without first obtaining a permit and approval from the fire code official. Mobile fueling operations shall occur only at approved locations. The fire code official is authorized to approve individual locations or geographic areas where mobile fueling is allowed.

5707.2 Mobile fueling vehicle. An on-demand mobile fueling vehicle shall be ~~one of the following:~~ that which is utilized in on-demand fueling operations for the dispensing of Class I, II or III liquids into the fuel tanks of motor vehicles.

5707.2.1 Mobile fueling vehicle classifications. An on-demand mobile fueling vehicle shall be characterize as one of the following:

1. Tier 1 mobile fueling vehicle. A tank vehicle that complies with NFPA 385 and that has chassis-mounted tanks ~~or containers~~ where the aggregate ~~cargo~~ capacity does not exceed ~~1200~~ 1,600 gallons (~~4592~~ 6057 L).
2. Tier 2 mobile fueling vehicle. A ~~mobile fueling~~ vehicle with ~~a mounted *tank* in excess of~~ one or more chassis-mounted tanks or containers that do not exceed 110 gallons (416 L) ~~shall comply with the requirements of Section 5706.6, Section 5707 and NFPA 385~~ in capacity with an aggregate capacity that does not exceed 800 gallons (3028 L) or the weight capacity of the vehicle in accordance with DOTn.



Photo courtesy of Booster Fuels, Inc.

Tier 1 mobile fueling vehicle.

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3. Tier 3 mobile fueling vehicle. A vehicle that carries a maximum aggregate capacity of 60 gallons (227 L) of motor fuel in metal safety cans *listed* in accordance with UL 30 or other *approved* metal containers, each not to exceed 5 gallons (19 L) in capacity. ~~Containers shall be secured to the mobile fueling vehicle except when in use.~~

5707.2.2 Mobile fueling vehicle requirements. ~~The~~ Each mobile fueling vehicle shall comply with all local, state and federal requirements~~.~~, as well as the following:

1. Mobile fueling vehicles with a chassis-mounted tank in excess of 110 gallons (416 L) shall also comply with the requirements of Section 5706.6 and NFPA 385.
2. The mobile fueling vehicle and its equipment shall be maintained in good repair.
3. Safety cans and approved metal containers shall be secured to the mobile fueling vehicle except when in use.
4. Fueling a motor vehicle from tanks or containers mounted in a trailer connected to a mobile fueling vehicle shall be prohibited.

CHANGE SIGNIFICANCE: The on-demand mobile fueling industry is quickly expanding as need and use increases. The requirements for on-demand mobile fueling were adding in the 2018 *International Fire Code* (IFC). Additional provisions and requirements have been included in the 2021 IFC.

Note that this section contains requirements for "on-demand mobile fueling" which is different from "mobile fueling."

- Mobile fueling is limited to commercial, industrial, governmental or manufacturing establishments where the fuel delivery vehicle arrives at a site to fuel multiple vehicles or a fleet of vehicles. This operation is regulated in Section 5706.5.4.5.
- On-demand mobile fueling is the operation where any vehicle owner can contact a fueling service to bring fuel to their private vehicle. This fueling operation is not limited to commercial, industrial, governmental or manufacturing establishments. This section regulates on-demand mobile fueling.

Section 5707.1 is revised to allow the code official to either approve a specific location for the fueling operation, or to approve a geographic area. This allows latitude in the day-to-day operation of the mobile fueling operation. For example, consider a covered mall with a large parking lot. The code official can approve fueling at any location in the parking lot, rather than needing to approve each specific space where fueling may occur. When the area is approved, the mobile fueling operator must still ensure that each fueling location meets the separation and safety requirements prior to fueling. This could be carried even further to approve an area consisting of several blocks in the downtown area. Again, the operator is responsible to ensure compliance with the requirements is met for each fueling operation.

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On-demand mobile fueling vehicles regulated in this section are limited to Class I, II or III liquid fuels. When evaluating the aggregate quantity of fuel carried, the fuel tank for the delivery vehicle is not counted as part of the cargo.

Section 5707.2.1 is revised to allow on-demand mobile fueling vehicles to carry up to 1,600 gallons of fuel. There are three classifications of on-demand mobile fueling vehicles:

- Tier 1 – this is a mobile fueling vehicle with a tank mounted on the vehicle and attached to the vehicle chassis. This could be a single tank, multiple tanks or a compartmented tank. The aggregate quantity cannot exceed 1,600 gallons.
- Tier 2 – this is a mobile fueling vehicle with a tank or container mounted on the vehicle and attached to the vehicle chassis. Each tank or container is limited to 110 gallons. The aggregate quantity cannot exceed 800 gallons.
- Tier 3 – this is a mobile fueling vehicle carrying listed metal safety cans or other approved containers. Each container is limited to 5 gallons. The aggregate quantity cannot exceed 60 gallons.

New requirements in Sections 5707.5.2 and 5707.5.3 require the fueling vehicle to have a break-away device at the fueling nozzle and a listed shutoff valve at the tank.

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6303.1.4, Table 6303.1.4, Table 6304.1.5(1), Table 6304.1.5(2)

Storage of Oxidizers

CHANGE TYPE: Clarification

CHANGE SUMMARY: The requirements for oxidizer storage configurations have been correlated and revised.

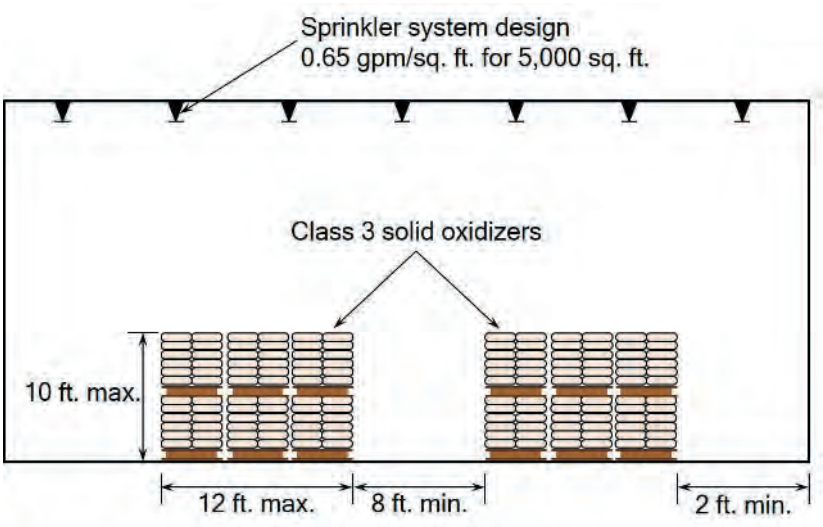
2021 CODE TEXT: ~~**6303.2**~~ **6303.1.4** ~~**Class 1 oxidizer storage**~~ **Storage configuration.** The storage configuration of Class 1, 2 and 3 liquid and solid oxidizers shall be as set forth in Table ~~6303.2~~ 6303.1.4.

TABLE ~~6303.2~~ 6303.1.4 Storage of Class 1, 2 and 3 Oxidizer Liquids and Solids

STORAGE CONFIGURATION	LIMITS (feet)		
	Class 1	Class 2	Class 3
Piles			
Maximum width	24	16	12
Maximum height	20	Note c	Note c
Maximum distance to aisle	12	8	8
Maximum distance to next pile[a]	4[a]	Note a	Note a
Maximum distance to walls[b]	2[b]	2	4
Maximum quantity per pile	200 tons	MAQ	NA
Maximum quantity per building	No limit	Note d	Note d

For SI: 1 foot = 304.8 mm, 1 pound = 0.454 kg, 1 ton = 0.907185 metric ton.
MAQ = Maximum Allowable Quantity.
NA = Not Applicable.

a. The minimum aisle width shall be equal to the pile height, but not less than 4 feet and not greater than 8 feet.
b. There shall not be a minimum distance from the pile to a wall for amounts less than 9,000 pounds.
c. Maximum storage height in nonsprinklered buildings is limited to 6 feet. In sprinklered buildings see NFPA 400 for storage heights based on ceiling sprinkler protection.
d. Maximum quantity per building varies. See Chapter 50 for control areas and MAQs.



Criteria is added for palletized storage of Class 3 oxidizers. Every portion of a pile must be within 8 feet of an aisle.

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~~6303.1.1.2~~ 6303.1.5 Class 3 liquid and solid oxidizers. Not more than 220 pounds (99 kg) of solid or 22 gallons (83 L) of liquid Class 3 oxidizer is allowed in storage and use where such materials are necessary for maintenance purposes or operation of equipment. The oxidizers shall be stored in approved containers and in an approved manner.

TABLE 6304.1.5(1) Storage of Class 2 Oxidizer Liquids and Solids

STORAGE CONFIGURATION	LIMITS		
	~~Control Area Storage~~	Group H Occupancy Storage	Detached Storage
Piles			
Maximum width	~~16 feet~~	25 feet	25 feet
Maximum height	~~Note a~~	Note a	Note a
Maximum distance to aisle	~~8 feet~~	12 feet	12 feet
Maximum distance to next pile[a]	~~Note b~~	Note b	Note b
Maximum distance to walls[b]	~~2 feet~~	2 feet[c]	2 feet[c]
Maximum quantity per pile	~~MAQ~~	100 tons	100 tons
Maximum quantity per building	~~MAQ~~	2,000 tons	No Limit

For SI: 1 foot = 304.8 mm, 1 pound = 0.454 kg, 1 ton = 0.907185 metric ton.
a. through c. *(No change in footnotes.)*

TABLE 6304.1.5(2) Storage of Class 3 Oxidizer Liquids and Solids

STORAGE CONFIGURATION	LIMITS		
	~~Control Area Storage~~	Group H Occupancy Storage	Detached Storage
Piles			
Maximum width	~~16 feet~~	16 feet	20 feet
Maximum height	~~Note a~~	Note a	Note a
Maximum distance to aisle	~~8 feet~~	10 feet	10 feet
Maximum distance to next pile[a]	~~Note b~~	Note b	Note b
Maximum distance to walls[b]	~~2 feet~~	4 feet[c]	4 feet[c]
Maximum quantity per pile	~~MAQ~~	30 tons	100 tons
Maximum quantity per building	~~MAQ~~	1,200 tons	No Limit

For SI: 1 foot = 304.8 mm, 1 pound = 0.454 kg, 1 ton = 0.907185 metric ton.
a. through c. *(No change in footnotes.)*

CHANGE SIGNIFICANCE: There are five separate tables within two pages of Chapter 63 regarding oxidizer storage. These tables provide criteria for storage of solid and liquid oxidizers Classes 1, 2 and 3. These revisions are intended to simplify the tables to assist the code user. Section 6303.1 contains requirements for oxidizers for quantities below the maximum allowable quantity. Therefore, everything addressing oxidizers below the MAQ is relocated to this section and subsections. Section 6303.2 and the associated table have been relocated as a subsection of Section 6303.1. Additionally, one column from Table 6304.1.5(1) and one from Table 6304.1.5(2) dealing with quantities below the MAQ have been included in

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the relocated table. Pile size and storage configuration for Class 1, 2 and 3 oxidizers are now all located in Table 6303.1.4.

Footnote c has been added to Table 6303.1.4. This footnote specifies that the maximum storage height for Class 2 and 3 oxidizers is 6 feet in nonsprinklered buildings and refers to storage heights allowed by NFPA 400 in sprinklered buildings. NFPA 400 has several different height restrictions based on method of storage and the delivered density and area of application for the sprinkler system. For example, palletized storage of Class 2 oxidizers is limited to a height of 8 feet if the sprinkler system is designed to deliver 0.2 gallons per minute per square foot with a design area of 3,750 square feet. The pile height for the same product can be increased to 12 feet when the sprinkler density is increased to 0.35 gallons per minute per square foot.

Footnote d has been added to Table 6303.1.4 and is applicable to Class 2 and 3 oxidizers. This is intended to recognize that when an entire building is evaluated, that building may have more than one control area. The allowed number of control areas is limited based on fire-resistive construction and the number of floors. Footnote d will now send the user to Chapter 50 where all the control area options are contained.

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PART 6

Appendices A through N



- **Appendix A** Board of Appeals
  No changes addressed
- **Appendix B** Fire-flow Requirements for Buildings
  No changes addressed
- **Appendix C** Fire Hydrant Locations and Distribution
  No changes addressed
- **Appendix D** Fire Apparatus Access Roads
  No changes addressed
- **Appendix E** Hazard Categories
  No changes addressed
- **Appendix F** Hazard Ranking
  No changes addressed
- **Appendix G** Cryogenic Fluids—Weight and Volume Equivalents
  No changes addressed
- **Appendix H** Hazardous Materials Management Plan (HMMP) and Hazardous Materials Inventory Statements (HMIS) Instructions
- **Appendix I** Fire Protection Systems—Noncompliant Conditions
  No changes addressed
- **Appendix J** Building Information Sign
  No changes addressed
- **Appendix K** Construction Requirements for Existing Ambulatory Care Facilities
  No changes addressed
- **Appendix L** Requirements for Fire Fighter Air Replenishment Systems
  No changes addressed
- **Appendix M** High-Rise Buildings—Retroactive Automatic Sprinkler Requirements
  No changes addressed
- **Appendix N** Indoor Trade Shows and Exhibitions No changes addressed

Appendices A through N contain provisions for establishing boards of appeals, fire department access, fire-flow requirements for buildings, locations for fire hydrants, inspection criteria for noncompliant fire protection systems, building information signs, retroactive installation of fire sprinklers in existing high-rise buildings and indoor trade shows and exhibits. They contain information concerning the classification of hazardous materials and the equivalent weights and volumes of the most commonly found cryogenic fluids. Appendices A through D and H through N do not have the force of law unless they are adopted by the jurisdiction. Appendices E through G are intended only as information sources that supplement the requirements of the *International Fire Code* (IFC) and are not intended to be adopted. ■

APPENDIX H, SECTION H104 (NEW), H104.1 (NEW), H104.2 (NEW)

Chemical Facility Anti-Terrorism Standards

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Appendix H, Section H104 (New), H104.1 (New), H104.2 (New)

Chemical Facility Anti-Terrorism Standards

CHANGE TYPE: Addition

CHANGE SUMMARY: Security requirements are added to Appendix H along with a reference to evaluation of security by Department of Homeland Security in accordance with the Chemical Facility Anti-Terrorism Standards.

2021 CODE TEXT: **SECTION H104 SECURITY**

H104.1 General. Hazardous materials storage, dispensing, use and handling areas shall be secured against unauthorized entry and safeguarded in a manner approved by the fire code official.

H104.2 Chemical facility anti-terrorism standards (CFATS). Chemical facilities deemed to be high risk by the US Department of Homeland Security shall be required to develop and implement security plans in accordance with the Chemical Facility Anti-Terrorism Standards (CFATS) set forth in DHS CFATS 6 CFR Part 27.

SECTION ~~H104~~ H105 Referenced Standards

STANDARD ACRONYM	STANDARD NAME	SECTIONS HEREIN REFERENCED
DHS CFATS 6 CFR Part 27—2007	Chemical Facility Anti-Terrorism Standards	H104.2
IBC—21	International Building Code	H102.1

CHANGE SIGNIFICANCE: The U.S. Department of Homeland Security (DHS) has developed regulations to strengthen security at the nation's highest-risk chemical facilities by developing Chemical Facility Anti-Terrorism Standards (CFATS) published in the Code of Federal regulations. CFATS is the nation's first regulatory program focused specifically on security at high-risk chemical facilities. Managed by the Cybersecurity and



Evaluation by DHS under the CFATS is required in addition to security at this facility.

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Infrastructure Security Agency, the CFATS program identifies and regulates high-risk facilities to ensure they have security measures in place to reduce the risk that certain hazardous chemicals are weaponized by terrorists.

The Chemical Facility Anti-Terrorism Standards (CFATS) program identifies and regulates high-risk chemical facilities to ensure they have security measures in place to reduce the risks associated with these chemicals. Initially authorized by Congress in 2007, the program uses a dynamic multitiered risk assessment process and requires facilities identified as high-risk to meet and maintain performance-based security standards appropriate to the facilities and the risks they pose.

This revision is not intended to require the fire code official to enforce the CFATS regulations, but rather to ensure that fire code officials and chemical facility operators are aware of the existence of these regulations. Chemical facility operators are able to determine whether their facility possesses Chemicals of Interest covered by CFATS at or above the applicable Screening Threshold Quantity. Guidance for this determination can be found in Appendix A of 6 CFR Part 27, which can be accessed at https://www.dhs.gov/xlibrary/assets/chemsec_appendixafinalrule.pdf. If the facility exceeds the Screening Threshold Quantity, the applicant must submit a Top-Screen document to DHS. DHS will conduct a review and determine if further information is needed.

Section H104.1 is underlined as new language and was not previously found in Appendix H. However, this requirement already exists in Section 5003.9.2.

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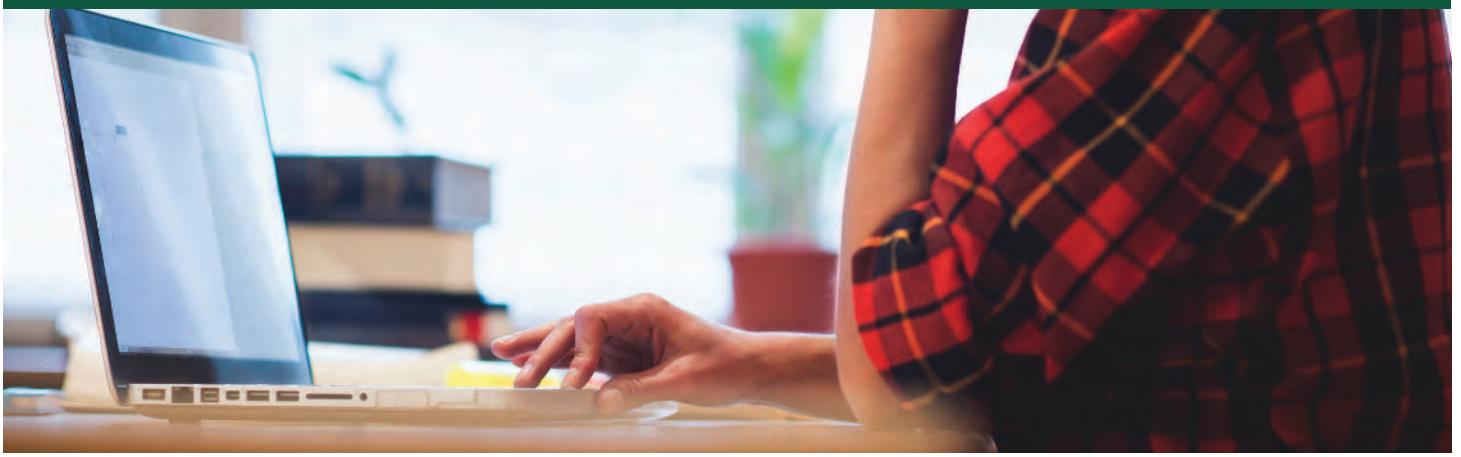
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2021 EDITION

SIGNIFICANT CHANGES to the International Energy Conservation Code®

Michelle L. Britt, LEED AP
Jerica Stacey



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SIGNIFICANT CHANGES TO THE

INTERNATIONAL ENERGY CONSERVATION CODE®

2021 EDITION

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2021 EDITION

International Code Council

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Preface

The purpose of *Significant Changes to the International Energy Conservation Code®, 2021 Edition* is to familiarize building officials, plans examiners, inspectors, design professionals, contractors and others in the construction industry with many of the important changes in the 2021 *International Energy Conservation Code®* (IECC®). This publication is designed to assist those code users in identifying the specific code changes that have occurred and, more importantly, understanding the reasons behind the changes. It is also a valuable resource for jurisdictions in their code-adoption process.

Only a portion of the total number of code changes to the IECC are discussed in this book. The changes selected were identified for a number of reasons, including the frequency of application, special significance or change in application. However, the importance of those changes not included is not to be diminished. Further information on all code changes can be found in the *Complete Revision History to the 2021 I-Codes,* available from the International Code Council® (ICC®) online store. The revision history provides the published documentation for each successful code change contained in the 2021 IECC since the 2018 edition.

The IECC discussion in this publication addressing significant code changes is arranged to follow the general layout of the IECC, including code sections and section number format. The table of contents, in addition to providing guidance in the use of this publication, allows for the quick identification of the significant code changes that occur in the IECC.

Throughout the book, each change is accompanied by a photograph, an application example or an illustration to assist and enhance the reader's understanding of the specific change. A summary and a discussion of the significance of the changes are also provided. Each code change is identified by type, either an addition, modification, clarification or deletion.

The code change itself is presented in a format similar to the style utilized for code-change proposals. Deleted code language is shown with a strike-through, and new code text is indicated by underlining. As a result, the actual 2021 code language is provided as well as a comparison with the 2018 code language so the user can easily determine changes to the specific code text.

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As with any code-change text, *Significant Changes to the International Energy Conservation Code, 2021 Edition* is best used as a study companion to the 2021 IECC. Because only a limited discussion of each change is provided, the code itself should always be referenced to gain a more comprehensive understanding of the code change and its application.

The commentary and opinions set forth in this text are those of the authors and do not necessarily represent the official position of the ICC. In addition, they may not represent the views of any enforcing agency, as such agencies have the sole authority to render interpretations of the IECC. In many cases, the explanatory material is derived from the reasoning expressed by the code-change proponent.

Comments concerning this publication are encouraged and may be directed to the ICC at significantchanges@iccsafe.org.

About the *International Energy Conservation Code*

The IECC is a comprehensive model code that regulates minimum energy-efficient provisions for new buildings and additions and alterations to existing buildings. The IECC contains two separate sets of provisions – commercial and residential. These provisions apply to the building thermal envelope and mechanical, service water heating and electrical power and lighting systems of applicable building types. Administrative provisions and definitions specific to each set of requirements are also included. The IECC integrates easy-to-understand prescriptive provisions for compliance as well as performance criteria that make possible the use of new and innovative materials, equipment and building designs.

The IECC is one of many codes in the family of International Codes published by the International Code Council (ICC). These codes are maintained and updated through an open code development process. Building officials, design professionals and others involved in the building construction industry recognize the need for a modern, up-to-date energy code addressing the design and installation of building systems through requirements emphasizing energy efficiency. The IECC, in the 2021 edition, is intended to meet these needs through model code regulations for energy efficient buildings in all communities, large and small.

The ICC was established in 1994 and is a nonprofit association that provides a wide range of building safety solutions including product evaluation, accreditation, certification, codification and training. The ICC develops model codes and standards used worldwide to construct safe, sustainable, affordable and resilient structures. The ICC's mission is to provide the highest-quality codes, standards, products and services for all concerned with the safety and performance of the built environment.

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Jerica Stacey has over a decade of experience in the development, adoption and implementation of building energy codes and standards, as well as with energy code compliance evaluations and field studies and energy efficiency program evaluations. Ms. Stacey has worked in both the public and private sectors, supporting the energy codes and standards practice area at Cadmus, working as an energy code consultant with the Britt/Makela Group and contributing to projects under the U.S. Department of Energy's Building Energy Codes Program while at the Pacific Northwest National Laboratory. Ms. Stacey is currently an energy code specialist supporting ICC's Business and Product Development group.

Ms. Stacey has authored a wide variety of energy code support publications and studies, including the 2021 *Energy Code Essentials; 2018 CARICOM Energy Code Essentials; Attributing Codes and Standards Savings to Program Administrator Activities: Review of Approaches in Canada and the United States; Giving Credit Where Credit Is Due: Assessing Attribution and Savings from a Building Energy Code Compliance Enhancement Program; Compliance Verification Paths for Residential and Commercial Energy Codes*; and numerous impact and process evaluations for utilities, state government offices and program administrators.

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About the International Code Council®

The International Code Council is a nonprofit association that provides a wide range of building safety solutions including product evaluation, accreditation, certification, codification and training. It develops model codes and standards used worldwide to construct safe, sustainable, affordable and resilient structures. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance, fostering safe and sustainable design and construction.

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PART 1

Commercial Energy Provisions: Administration

Chapters 1 and 2



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- **Chapter 1** Scope and Administration
- **Chapter 2** Definitions

The administration chapter of the *International Energy Conservation Code* (IECC) covers the general scope, intent, applicability and enforcement of the IECC. Section C101.2 establishes the criteria for buildings that are regulated by the IECC Commercial provisions. Buildings outside the scope of Section C101.2 are regulated by the Residential provisions of the IECC. The administration provisions of Chapter 1 also cover the applicability of the code to mixed-use buildings; alternative materials, design and methods of construction; construction documents; inspection fees; referenced standards; and stop work orders.

Definitions used throughout the IECC are found in Chapter 2. The definitions contained within the IECC are intended to reflect the special meaning of such terms within the scope of the code. As terms can often have multiple meanings in their ordinary day-to-day use or within the various disciplines of the construction industry, it is important that their meanings be understood within the context of the IECC. ■

C103.1

Digital Plans

C103.2

Information on Construction Documents

C202

Definition of Biogas and Biomass

C202

Definitions of Fan Efficiencies

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C103.1

Digital Plans

CHANGE TYPE: Clarification

CHANGE SUMMARY: Provisions related to energy code documentation clarify that construction documents and supporting data may be submitted digitally.

2021 CODE: **C103.1 General.** Construction documents and other supporting data shall be submitted in one or more sets, or in a digital format where allowed by the building official, with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the code official is authorized to require necessary construction documents to be prepared by a registered design professional.

> **Exception:** The code official is authorized to waive the requirements for construction documents or other supporting data if the code official determines they are not necessary to confirm compliance with this code.

CHANGE SIGNIFICANCE: This provision was first drafted when blueprints were the standard, and construction plans and documentation were submitted on paper. As more jurisdictions move to an online, digital submittal process, the construction documents provisions proved confusing because the requirement for "one or more sets" implied to some that paper copies are still required. This code change clarifies that the code official may choose to accept digital submittals in lieu of paper documentation. The digital format facilitates a comprehensive electronic permitting, plan review and inspection system, and includes these benefits:

- Streamlined online submittals, payments, reviews and inspection scheduling
- Standardized building site information
- Readily available project status and information
- Real-time inspection results from the field.



Photo courtesy of SolStock

Plans may be submitted digitally.

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C103.2

Information on Construction Documents

CHANGE TYPE: Modification

CHANGE SUMMARY: The information required on the construction documents has been expanded to include an indication of the energy compliance path used and additional air barrier details.

2021 CODE: **C103.2 Information on construction documents.** Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of daylight zones on floor plans.
13. Air ~~sealing details~~.barrier and air sealing details, including the location of the air barrier.

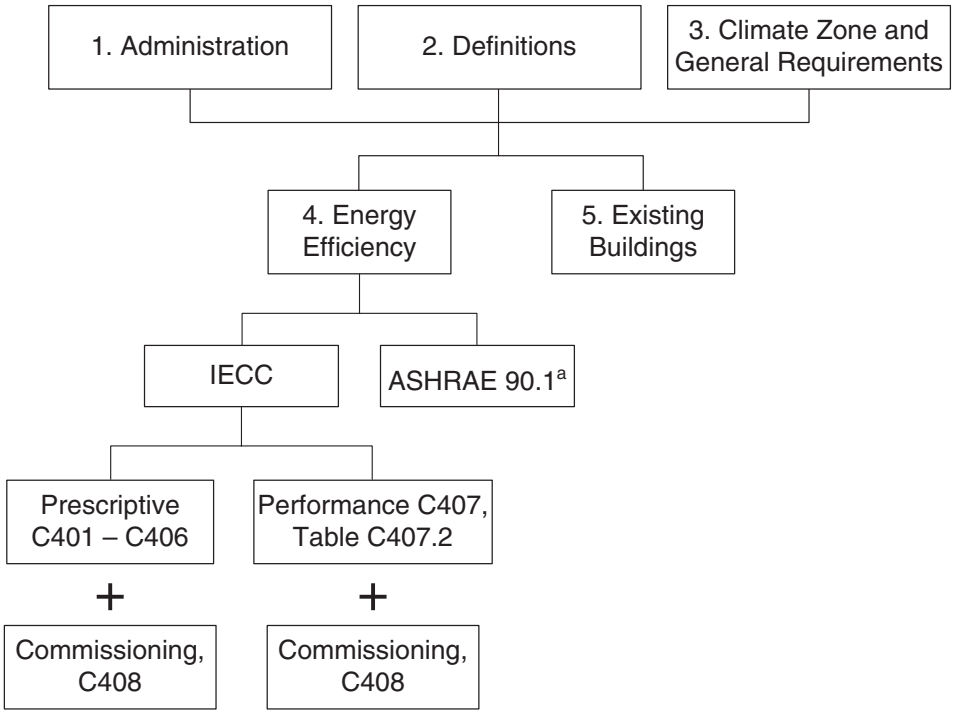
CHANGE SIGNIFICANCE: Two additions were made to the information required on construction documents to aid in plan review and inspection. The first is the identification of the compliance path. This information is essential for the plan reviewer to determine if the project demonstrates compliance with the specific energy requirements. When this information is not provided on the construction documents and plans examiners are required to investigate, the review process is lengthened. This extension may be in the form of a review comment or the time it takes to retrieve the information by email or phone. Providing the energy code compliance path details at submittal allows the plans examiner to review the plans according to the intended energy compliance path the architect/designer chose for the project.

Additionally, the requirement for air sealing documentation is clarified, providing all parties involved a clear understanding of what is required and, thus, what is to be reviewed and inspected.

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a. ANSI/ASHRAE/IES Standard 90.1-2019

Energy compliance path must be noted on construction documents.

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C202

Definition of Biogas and Biomass

CHANGE TYPE: Addition

CHANGE SUMMARY: Definitions for biogas, biomass and renewable energy resources are introduced and the definition of on-site renewable energy is clarified.

2021 CODE: **BIOGAS.** A mixture of hydrocarbons that is a gas at 60°F (15.5°C) and 1 atmosphere of pressure that is produced through the anaerobic digestion of organic matter.

BIOMASS. Nonfossilized and biodegradable organic material originating from plants, animals and/or micro-organisms, including products, by-products, residues and waste from agriculture, forestry and related industries as well as the nonfossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of nonfossilized and biodegradable organic material.

ON-SITE RENEWABLE ENERGY. Energy ~~derived~~ from renewable energy resources harvested at the building project site. ~~solar radiation, wind, waves, tides, landfill gas, biogas, biomass or the internal heat of the earth. The energy system providing onsite renewable energy shall be located on the project site.~~

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or extracted from hot fluid or steam heated within the earth.

CHANGE SIGNIFICANCE: The definition of on-site renewable energy was first introduced in the 2012 IECC. When it was written in 2010, it was the first time that renewable energy had been defined in an I-code,



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Biomass is a form of renewable energy.

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and it reflected a very early understanding of the industry. The definition had not been significantly revised until the 2021 IECC clarified that the resources must be harvested at the project site to be considered on-site renewable energy.

A new definition for renewable energy resources delineates exactly what constitutes a renewable energy resource and includes both biogas and biomass. The definition for biomass sources is limited to those that meet specifications as waste products, as defined in the glossary of the Energy Information Administration. There are many types of biomass energy and this definition ensures that virgin material of unknown origin is not used as a steady source of energy. Collectively, these new and revised definitions support the provisions in Section C406 for on-site renewable energy, which are covered in Part 3 of this text.

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C202

Definitions of Fan Efficiencies

CHANGE TYPE: Addition

CHANGE SUMMARY: New definitions related to fans introduce and support the Fan Energy Index, which replaces the Fan Efficiency Grade metric and aligns the IECC more closely with the fan requirements in ASHRAE 90.1.

2021 CODE: **FAN, EMBEDDED.** A fan that is part of a manufactured assembly where the assembly includes functions other than air movement.

FAN ARRAY. Multiple fans in parallel between two plenum sections in an air distribution system.

FAN ENERGY INDEX (FEI). The ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated in accordance with AMCA 208.

FAN NAMEPLATE ELECTRICAL INPUT POWER. The nominal electrical input power rating stamped on a fan assembly nameplate.

FAN SYSTEM ELECTRICAL INPUT POWER. The sum of the fan electrical power of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces and/or return it to the source or exhaust it to the outdoors.



Photo courtesy of AMCA international, Nordroden/bigstock.com

The Fan Energy Index replaces the Fan Efficiency Grade.

CHANGE SIGNIFICANCE: The Fan Energy Index (FEI) is defined as a ratio of the electrical input power of a reference fan (FEPref) to the electrical input power of the actual fan (FEPact) for which the FEI is calculated. The reference fan concept is used to normalize the FEI calculation to a consistent power level independent of fan type, fan drive components or any regulatory requirements. FEPact is the fan electrical input power associated with a given fan duty point in terms of airflow and pressure. There are slightly different FEI equations for fans rated using total pressure and those rated using static pressure. An FEI value less than 1.0 indicates that the fan does not meet the efficiency level being analyzed, while a value greater than 1.0 indicates that the fan is more efficient than the efficiency level being analyzed.

Replacing the Fan Efficiency Grade (FEG) metric with the FEI results in a more effective energy savings metric. The FEI was developed in response to the U.S. Department of Energy (DOE) rulemaking for commercial fans and blowers in which a wire-to-air metric was deemed to be more effective at saving energy because it would consider the impacts of motors and drives on fan energy performance.

The use of the FEI also aligns with updates in ASHRAE 90.1-2019, with the significant difference being that the IECC requires FEI ratings be determined in accordance with AMCA 208 by an approved, independent testing laboratory and labeled by the manufacturer.

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PART 2

Commercial Energy Provisions: General Requirements

Chapter 3

Chapter 3 General Requirements

Chapter 3 provides the foundational requirements for the provisions in Chapters 4 and 5.

Climate zone designations in Chapter 3 are used as a reference for the building envelope and mechanical provisions that are climate-specific. The code establishes many requirements, such as wall and roof insulation *R*-values and window and door thermal transmittance (*U*-factors), that affect the mechanical systems based on the climate where the building is located.

In addition, Chapter 3 provides interior design conditions that are used as a basis for assumptions in heating and cooling load calculations and provides the basic material requirements for insulation and fenestration. The requirements for labeling and product rating are also provided; these are foundational to the envelope requirements of Chapter 4. Finally, Chapter 3 provides specifications for insulation installation that help ensure the effectiveness of the insulation.

C301.3

Climate Zone Definitions

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C301.3

Climate Zone Definitions

CHANGE TYPE: Modification

CHANGE SUMMARY: The climate zone provisions have been comprehensively updated and include a new Climate Zone 0. Ten percent of U.S. counties are now in a new climate zone.

2021 CODE TEXT: **C301.3 ~~International climate zones~~ Climate zone definitions.** ~~The climate zone for any location outside the United States shall be determined by applying Table C301.3(1) and then Table C301.3(2).~~ To determine the climate zones for locations not listed in this code, use the following information to determine climate zone numbers and letters in accordance with Items 1 through 5.

1. Determine the thermal climate zone, 0 through 8, from Table C301.3 using the heating (HDD) and cooling degree-days (CDD) for the location.
2. Determine the moisture zone (Marine, Dry or Humid) in accordance with Items 2.1 through 2.3.
   - 2.1. If monthly average temperature and precipitation data are available, use the Marine, Dry, and Humid definitions to determine the moisture zone (C, B or A).
   - 2.2. If annual average temperature information (including degree-days) and annual precipitation (i.e., annual mean) are available, use Items 2.2.1 through 2.2.3 to determine the moisture zone. If the moisture zone is not Marine, then use the Dry definition below to determine whether Dry or Humid.
     - 2.2.1. If thermal climate zone is 3 and CDD50°F ≤ 4,500 (CDD10°C ≤2500), climate zone is Marine (3C).
     - 2.2.2. If thermal climate zone is 4 and CDD50°F ≤ 2,700 (CDD10°C ≤ 1500), climate zone is Marine (4C).
     - 2.2.3. If thermal climate zone is 5 and CDD50°F ≤ 1,800 (CDD10°C ≤ 1000), climate zone is Marine (5C).



Photo courtesy of Daniel Schnherr / EyeEm/Getty Images



Photo courtesy of kolderal/Moment/ Getty Images

The IECC provisions are climate-specific.

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2.3. If only degree-day information is available, use Items 2.3.1 through 2.3.3 to determine the moisture zone. If the moisture zone is not Marine, then it is not possible to assign Humid or Dry moisture zone for this location.

2.3.1. If thermal climate zone is 3 and CDD50°F ≤ 4,500 (CDD10°C ≤ 2500), climate zone is Marine (3C).

2.3.2. If thermal climate zone is 4 and CDD50°F ≤ 2,700 (CDD10°C ≤ 1500), climate zone is Marine (4C).

2.3.3. If thermal climate zone is 5 and CDD50°F ≤ 1,800 (CDD10°C ≤ 1000), climate zone is Marine (5C).

3. Marine (C) Zone definition: Locations meeting all the criteria in Items 3.1 through 3.4.

3.1. Mean temperature of coldest month between 27°F (–3°C) and 65°F (18°C).

3.2. Warmest month mean < 72°F (22°C).

3.3. Not fewer than four months with mean temperatures over 50°F (10°C).

3.4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

4. Dry (B) definition: Locations meeting the criteria in Items 4.1 through 4.4.

4.1. Not Marine (C).

4.2. If 70 percent or more of the precipitation, P, occurs during the high sun period, defined as April through September in the Northern Hemisphere and October through March in the Southern Hemisphere, then the dry/humid threshold is in accordance with Equation 3-1.

$$P < 0.44 \times (T - 7)$$

$$[P < 20.0 \times (T + 14) \text{ in SI units}] \qquad \text{(Equation 3-1)}$$

where:

P = Annual precipitation, inches (mm).
T = Annual mean temperature, °F (°C).

4.3. If between 30 and 70 percent of the precipitation, P, occurs during the high sun period, defined as April through September in the Northern Hemisphere and October through March in the Southern Hemisphere, then the dry/humid threshold is in accordance with Equation 3-2.

$$P < 0.44 \times (T - 19.5)$$

$$[P < 20.0 \times (T + 7) \text{ in SI units}] \qquad \text{(Equation 3-2)}$$

where:

P = Annual precipitation, inches (mm).

T = Annual mean temperature, °F (°C).

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4.4. If 30 percent or less of the precipitation, P, occurs during the high sun period, defined as April through September in the Northern Hemisphere and October through March in the Southern Hemisphere, then the dry/humid threshold is in accordance with Equation 3-3.

$P < 0.44 \times (T - 32)$

[$P < 20 \times T$ in SI units] (Equation 3-3)

where:

P = Annual precipitation, inches (mm).

T = Annual mean temperature, °F (°C).

5. Humid (A) definition: Locations that are not Marine (C) or Dry (B).

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TABLE C301.1 Climate Zones, Moisture Regimes, and Warm Humid Designations by State, County and Territory[a]

US STATES

ALABAMA
~~3A~~ 2A Coffee*
~~3A~~ 2A Covington*
~~3A~~ 2A Dale*
~~3A~~ 2A Escambia*
~~3A~~ 2A Geneva*
~~3A~~ 2A Henry*
~~3A~~ 2A Houston*

ALASKA
~~8~~ 7 Bethel
~~7~~ 8 Denali
~~8~~ 7 Dillingham
~~7~~ 6A Haines
~~7~~ 6A Juneau
~~7~~ 5C Ketchikan Gateway
~~7~~ 6A Kodiak Island
~~7~~ 5C Prince of Wales Outer Ketchikan
~~7~~ 5C Sitka
~~7~~ 6A Skagway-Hoonah-Angoon
~~7~~ 6A Wrangell-Petersburg

ARIZONA

ARKANSAS

CALIFORNIA

COLORADO
~~5B~~ 4B Bent
~~6B~~ 5B Custer
~~5B~~ 4B Prowers

CONNECTICUT

DELAWARE

DISTRICT OF COLUMBIA

FLORIDA
~~2A~~ 1A Palm Beach*

GEORGIA
~~4A~~ 3A Banks
~~3A~~ 2A Calhoun*
~~4A~~ 3A Catoosa
~~4A~~ 3A Chattooga
~~3A~~ 2A Coffee*
~~4A~~ 3A Dade
~~4A~~ 3A Dawson
~~3A~~ 2A Dougherty*
~~3A~~ 2A Early*
~~4A~~ 3A Fannin
~~4A~~ 3A Floyd
~~4A~~ 3A Franklin
~~4A~~ 3A Gilmer
~~4A~~ 3A Gordon
~~4A~~ 3A Habersham
~~4A~~ 3A Hall
~~4A~~ 3A Lumpkin
~~4A~~ 3A Murray
~~4A~~ 3A Pickens
~~4A~~ 3A Rabun
~~4A~~ 3A Stephens
~~3A~~ 2A Tift*
~~4A~~ 3A Towns
~~4A~~ 3A Union
~~4A~~ 3A Walker
~~4A~~ 3A White
~~4A~~ 3A Whitfield
~~3A~~ 2A Worth*

HAWAII

IDAHO

ILLINOIS
~~5A~~ 4A Calhoun
~~5A~~ 4A Clark
~~5A~~ 4A Coles
~~5A~~ 4A Cumberland
~~5A~~ 4A Greene
~~5A~~ 4A Jersey

INDIANA
~~5A~~ 4A Bartholomew
~~5A~~ 4A Clay
~~5A~~ 4A Decatur
~~5A~~ 4A Fayette
~~5A~~ 4A Franklin
~~5A~~ 4A Hendricks
~~5A~~ 4A Johnson
~~5A~~ 4A Marion
~~5A~~ 4A Morgan
~~5A~~ 4A Owen
~~5A~~ 4A Putnam
~~5A~~ 4A Rush
~~5A~~ 4A Shelby
~~5A~~ 4A Union
~~5A~~ 4A Vigo

IOWA
~~6A~~ 5A Allamakee
~~6A~~ 5A Bremer
~~6A~~ 5A Buchanan
~~6A~~ 5A Buena Vista
~~6A~~ 5A Butler
~~6A~~ 5A Calhoun
~~6A~~ 5A Cherokee
~~6A~~ 5A Chickasaw
~~6A~~ 5A Clayton
~~6A~~ 5A Delaware
~~6A~~ 5A Fayette
~~6A~~ 5A Floyd
~~6A~~ 5A Franklin
~~6A~~ 5A Grundy
~~6A~~ 5A Hamilton
~~6A~~ 5A Hardin
~~6A~~ 5A Howard
~~6A~~ 5A Humboldt
~~6A~~ 5A Ida
~~6A~~ 5A Plymouth
~~6A~~ 5A Pocahontas
~~6A~~ 5A Sac
~~6A~~ 5A Webster
~~6A~~ 5A Winneshiek
~~6A~~ 5A Wright

KANSAS
~~5A~~ 4A Cloud
~~5A~~ 4A Ellis
~~5A~~ 4A Graham
~~5A~~ 4A Hamilton
~~5A~~ 4A Lane
~~5A~~ 4A Mitchell
~~5A~~ 4A Ness
~~5A~~ 4A Osborne
~~5A~~ 4A Rooks
~~5A~~ 4A Trego

(*continued*)

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TABLE C301.1 (*continued*)

KENTUCKY

LOUISIANA

MAINE

MARYLAND
~~4A~~ 5A Allegany

MASSACHUSETTS

MICHIGAN
~~7~~ 6A Baraga
~~7~~ 6A Chippewa
~~7~~ 6A Gogebic
~~7~~ 6A Houghton
~~6A~~ 5A Huron
~~7~~ 6A Iron
~~7~~ 6A Luce
~~7~~ 6A Mackinac
~~6A~~ 7 Marquette
~~7~~ 6A Ontonagon
~~6A~~ 5A Sanilac
~~7~~ 6A Schoolcraft

MINNESOTA
~~7~~ 6A Becker
~~7~~ 6A Clay
~~6A~~ 5A Fillmore
~~7~~ 6A Grant
~~6A~~ 5A Houston
~~7~~ 6A Kanabec
~~7~~ 6A Mille Lacs
~~7~~ 6A Otter Tail
~~7~~ 6A Wilkin
~~6A~~ 5A Winona

MISSISSIPPI
~~3A~~ 2A George*

MISSOURI
~~5A~~ 4A Buchanan
~~5A~~ 4A Caldwell
~~5A~~ 4A Chariton
~~5A~~ 4A Clinton
~~4A~~ 3A Dunklin
~~4A~~ 3A Pemiscot

MONTANA

NEBRASKA

NEVADA
~~5B~~ 4B Carson City (city)
~~5B~~ 4B Douglas
~~5B~~ 4B Esmeralda
~~5B~~ 4B Lincoln
~~5B~~ 4B Lyon
~~5B~~ 4B Mineral
~~5B~~ 4B Nye

NEW HAMPSHIRE
~~6A~~ 5A Merrimack

NEW JERSEY
~~5A~~ 4A Mercer

NEW MEXICO
~~5B~~ 4B Catron
~~4B~~ 3B Sierra

NEW YORK
~~6A~~ 5A Allegany
~~6A~~ 5A Broome
~~6A~~ 5A Cattaraugus
~~6A~~ 5A Schoharie
~~6A~~ 5A Schuyler
~~6A~~ 5A Steuben
~~6A~~ 5A Tompkins
~~6A~~ 5A Wyoming

NORTH CAROLINA
~~4A~~ 3A Alamance
~~4A~~ 3A Alexander
~~4A~~ 3A Bertie
~~4A~~ 3A Caswell
~~4A~~ 3A Catawba
~~4A~~ 3A Chatham
~~4A~~ 3A Cherokee
~~4A~~ 3A Clay
~~4A~~ 3A Cleveland
~~4A~~ 3A Davie
~~4A~~ 3A Durham
~~4A~~ 3A Forsyth
~~4A~~ 3A Franklin
~~4A~~ 3A Gates
~~4A~~ 3A Granville
~~4A~~ 3A Guilford
~~4A~~ 3A Halifax
~~4A~~ 3A Harnett
~~4A~~ 3A Hertford
~~4A~~ 3A Iredell
~~4A~~ 3A Lee
~~4A~~ 3A Lincoln
~~5A~~ 4A Mitchell
~~4A~~ 3A Nash
~~4A~~ 3A Northampton
~~4A~~ 3A Orange
~~4A~~ 3A Person
~~4A~~ 3A Polk
~~4A~~ 3A Rockingham
~~4A~~ 3A Rutherford
~~4A~~ 3A Vance
~~4A~~ 3A Wake
~~4A~~ 3A Warren
~~4A~~ 3A Wilkes

NORTH DAKOTA
~~7~~ 6A Barnes
~~7~~ 6A Cass
~~7~~ 6A Eddy
~~7~~ 6A Foster
~~7~~ 6A Griggs
~~7~~ 6A Kidder
~~7~~ 6A McLean
~~7~~ 6A Mountrail
~~7~~ 6A Sheridan
~~7~~ 6A Steele
~~7~~ 6A Stutsman
~~7~~ 6A Traill
~~7~~ 6A Wells
~~7~~ 6A Williams

OHIO
~~5A~~ 4A Athens
~~5A~~ 4A Butler
~~5A~~ 4A Clinton
~~5A~~ 4A Fayette
~~5A~~ 4A Franklin
~~5A~~ 4A Greene
~~5A~~ 4A Highland
~~5A~~ 4A Hocking
~~5A~~ 4A Jackson
~~5A~~ 4A Madison
~~5A~~ 4A Meigs
~~5A~~ 4A Pickaway
~~5A~~ 4A Ross
~~5A~~ 4A Vinton
~~5A~~ 4A Warren

OKLAHOMA
~~3A~~ 4A Alfalfa
~~3A~~ 4A Craig
~~3A~~ 4A Delaware
~~3A~~ 4A Ellis
~~3A~~ 4A Garfield
~~3A~~ 4A Grant
~~3A~~ 4A Harper
~~3A~~ 4A Kay
~~3A~~ 4A Major

(*continued*)

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TABLE C301.1 (*continued*)

~~3A~~ 4A Nowata
~~3A~~ 4A Osage
~~3A~~ 4A Ottawa
~~3A~~ 4A Washington
~~3A~~ 4A Woods
~~3A~~ 4A Woodward

OREGON

PENNSYLVANIA
~~5A~~ 4A Adams
~~5A~~ 4A Berks
~~6A~~ 5A Cameron
~~6A~~ 5A Clearfield
~~5A~~ 4A Cumberland
~~5A~~ 4A Dauphin
~~6A~~ 5A Elk
~~5A~~ 4A Franklin
~~5A~~ 4A Lancaster
~~5A~~ 4A Lebanon
~~6A~~ 5A McKean
~~5A~~ 4A Perry
~~6A~~ 5A Potter
~~6A~~ 5A Susquehanna
~~6A~~ 5A Tioga
~~6A~~ 5A Wayne

RHODE ISLAND

SOUTH CAROLINA
~~3A~~ 2A Beaufort*
~~3A~~ 2A Jasper*

SOUTH DAKOTA
~~6A~~ 5A Brule
~~6A~~ 5A Haakon
~~6A~~ 5A Jones
~~6A~~ 5A Lyman
~~6A~~ 5A Stanley

TENNESSEE
~~4A~~ 3A Bedford
~~4A~~ 3A Coffee
~~4A~~ 3A Davidson
~~4A~~ 3A Decatur
~~4A~~ 3A Franklin
~~4A~~ 3A Gibson
~~4A~~ 3A Giles
~~4A~~ 3A Grundy
~~4A~~ 3A Hamilton
~~4A~~ 3A Hickman
~~3A~~ 4A Lake
~~4A~~ 3A Lawrence
~~4A~~ 3A Lewis
~~4A~~ 3A Lincoln
~~4A~~ 3A Marion
~~4A~~ 3A Marshall
~~4A~~ 3A Maury
~~4A~~ 3A Moore
~~4A~~ 3A Perry
~~4A~~ 3A Rutherford
~~4A~~ 3A Wayne
~~4A~~ 3A Williamson

TEXAS
~~2A~~ 1A Cameron*
~~3A~~ 2A Dallas*
~~3A~~ 2A Ellis*
~~2A~~ 1A Hidalgo*
~~3A~~ 2A Johnson*
~~3A~~ 2A Navarro*
~~3A~~ 2A Tarrant*
~~2A~~ 1A Willacy*

UTAH
~~6B~~ 5B Box Elder
~~6B~~ 5B Cache
~~6B~~ 5B Carbon

VERMONT

VIRGINIA
4A (all except as follows:)
5A Alleghany
5A Bath
3A Brunswick
3A Chesapeake
5A Clifton Forge
5A Covington
3A Emporia
3A Franklin
3A Greensville
3A Halifax
3A Hampton
5A Highland
3A Isle of Wight
3A Mecklenburg
3A Newport News
3A Norfolk
3A Pittsylvania
3A Portsmouth
3A South Boston
3A Southampton
3A Suffolk
3A Surry
3A Sussex
3A Virginia Beach

WASHINGTON
~~4C~~ 5C Clallam
~~4C~~ 5C Island
~~4C~~ 5C Kitsap
~~6B~~ 5B Okanogan
~~4C~~ 5C San Juan

WEST VIRGINIA
~~5A~~ 4A Doddridge
~~5A~~ 4A Fayette
~~5A~~ 4A Greenbrier
~~5A~~ 4A Lewis
~~5A~~ 4A Nicholas
~~5A~~ 4A Raleigh
~~5A~~ 4A Summers
~~5A~~ 4A Upshur
~~5A~~ 4A Webster

WISCONSIN
~~6A~~ 5A Adams
~~7~~ 6A Ashland
~~7~~ 6A Bayfield
~~7~~ 6A Burnett
~~6A~~ 5A Calumet
~~6A~~ 5A Columbia
~~6A~~ 5A Crawford
~~6A~~ 5A Dane
~~6A~~ 5A Dodge
~~7~~ 6A Douglas
~~7~~ 6A Florence
~~6A~~ 5A Fond du Lac
~~7~~ 6A Forest
~~6A~~ 5A Grant
~~6A~~ 5A Green
~~6A~~ 5A Green Lake
~~6A~~ 5A Iowa
~~7~~ 6A Iron
~~6A~~ 5A Jefferson
~~6A~~ 5A Juneau
~~6A~~ 5A Kenosha
~~6A~~ 5A La Crosse
~~6A~~ 5A Lafayette
~~7~~ 6A Langlade
~~7~~ 6A Lincoln
~~6A~~ 5A Milwaukee
~~6A~~ 5A Monroe
~~7~~ 6A Oneida

(*continued*)

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TABLE C301.1 (*continued*)

~~6A~~ 5A Outagamie
~~6A~~ 5A Ozaukee
~~7~~ 6A Price
~~6A~~ 5A Racine
~~6A~~ 5A Richland
~~6A~~ 5A Rock
~~6A~~ 5A Sauk
~~7~~ 6A Sawyer
~~7~~ 6A Taylor
~~6A~~ 5A Vernon
~~7~~ 6A Vilas
~~6A~~ 5A Walworth
~~7~~ 6A Washburn
~~6A~~ 5A Washington
~~6A~~ 5A Waukesha
~~6A~~ 5A Waushara
~~6A~~ 5A Winnebago

WYOMING
~~6B~~ 5B Laramie

US TERRITORIES
AMERICAN SAMOA

GUAM

NORTHERN MARIANA ISLANDS

PUERTO RICO
1A (all except as follows:)*
2B Barraquitas
2B Cayey

VIRGIN ISLANDS

a. Key: A – Moist, B – Dry, C – Marine. Absence of moisture designation indicates moisture regime is irrelevant.
Asterisk (*) indicates a Warm Humid location.
Note: Only counties assigned a new climate zone are shown here. Please refer to Table C301.1 for the full list of counties.

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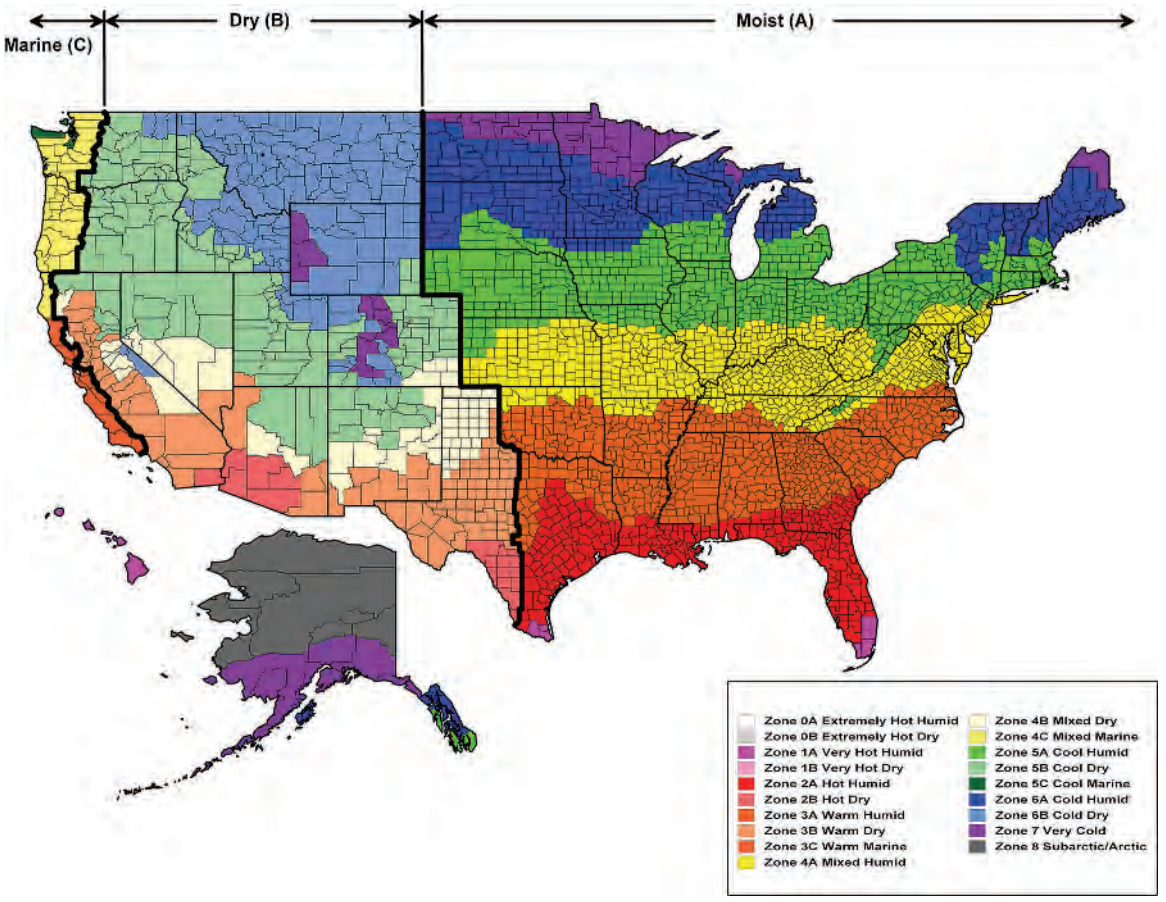


Figure C301.1 Climate Zones.

~~TABLE C301.3(1) International Climate Zone Definitions~~

~~MAJOR CLIMATE TYPE DEFINITIONS~~
~~**Marine (C) Definition—Locations meeting all four criteria:**~~ ~~**1. Mean temperature of coldest month between –3°C (27°F) and 18°C (65°F).**~~ ~~**2. Warmest month mean < 22°C (72°F).**~~ ~~**3. At least four months with mean temperatures over 10°C (50°F).**~~ ~~**4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.**~~
~~**Dry (B) Definition—Locations meeting the following criteria:**~~ ~~**Not marine and $P_{in} < 0.44 \times (TF - 19.5)$ [$P_{cm} < 2.0 \times (TC + 7)$ in SI units]**~~ ~~**where:**~~ ~~**P_{in} = Annual precipitation in inches (cm)**~~ ~~**T = Annual mean temperature in °F (°C)**~~
~~**Moist (A) Definition—Locations that are not marine and not dry.**~~
~~**Warm-humid Definition—Moist (A) locations where either of the following wet-bulb temperature conditions shall occur during the warmest**~~ ~~**six consecutive months of the year:**~~ ~~**1. 67°F (19.4°C) or higher for 3,000 or more hours; or**~~ ~~**2. 73°F (22.8°C) or higher for 1,500 or more hours.**~~

~~For SI: °C = [(°F) – 32]/1.8, 1 inch = 2.54 cm.~~

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TABLE ~~C301.3(2)~~ C301.3 Thermal Climate Zone Definitions

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
0	10,800 < CDD50°F	6000 < CDD10°C
1	9,000 < CDD50°F ≤ 10,800	5000 < CDD10°C ≤ 6000
2	6,300 < CDD50°F ≤ 9,000	3500 < CDD10°C ≤ 5000
~~3A and 3B~~ 3	~~4,500 <~~ CDD50°F ≤ 6,300 AND HDD65°F ≤ ~~5,400~~ 3,600	CDD10°C < 3500 AND HDD18°C ≤ ~~3000~~ 2000
~~4A and 4B~~ 4	CDD50°F ≤ ~~4,500~~ 6,300 AND 3,600 < HDD65°F ≤ 5,400	CDD10°C < ~~2500~~ 3500 AND 2000 < HDD18°C ≤ 3000
~~3C~~	~~HDD65°F ≤ 3,600~~	~~HDD18°C ≤ 2000~~
~~4C~~	~~3,600 < HDD65°F ≤ 5,400~~	~~2000 < HDD18°C ≤ 3000~~
5	CDD50°F < 6,300 AND 5,400 < HDD65°F ≤ 7,200	CDD10°C < 3500 AND 3000 < HDD18°C ≤ 4000
6	7,200 < HDD65°F ≤ 9,000	4000 < HDD18°C ≤ 5000
7	9,000 < HDD65°F ≤ 12,600	5000 < HDD18°C ≤ 7000
8	12,600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F)-32]/1.8.

CHANGE SIGNIFICANCE: The climate zone provisions in Chapter 3, from Section C301.3 through the climate zone tables and map, have undergone a significant update. This update corresponds with ASHRAE Standard 169-2013, which is referenced in the 2018 International Green Construction Code® (IgCC®), ANSI/ASHRAE/IES Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1) and ANSI/ASHRAE/IES Standard 90.2 – Energy-Efficient Design of Low-Rise Residential Buildings (ASHRAE 90.2). ICC has a licensing agreement with ASHRAE to include the climate zone map, definitions and tables for consistency with ASHRAE Standard 169 and other key codes and standards.

These two key updates are relevant to most code users:

- Updates to the climate zone designations in Table C301.1 for approximately 10 percent of the counties in the United States. In general, the counties were assigned a warmer climate zone.
- Updates to Figure C301.1, the climate zone map, to reflect the changes in county climate zone designations.

The number of climate zones increased to include Climate Zone 0, representing the hottest of climates. Climate Zone 0 is a subset of the previous Climate Zone (CZ) 1, which included all locations with more than 9,000 Cooling Degree Days (CDDs). Climate Zone 1 now tops out at 10,800 CDDs, and Climate Zone 0 includes those locations with more than that. Cities in Climate Zone 0 include extremely hot locations such as Mumbai (Bombay), Jakarta and Abu Dhabi. There are no cities in the United States in Climate Zone 0; Miami and the islands of Hawaii are in Climate Zone 1. Several code changes introduce specific provisions for

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Climate Zone 0. Because Climate Zone 0 is a subset of the former Climate Zone 1, most references throughout the IECC to CZ 1 have been edited to CZ 0 and 1.

Code users needing to calculate the moisture zone (marine, dry or humid) will find Section C301.3 entirely revised. Calculations are in three categories: (a) when monthly average temperature and precipitation data are available, (b) when annual average temperature, degree days and precipitation are available, and (c) when only degree day information is available.

C301.3(1) has been eliminated and C301.3(2) renumbered to C301.3. Section C301.3 now includes Climate Zone 0 and the revised heating and cooling degree day thresholds for climate zones. Table C301.3 Thermal Climate Zone Definitions has also been revised to include CZ 0 and the adjusted degree days for other climate zones.

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PART 3

Commercial Energy Provisions: Energy Efficiency Requirements



Chapters 4 and 5

- **Chapter 4** Commercial Energy Efficiency
- **Chapter 5** Existing Buildings
  No changes addressed

Chapters 4 and 5 of the *International Energy Conservation Code* (IECC) contain the bulk of the design and construction requirements for commercial buildings and residential buildings greater than three stories in height above grade. Chapter 4 includes provisions for the entire building, including the building envelope and mechanical, service water heating and electrical power and lighting systems. It also includes required additional efficiency packages, an alternative performance compliance path and commissioning requirements. The provisions in Chapter 4 address the portions of the building and building systems that impact energy use and promote the effective use of energy.

Chapter 5 addresses construction of existing buildings – additions, alterations and changes to occupancy – correlating to the requirements of Chapter 4. ■

C401.2
Compliance Paths

C401.3
Envelope Certificate

TABLE C402.1.3
Minimum *R*-values

TABLE C402.1.4
Insulation and Fenestration *U*-Factor Criteria

C402.1.4.1 AND C402.2.1
Roof Insulation and Assembly

TABLE C402.4
U-Factor and SHGC Requirements

C402.5
Air Leakage

C402.5.11
Operable Openings Interlocking

C403
Building Mechanical Systems

C403.4.2.3
Automatic Start and Stop

C403.8.3
Fan Efficiency

C403.8.5
Low-Capacity Ventilation Fans

C405
Electrical Power and Lighting Systems

C405.2.1.2
Occupant Sensor Controls in Warehouse Storage Areas

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C405.2.8
Parking Garage Lighting Control

C405.4
Lighting for Plant Growth

C405.11
Automatic Receptacle Control

C405.12
Energy Monitoring

C406
Additional Efficiency Requirements

C407
Total Building Performance

C407.2
Performance-Based Compliance

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C401.2
Compliance Paths

CHANGE TYPE: Modification

CHANGE SUMMARY: Compliance path options for the commercial provisions of the IECC are named and the sections required for each option are outlined.

2021 CODE: **C401.2 Application.** Commercial buildings shall comply with Section C401.2.1 or C401.2.2. ~~one of the following~~:

~~The requirements of ANSI/ASHRAE/IESNA 90.1.~~

~~The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.~~

~~The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.~~

C401.2.1 International Energy Conservation Code. Commercial buildings shall comply with one of the following:

1. Prescriptive Compliance. The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings without systems serving multiple units shall be deemed to be in compliance with this chapter provided that they comply with Section R406.
2. Total Building Performance. The Total Building Performance option requires compliance with Section C407.

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.



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Commercial projects may comply with the IECC or ASHRAE 90.1.

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C401.2.2 ASHRAE 90.1. Commercial buildings shall comply with the requirements of ANSI/ASHRAE/IES 90.1.

CHANGE SIGNIFICANCE: Since the 2009 IECC, Section C401.2 has included three options for compliance with the energy code: two IECC compliance options and ASHRAE 90.1. The two IECC options were not named within the code but have commonly been referred to as the prescriptive and performance compliance paths. In the 2012 IECC, the performance compliance option in Section C401.2 required the building energy cost to be less than or equal to 85 percent of the standard reference design. Yet in Section C407, the requirement for the performance path was to have an annual energy cost less than or equal to the annual energy cost of the standard reference design, which led to some confusion among code users.

Section C401.2 has been revised to clarify compliance paths, eliminate conflicting requirements and move existing building requirements to Chapter 5. The IECC compliance options are now named Prescriptive and Total Building Performance, which formalizes the way in which the paths are typically identified and adds clarity for training, education and new code users. Each path is clearly identified as an option, a term that reinforces that it is the designer's choice as to which path is followed. Finally, this change further clarifies that one cannot combine the IECC and ASHRAE compliance paths on a given project.

The list of "mandatory" requirements is eliminated, reducing conflicts with information in Section C407 for Total Building Performance. This corresponds to the creation of a project requirements table in Section C407 and the elimination of the terms *prescriptive* and *mandatory* in provision titles throughout Chapter 4. All requirements associated with the Total Building Performance path are now located in Section C407, increasing usability for those selecting the performance option of the IECC.

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C401.3
Envelope Certificate

CHANGE TYPE: Addition

CHANGE SUMMARY: A requirement for the completion of a thermal envelope certificate, which serves as a permanent record of the envelope components installed in the building, is introduced.

2021 CODE: **C401.3 Thermal envelope certificate.** A permanent thermal envelope certificate shall be completed by an approved party. Such certificate shall be posted on a wall in the space where the space conditioning equipment is located, a utility room or other approved location. If located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. A copy of the certificate shall also be included in the construction files for the project. The certificate shall include the following:

1. *R*-values of insulation installed in or on ceilings, roofs, walls, foundations and slabs, basement walls, crawl space walls and floors and ducts outside conditioned spaces.

Energy Efficiency Certificate

Code edition	
Compliance path	

Insulation Rating		***R* -Value**		***R* -Value**
Ceiling/Roof		*R*-		*R*-
Walls	**Frame**	*R*-	**Mass**	*R*-
	Basement	*R*-	**Crawl space**	*R*-
Floors	**Over unconditioned space**	*R*-	**Slab edge**	*R*-
Ducts	**Attic**	*R*-	**Other**	*R*-

Air Leakage Test Results

Envelope testing ____ **ACH** _____ **Pa.** **Duct testing** ____ **cfm/100 ft²**

Fenestration Rating	**NFRC U-Factor**	**NFRC SHGC**
Window	*U*-	
Opaque door	*U*-	
Skylight	*U*-	
Weighted average	*U*-	

Designer/builder ____ **Date** ____

This Certificate is to be posted in accordance with Section C401.3 of the International Energy Conservation Code.

Sample thermal envelope certificate.

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2. *U*-factors and solar heat gain coefficients (SHGCs) of fenestrations.
3. Results from any building envelope air leakage testing performed on the building.

Where there is more than one value for any component of the building envelope, the certificate shall indicate the area-weighted average value where available. If the area-weighted average is not available, the certificate shall list each value that applies to 10 percent or more of the total component area.

CHANGE SIGNIFICANCE: The addition of C401.3 completes the general requirements of Chapter 4. The new language provides for a permanent certificate for commercial buildings that will record basic information related to the building's thermal envelope. This will complement the information required in Section C408 related to the documentation of mechanical and lighting systems. The certificate requirement is simplified to cover only the basic elements of the thermal envelope, similar to the requirement for residential buildings in Section R401.3, which has been in the IECC since at least the 2006 edition and has been successfully integrated into software programs such as RES*check*.

The information contained in this certificate, while readily available at construction, is often lost as the building ages and ownership is transferred. As future owners or lessors undertake load calculations for HVAC sizing or other measures that require a working knowledge of the building's thermal envelope characteristics, this information will be important. Recording the information in a permanent manner at an approved location in the building, as well as including documentation in the construction files for the project, provides the needed information for future alterations and additions to the building.

This new provision is applicable to both IECC compliance paths.

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C402
Building Envelope

Section C402 provides building thermal envelope provisions for commercial buildings, including limitations on air infiltration, or air leakage. The building envelope is important to building energy efficiency. When it is cold outside, heat loss and air leakage through the building envelope add to the heating load. On hot days, solar gains through windows, heat gain through opaque assemblies and the infiltration of hot or humid air contribute to the cooling load. The requirements of Section C402 are intended to reduce these heat gains and losses through the building envelope. Increased envelope efficiency also reduces the initial cost of the mechanical system when the heating and cooling loads of a building are adequately sized, which in turn decreases ongoing heating and cooling related utility costs. Additionally, envelope efficiency contributes to the resiliency of a building; for example, a tight building envelope maintains habitable temperatures for longer periods during power outages.

The commercial envelope provisions have seen few significant changes since the 2012 IECC. Changes to the 2021 IECC are intended to reduce energy use, the single largest operating expense in commercial buildings, representing approximately one-third of typical operating budgets.

These significant changes to the building envelope are addressed in the following sections:

- Increased insulation requirements
- Clarifying language for roof and ceiling assembly insulation
- Reduced fenestration *U*-factors and solar heat gain coefficients (SHGCs), and the elimination of orientation as a factor in these values
- Expanded air leakage requirements
- New operable openings interlocking requirements



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Efficient building envelopes contribute to the resiliency of the building.

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Table C402.1.3

Minimum *R*-Values

CHANGE TYPE: Modification

CHANGE SUMMARY: The minimum *R*-values in Table C402.1.3 are increased to improve the efficiency of the building envelope and to align with ASHRAE 90.1.

2021 CODE: Table C402.1.3

CHANGE SIGNIFICANCE: The *R*-values for many roof, wall and floor components have been increased in Climate Zones 4 through 8 to align with the values in ASHRAE 90.1. These updated *R*-values were deemed cost effective by the ASHRAE envelope committee.

In addition to increased insulation requirements throughout the table, notable changes for Climate Zones 0 through 3 include the addition of R-13 insulation for framed floors in Climate Zones 0 and 1 aligning with the corresponding *U*-factor in Table C402.1.4, and the new R-10 continuous insulation requirement for unheated slabs in Climate Zone 3 Group R buildings. The increased *R*-values reduce tradeoff flexibility for commercial buildings using the Total Building Performance compliance option of Section C407.

Finally, doors have been removed from this table and are listed solely in Table C402.1.4. The proponents of this change based it on cost data gathered from industry partners and thermal performance data from ASHRAE research. The performance of doors is more accurately reflected using *U*-factors, and the industry is moving toward assembly *U*-factors rather than *R*-values for doors.

Table C402.1.3 is shown on the following page. Please refer to the code text for tablenotes and footnotes as these are an integral part of this table. This table is applicable to the Prescriptive Compliance option only.



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R-Value is used to measure thermal resistance of insulation.

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TABLE C402.1.3 Opaque Thermal Envelope Insulation Component Minimum Requirements, *R*-Value Method

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings[b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	~~R-25 + R-11 LS~~ R-30 + R11 LS	R-30 + R-11 LS	R-30 + R-11 LS	~~R-30 + R-11 LS~~ R-25 + R11+R11 LS	~~R-30 + R-11 LS~~ R-25 + R11+R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	~~R-38~~ R-49	~~R-38~~ R-49	~~R-38~~ R-49	R-49	R-49	R-49	~~R-49~~ R-60	~~R-49~~ R-60	~~R-49~~ R-60	~~R-49~~ R-60
Walls, above grade																
Mass[f]	R-5.7ci[c]	R-5.7ci[c]	R-5.7ci[c]	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	~~R-13 + R-13ci~~ R-13+R-14 ci	~~R-13 + R-13ci~~ R-13+R-14 ci	~~R-13 + R-13ci~~ R-13+R-14 ci	~~R-13 + R-13ci~~ R-13+R-14 ci	~~R-13 + R-13ci~~ R-13+R-14 ci	~~R-13 + R-13ci~~ R-13+R-17ci	R-13+ R-19.5ci	~~R-13 + R-13ci~~ R-13+R-19.5ci	R-13+ R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	~~R-13 + R-7.5ci~~ R-13+R-10ci	~~R-13 + R-7.5ci~~ R-13+R-10ci	~~R-13 + R-7.5ci~~ R-13+R-12.5ci	~~R-13 + R-7.5ci~~ R-13+R-12.5ci	~~R-13 + R-7.5ci~~ R-13+R-12.5ci	R-13 + R-15.6ci	~~R-13 + R-7.5ci~~ R-13+R-18.8ci	~~R-13+ R17.5ci~~ R-13+R-18.8ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	~~R-13 + R-3.8ci or R-20~~ R-13+R-7.5ci or R-20+R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13+R18.8ci	~~R13 + R-15.6ci or R-20 + R-10ci~~ R-13+R18.8ci
Walls, below grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	~~R-7.5ci~~ R-10ci	R-7.5ci	~~R-7.5ci~~ R-10ci	~~R-7.5ci~~ R-10ci	~~R-7.5ci~~ R-15ci	~~R-10ci~~ R-15ci	~~R-10ci~~ R-15ci	~~R-10ci~~ R-15ci	~~R-12.5ci~~ R-15ci
Floors																
Mass[e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	~~R-10ci~~ R-14.6ci	~~R-10.4ci~~ R-16.7ci	~~R-10ci~~ R-14.6ci	~~R-12.5ci~~ R-16.7ci	~~R-12.5ci~~ R-16.7ci	~~R-12.5ci~~ R-16.7ci	~~R-15ci~~ R-20.9ci	~~R-16.7ci~~ R20.9ci	~~R-15ci~~ R-23ci	~~R-16.7ci~~ R-23ci
Joist/framing	~~NR~~ R-13	~~NR~~ R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	~~R-30~~ R-38	~~R-30[f]~~ R-38	~~R-30[f]~~ R-38	~~R-30[f]~~ R-38	~~R-30[f]~~ R-38	~~R-30[f]~~ R-38
Slab-on-grade floors																
Unheated slabs[g]	NR	NR	NR	NR	NR	~~NR~~ R-10 for 24" below	~~R-10 for 24" below~~ R-15 for 24" below	~~R-10 for 24" below~~ R-15 for 24" below	~~R-10 for 24" below~~ R-15 for 24" below	~~R-10 for 24² below~~ R-20 for 24" below	~~R-10 for 24" below~~ R-20 for 24" below	~~R-15 for 24" below~~ R-20 for 48" below	R-15 for 24" below R-20 for 24" below	~~R-15 for 24" below~~ R-20 for 48" below	~~R-15 for 24" below~~ R-20 for 48" below	~~R-20 for 24" below~~ R-25 for 48" below
Heated slabs[h]	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab
~~**Opaque doors**~~																
~~Nonswinging~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~	~~R-4.75~~

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Table C402.1.4

Insulation and Fenestration *U*-Factor Criteria

CHANGE TYPE: Modification

CHANGE SUMMARY: The *U*-factor requirements in Table C402.1.4 are decreased to improve the efficiency of the building envelope and to align with ASHRAE 90.1.

2021 CODE: Table C402.1.4

CHANGE SIGNIFICANCE: The assembly *U*-factors for many roof, wall and floor assemblies have been decreased in Climate Zones 4 through 8 to align with the values in ASHRAE 90.1. These assemblies were deemed cost effective by the ASHRAE envelope committee.

Previously, the *F*-factors for heated slabs in Table C402.1.4 were incorrectly shown as two separate factors for the two insulation components; this has been corrected in the 2021 IECC and now only one *F*-factor is shown. *F*-factors are like *U*-factors in that they represent the net effect of all insulation materials applied to an assembly, and there should only be one *F*-factor representing the *R*-value of the insulation materials used on the slab construction.

As with the changes to Table C402.1.3, the change to maximum *U*-factors reduces tradeoff flexibility for commercial buildings using the Total Building Performance compliance option of Section C407.

Finally, all door *U*-factor values are consolidated into this table. The proponents of this change based it on cost data gathered from industry partners and thermal performance data from ASHRAE research. The performance of doors is more accurately reflected using *U*-factors, and the industry is moving toward assembly *U*-factors rather than *R*-values for doors.

This table is applicable to the Prescriptive Compliance option only.



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U-factor is used to measure thermal transmittance of fenestration and envelope assemblies.

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TABLE C402.1.4 Opaque Thermal Envelope Assembly Maximum Requirements, *U*-Factor Method[a,b]

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	~~U-0.044~~ U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	~~U-0.031~~ U-0.029	U-0.029	U-0.029	~~U-0.029~~ U-0.026	~~U-0.029~~ U-0.026
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	~~U-0.027~~ U-0.021	~~U-0.027~~ U-0.021	~~U-0.027~~ U-0.021	U-0.021	U-0.021	U-0.021	~~U-0.021~~ U-0.017	~~U-0.021~~ U-0.017	~~U-0.021~~ U-0.017	~~U-0.021~~ U-0.017
Walls, above grade																
Mass[g]	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	~~U-0.061~~ U-0.037	~~U-0.061~~ U-0.037
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.050	~~U-0.052~~ U-0.044	U-0.039	~~U-0.052~~ U-0.039	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	~~U-0.064~~ U-0.055	~~U-0.064~~ U-0.055	~~U-0.064~~ U-0.049	~~U-0.064~~ U-0.049	~~U-0.064~~ U-0.049	~~U-0.052~~ U-0.042	~~U-0.064~~ U-0.037	~~U-0.045~~ U-0.037
Wood framed and other[c]	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	~~U-0.064~~ U-0.051	~~U-0.064~~ U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	~~U-0.036~~ U-0.032	~~U-0.036~~ U-0.032
Walls, below grade																
Below-grade wall[c]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-0.119	~~C-0.119~~ C-0.092	C-0.119	~~C-0.119~~ C-0.092	~~C-0.119~~ C-0.092	~~C-0.119~~ C-0.063	~~C-0.092~~ C-0.063	~~C-0.092~~ C-0.063	~~C-0.092~~ C-0.063	~~C-0.092~~ C-0.063
Floors																
Mass[d]	U-0.322[e]	U-0.322[e]	U-0.107	U-0.087	~~U-0.076~~ U-0.074	~~U-0.076~~ U-0.074	~~U-0.076~~ U-0.057	~~U-0.074~~ U-0.051	~~U-0.074~~ U-0.057	~~U-0.064~~ U-0.051	~~U-0.064~~ U-0.051	~~U-0.064~~ U-0.051	~~U-0.055~~ U-0.042	~~U-0.051~~ U-0.042	~~U-0.055~~ U-0.038	~~U-0.051~~ U-0.038
Joist/framing	U-0.066[e]	U-0.066[e]	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	~~U-0.033~~ U-0.027	~~U-0.033~~ U-0.027	~~U-0.033~~ U-0.027	~~U-0.033~~ U-0.027	~~U-0.033~~ U-0.027	~~U-0.033~~ U-0.027

(*Continued*)

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TABLE C402.1.4 (*Continued*)

CLIMATE ZONE	0-1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Slab-on-grade floors																
Unheated slabs	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.73[e]	~~F-0.73~~ F-0.54	~~F-0.54~~ F-0.52	~~F-0.54~~ F-0.52	~~F-0.54~~ F-0.52	~~F-0.54~~ F-0.51	~~F-0.54~~ F-0.51	~~F-0.52~~ F-0.434	~~F-0.40~~ F-0.51	~~F-0.40~~ F-0.434	~~F-0.40~~ F-0.434	~~F-0.40~~ F-0.424
Heated slabs[f]	~~F-1.02 0.74~~ F-0.69	~~F-1.02 0.74~~ F-0.69	~~F-1.02 0.74~~ F-0.69	~~F-1.02 0.74~~ F-0.69	~~F-0.90 0.74~~ F-0.66	~~F-0.90 0.74~~ F-0.66	~~F-0.86 0.64~~ F-0.62	~~F-0.86 0.64~~ F-0.62	~~F-0.79 0.64~~ F-0.62	~~F-0.79 0.64~~ F-0.62	~~F-0.79 0.55~~ F-0.62	~~F-0.69 0.55~~ F-0.602	~~F-0.69 0.55~~ F-0.602	~~F-0.69 0.55~~ F-0.602	~~F-0.69 0.55~~ F-0.602	~~F-0.69 0.55~~ F-0.602
Opaque doors																
Nonswinging door	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31
Swinging door[g]	~~U-0.61~~ U-0.37	~~U-0.61~~ U-0.37	~~U-0.61~~ U-0.37	~~U-0.61~~ U-0.37	~~U-0.61~~ U-0.37	~~U-0.61~~ U-0.37	~~U-0.61~~ U-0.37	~~U-0.61~~ U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing[h]	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous Insulation, NR = No Requirement, LS = Liner System.

a. Where assembly *U*-factors, *C*-factors and *F*-factors are established in ANSI/ASHRAE/IES 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/IES 90.1 Appendix A.

b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.

c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.

d. "Mass floors" shall be in accordance with Section C402.2.3.

e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.

~~f. The first value is for perimeter insulation and the second value is for full, **under-slab** insulation.~~

f. "Mass walls" shall be in accordance with Section C402.2.2.

g. Swinging door *U*-factors shall be determined in accordance with NFRC-100.

h. Garage doors having a single row of fenestration shall have an assembly *U*-factor less than or equal to 0.44 in Climate Zones 0 through 6 and less than or equal to 0.36 in Climate Zones 7 and 8, provided that the fenestration area is not less than 14 percent and not more than 25 percent of the total door area.

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C402.1.4.1 and C402.2.1

Roof Assembly and Insulation

CHANGE TYPE: Modification

CHANGE SUMMARY: Roof insulation requirements are clarified and separated for compliance with either the *U*-factor or *R*-value method in Sections C402.1.4.1 and C402.2.1.

2021 CODE: **C402.1.4.1 Roof/ceiling assembly.** The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on construction materials used in the roof/ceiling assembly.

C402.1.4.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *U*-factor compliance as prescribed in Section C402.1.4.

C402.1.4.1.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling construction.

C402.1.4.1.3 Joints staggered. Continuous insulation board shall be installed in not less than two layers, and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

C402.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly. ~~Insulation installed on a suspended ceiling having removable ceiling tiles shall not be considered~~



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Roof insulation may comply with the *R*-value or *U*-factor method.

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~~as part of the minimum thermal resistance of the roof insulation. Continuous insulation board shall be installed in not less than 2 layers and the edge joints between each layer of insulation shall be staggered.~~

~~Exceptions:~~

1. ~~Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U*-factor is equivalent to the same assembly with the *R*-value specified in Table C402.1.3.~~
2. ~~Where tapered insulation is used with insulation entirely above deck, the *R*-value where the insulation thickness varies 1 inch (25 mm) or less from the minimum thickness of tapered insulation shall comply with the *R*-value specified in Table C402.1.3.~~
3. ~~Two layers of insulation are not required where insulation tapers to the roof deck, such as at roof drains.~~

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *R*-value compliance as prescribed in Section 402.1.3.

C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).

C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation in roof/ceiling construction.

C402.2.1.4 Joints staggered. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

CHANGE SIGNIFICANCE: The area-weighted average *U*-factor option in lieu of *R*-value compliance for roofs was introduced in the 2006 IECC, and the next code cycle brought forth the equivalent *U*-factor option most users are now accustomed to. However, changes to the 2018 IECC language resulted in confusion as to the application of weighted averages, minimum insulation thickness and exceptions associated with area-weighted *U*-factors under *R*-value requirements.

The 2021 IECC provisions provide clarity on roof/ceiling assembly requirements as they relate to *U*-factors and *R*-values. The new Section C402.1.4.1 includes provisions for roof/ceiling assemblies using a *U*-factor approach, while the new subsections of Section C402.2.1 include provisions for roof/ceiling assemblies using the *R*-value approach. The changes support improved application and enforcement of roof/ceiling assembly insulation requirements.

These sections are only applicable to the Prescriptive Compliance option.

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Table C402.4

U-Factor and SHGC Requirements

CHANGE TYPE: Modification

CHANGE SUMMARY: Changes to the *U*-factor and SHGC requirements in Table C402.4 increase the energy efficiency of windows, doors and skylights, and the table is revised to classify SHGC on the operable/fixed properties of the fenestration rather than orientation.

2021 CODE: Table C402.4

CHANGE SIGNIFICANCE: Commercial fenestration *U*-factors remained unchanged between the 2012 and 2018 versions of the IECC. SHGC values decreased slightly between versions, and the 2015 IECC saw the return of orientation as a component of SHGC. Within the 2021 IECC is a widespread reduction in fenestration *U*-factors and SHGCs, and orientation is once again eliminated as a factor for SHGC in the Prescriptive Compliance path.

The changes were analyzed by Pacific Northwest National Laboratory (PNNL) to determine what performance levels showed positive life cycle energy savings. Depending on the climate zone, *U*-factors are reduced by 0 to 14 percent for fixed and operable vertical fenestration, 7 to 25 percent for entrance doors and 0 to 18 percent for skylights; SHGC requirements for vertical fenestration and skylights are similarly reduced by 0 to 14 percent.

The elimination of orientation from the table simplifies compliance with and enforcement of the prescriptive fenestration SHGC requirements in the IECC for architects, designers and code officials by adopting a "fixed" and "operable" approach to setting SHGC requirements, rather than determining the orientation of each fenestration product in the building.

The projection factor adjustments are retained but modified to correspond with the new "fixed" and "operable" distinction. Analysis by PNNL indicated these changes result in energy savings and peak demand savings in every climate zone, and, in many cases, reduce the size of cooling equipment. The revision also brings greater consistency between IECC and ASHRAE 90.1 SHGC requirements.

Table C402.4 only applies to the Prescriptive Compliance option. To the extent that design professionals want to factor orientation into a more sophisticated design strategy, the Section C407 Total Building Performance compliance path can be used.



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U-Factor and SHGC requirements indicate heat transmittance of fenestration.

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TABLE C402.4 Building Envelope Fenestration Maximum *U*-Factor and SHGC Requirements

CLIMATE ZONE	0 AND 1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
***U*-factor**								
Fixed fenestration	0.50	~~0.50~~ 0.45	~~0.46~~ 0.42	~~0.38~~ 0.36	~~0.38~~ 0.36	~~0.36~~ 0.34	0.29	~~0.29~~ 0.26
Operable fenestration	~~0.65~~ 0.62	~~0.65~~ 0.60	~~0.60~~ 0.54	0.45	0.45	~~0.43~~ 0.42	~~0.37~~ 0.36	~~0.37~~ 0.32
Entrance doors	~~1.10~~ 0.83	~~0.83~~ 0.77	~~0.77~~ 0.68	~~0.77~~ 0.63	~~0.77~~ 0.63	~~0.77~~ 0.63	~~0.77~~ 0.63	~~0.77~~ 0.63
SHGC								
~~Orientation~~[a]	~~SEW~~ Fixed	~~N~~ Operable	~~SEW~~ Fixed	~~N~~ Operable	~~SEW~~ Fixed	~~N~~ Operable	~~SEW~~ Fixed	~~N~~ Operable	~~SEW~~ Fixed	~~N~~ Operable	~~SEW~~ Fixed	~~N~~ Operable	~~SEW~~ Fixed	~~N~~ Operable	~~SEW~~ Fixed	~~N~~ Operable
PF < 0.2	~~0.25~~ 0.23	~~0.33~~ 0.21	0.25	~~0.33~~ 0.23	0.25	~~0.33~~ 0.23	0.36	~~0.48~~ 0.33	0.38	~~0.51~~ 0.33	~~0.40~~ 0.38	~~0.53~~ 0.34	~~0.45~~ 0.40	~~NR~~ 0.36	~~0.45~~ 0.40	~~N~~ 0.36
0.2 ≤ PF < 0.5	~~0.30~~ 0.28	~~0.37~~ 0.25	0.30	~~0.37~~ 0.28	0.30	~~0.37~~ 0.28	0.43	~~0.53~~ 0.40	0.46	~~0.56~~ 0.40	~~0.48~~ 0.46	~~0.58~~ 0.41	NR 0.48	~~NR~~ 0.43	~~NR~~ 0.48	~~NR~~ 0.43
PF ≥ 0.5	~~0.40~~ 0.37	~~0.40~~ 0.34	0.40	~~0.40~~ 0.37	0.40	~~0.40~~ 0.37	0.58	~~0.58~~ 0.53	0.61	~~0.61~~ 0.53	~~0.64~~ 0.61	~~0.64~~ 0.54	NR 0.64	NR 0.58	NR 0.64	NR 0.58
Skylights								
U-factor	~~0.75~~ 0.70	0.65	0.55	0.50	0.50	0.50	~~0.50~~ 0.44	~~0.50~~ 0.41
SHGC	~~0.35~~ 0.30	~~0.35~~ 0.30	~~0.35~~ 0.30	0.40	0.40	0.40	NR	NR

NR = No Requirement, PF = Projection Factor.

a. ~~"N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.~~

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C402.5
Air Leakage

CHANGE TYPE: Modification

CHANGE SUMMARY: In Section C402.5, air leakage requirements are expanded to include requirements for residential and nonresidential air leakage testing and for building envelope performance verification for buildings not tested.

2021 CODE: C402.5 Air leakage—thermal envelope ~~(Mandatory).~~ The building thermal envelope ~~of buildings~~ shall comply with Sections C402.5.1 through C402.5.11.1, or the building thermal envelope shall be tested in accordance with Section C402.5.2 or C402.5.3. ~~ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (2.0 L/s · m²).~~ Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9.

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The continuous air barriers shall ~~be permitted to~~ be located on the inside or outside of the building thermal envelope, located within the assemblies composing the building thermal envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1 and C402.5.1.2.

Exception: Air barriers are not required in buildings located in Climate Zone 2B.

C402.5.1.1 Air barrier construction. The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.



Expanded air leakage provisions include testing requirements.

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2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
3. Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.
4. Recessed lighting fixtures shall comply with Section C402.5.10. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

C402.5.1.2 Air barrier compliance ~~options~~. A continuous air barrier for the opaque building envelope shall comply with ~~Section C402.5.1.2.1 or C402.5.1.2.2.~~ the following:

1. Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.

Exception: Buildings in Climate Zones 2B, 3C and 5C.

2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.

Exceptions:

1. Buildings in Climate Zones 2B, 3B, 3C and 5C.
2. Buildings larger than 5,000 square feet (464.5 m^2) floor area in Climate Zones 0B, 1, 2A, 4B and 4C.
3. Buildings between 5,000 square feet (464.5 m^2) and 50,000 square feet (4645 m^2) floor area in Climate Zones 0A, 3A and 5B.

3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

~~C402.5.1.2.1~~ C402.5.1.3 Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s × m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided that joints are sealed, and materials are installed as air barriers in accordance with the manufacturer's instructions.

1. Plywood with a thickness of not less than 3/8 inch (10 mm).
2. Oriented strand board having a thickness of not less than 3/8 inch (10 mm).

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3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch (12.7 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than 1/2 inch (12.7 mm).
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m^3) and having a thickness of not less than 11/2 inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) and having a thickness of not less than 4.5 inches (113 mm).
7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch (12.7 mm).
8. Cement board having a thickness of not less than 1/2 inch (12.7 mm).
9. Built-up roofing membrane.
10. Modified bituminous roof membrane.
11. ~~Fully adhered single-ply~~ Single-ply roof membrane.
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch (15.9 mm).
13. Cast-in-place and precast concrete.
14. Fully grouted concrete block masonry.
15. Sheet steel or aluminum.
16. Solid or hollow masonry constructed of clay or shale masonry units.

~~C402.5.1.2.2~~ C402.5.1.4 Assemblies. Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft^2 (0.2 L/s × m^2) under a pressure differential of 0.3 inch of water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM D8052 or ASTM E283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided that joints are sealed and the requirements of Section C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.
2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches (102 mm) or more.
3. A Portland cement/sand parge, stucco or plaster not less than 1/2 inch (12.7 mm) in thickness.

C402.5.1.5 Building envelope performance verification. The installation of the continuous air barrier shall be verified by the code official, a registered design professional or approved agency in accordance with the following:

- A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Sections C402.5.1.
- Inspection of continuous air barrier components and assemblies shall be conducted during construction while the air barrier is still accessible for inspection and repair to verify compliance with the requirements of Sections C402.5.1.3 and C402.5.1.4.
- A final commissioning report shall be provided for inspections completed by the registered design professional or approved agency. The commissioning report shall be provided to the building owner

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or owner's authorized agent and the code official. The report shall identify deficiencies found during the review of the construction documents and inspection and details of corrective measures taken.

C402.5.2 Dwelling and sleeping unit enclosure testing. The building thermal envelope shall be tested in accordance with ASTM E 779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.30 cfm/ft^2 (1.5 L/s × m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one building thermal envelope, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.
2. For buildings with eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of testing unit types and locations.

C402.5.3 Building thermal envelope testing The building thermal envelope shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.40 cfm/ft^2 (2.0 L/s × m^2) of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof.
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft^2 (2.0 L/s × m^2) but does not exceed 0.60 cfm/ft^2 (3.0 L/s × m^2), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

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CHANGE SIGNIFICANCE: Air leakage testing was introduced as a compliance alternative to meeting the material or assembly selection and installation provisions of the 2012 IECC, and the requirements remained largely unchanged until the expansion of requirements in the 2021 IECC. Three significant changes related to air leakage are made to the 2021 IECC:

1. New requirements for dwelling unit air leakage testing for Group R and I occupancies
2. Revised and required air leakage requirements for occupancies other than Group R and I
3. New performance verification requirements

Air leakage can be a significant source of energy waste in buildings, contributing to higher heating and cooling costs for building owners and occupants and impacting comfort and durability. Airtightness testing often results in increased attention to air barrier sealing and significantly reduced air leakage.

Adequate control over air leakage can provide many benefits, including reduced HVAC equipment sizing, better building pressurization and energy savings due to reduced heating and cooling of infiltrated outside air.

In moist climates, ensuring lower air leakage through whole building testing can also result in better humidity control and reduced risk of durability issues. Pacific Northwest National Laboratory's technical brief, titled, "Envelope Air Tightness for Commercial Buildings" notes:

> *While it is important that the materials and assemblies have limited leakage, that alone does not guarantee a low leakage building. Recent research*[1] *(Wiss 2014) shows that 40% of buildings constructed without an envelope consultant have air leakage exceeding the currently optional test standard requirements, while buildings with envelope consultants all had leakage below 0.25 cfm/ft². Testing is the most reliable means of ensuring that the intent of this code section—limiting unintended energy waste in buildings due to air infiltration—will be achieved.*

The updated air leakage testing requirements of Section C402.5 take into consideration occupancy type, climate zone and building size. Commercial buildings under 5,000 square feet can be tested using residential methods, technicians and equipment with the maximum leakage rate set at 0.30 cfm/ft² (1.5 L/s × m²) at 0.2 in. w.g. (50 Pa). This testing pressure differential is common for residential testing and is equivalent to a leakage rate of 0.40 cfm/ft² (1.5 L/s × m²) at 0.3 in. w.g. (75 Pa). Implementing the residential procedure can significantly reduce testing costs for these smaller buildings. Buildings that are not tested must meet the materials or assemblies requirements and the air barrier must be visually inspected. A final commissioning report is required for such inspections.

There are instances when the building is tested and it exceeds the maximum leakage rate. Section C402.5.3 provides reasonable options for mitigating air leakage when the rate is greater than allowed in the code but does not exceed 0.60 cfm/ft², including the use of a smoke tracer or infrared imaging along with a visual inspection. Leaks must be sealed where it is possible to do so without destroying building components. Documentation showing all leaks that were found and mitigating measures must be submitted to the code official and building owner.

These provisions are applicable to both IECC compliance paths.

1 Wiss J. 2014. *ASHRAE 1478-RP Measuring Airtightness of Mid- and High-Rise Non-Residential Buildings*. Elstner Associates, Inc. for ASHRAE. https://www.ashrae.org/resources--publications/periodicals/enewsletters/esociety/2014-12-10-articles/completed-research-december-2014.

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C402.5.11

Operable Openings Interlocking

CHANGE TYPE: Addition

CHANGE SUMMARY: Large, operable openings such as roll-up doors and windows must now be interlocked with the heating and cooling system.

2021 CODE: **C402.5.11 Operable openings interlocking.** Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet (3.7 m^2) in area, such openings shall be interlocked with the heating and cooling system so as to raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to 55°F (13°C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur within 10 minutes of opening the operable opening.

Exceptions:

1. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
2. Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.
3. The first entrance doors where located in the exterior wall and are part of a vestibule system.

C402.5.11.1 Operable controls. Controls shall comply with Section C403.14.

C403.14 Operable opening interlocking controls. The heating and cooling systems shall have controls that will interlock these mechanical systems to the set temperatures of 90°F (32°C) for cooling and 55°F (12.7°C) for heating when the conditions of Section C402.5.11 exist. The controls shall configure to shut off the systems entirely when the outdoor temperatures are below 90°F (32°C) or above 55°F (12.7°C).





Photo courtesy of Cushing Terrell Architects

Operable openings greater than 40 square feet require interlocking.

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CHANGE SIGNIFICANCE: A variety of occupancies, such as restaurants, bars and gyms, include large operable windows or roll-up, sliding or folding doors. This design feature is used for both ambience and with the intention of creating open spaces that take advantage of cross ventilation or wind for cooling and ventilation. Without controls, the cooling and heating systems for these spaces are still running, negatively impacting energy efficiency.

This new provision requires openings larger than 40 square feet to be interlocked with the heating and cooling system. The exceptions address very specific situations where this requirement would hinder the function of the space, such as separately zoned areas where food preparation areas contribute to the HVAC loads, warehouse doors and entrance doors that are part of a vestibule system.

The system is time and temperature specific, requiring system adjustments within ten minutes of opening. Required controls raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to 55°F (12.7°C) whenever the operable opening is open, and shut off the system when outdoor temperatures are between 90°F (32°C) and 55°F (12.7°C).

This new provision is applicable to both IECC compliance paths.

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C403

Building Mechanical Systems

Section C403 broadly addresses the efficiency, construction and operation of building mechanical systems. Federal regulation establishes energy efficiency standards for many consumer and commercial appliances under the Energy Policy and Conservation Act (EPCA). States are preempted from creating energy efficiency standards for appliances and equipment that are covered by federal law under the EPCA, 42 U.S.C. 6201, et seq.[2] Thus, the IECC includes both equipment efficiencies set by the U.S. Department of Energy (DOE) under the EPCA and efficiencies for equipment not covered under federal law. Additional efficiencies are derived from insulated and sealed delivery systems and controls.

The 2021 IECC Section C403 is divided into 14 parts:

- Sections C403.1 and C403.2 address general requirements that are applicable to all building cooling, heating and ventilation systems.
- Section C403.3 addresses efficiency requirements for building cooling, heating and ventilation equipment and appliances, turndown requirements for boiler systems and the limitations for hot gas bypass.
- Section C403.4 provides the control requirements for building cooling and heating systems, including hydronic systems controls.
- Section C403.5 addresses both air- and water-side economizer requirements.
- Section C403.6 includes provisions specific to multi-zone systems.
- Section C403.7 applies to building ventilation and exhaust systems.
- Section C403.8 provides efficiency and control requirements for fans.
- Section C403.9 references a standard new to the 2021 IECC for large-diameter ceiling fans.
- Section C403.10 provides requirements for heat rejection equipment.
- Section C403.11 applies to refrigerated warehouse coolers, refrigerated warehouse freezers, walk-in coolers, walk-in freezers and refrigerated display cases.
- Section C403.12 addresses ductwork construction, insulation and testing as well as piping insulation.
- Section C403.13 addresses mechanical systems that provide heat outside the building's thermal envelope.
- Section C403.14 introduces requirements for operable interlocking controls.

Significant changes to the building mechanical systems in the 2021 IECC include:

- Refined HVAC control requirements

2 For purposes of this document, EPCA refers the EPCA as amended and codified in 42 U.S.C. §§ 6201-6422. Since its enactment in 1975, EPCA has been amended by the National Energy Conservation Policy Act, Pub. L. No. 95-619, § 422, 92 Stat. 3206 (1978); the National Appliance Energy Conservation Act, Pub. L. No. 100-12, § 7, 101 Stat. 103 (1987); the Energy Policy Act of 1992, Pub. L. 102-486, §§ 121-28, 106 Stat. 2776 (1992); the Energy Policy Act of 2005, Pub. L. 109-58, §§ 135-36, 119 Stat. 594 (2005); Energy Independence and Security Act of 2007, Pub. L. 110-140, §§ 301-325, 121 Stat. 1492 (2007); and the American Energy Manufacturing Technical Corrections Act, Pub. L. 112-210, 126 Stat. 1514 (2012).

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Building mechanical systems are addressed in Section C403.

- Added requirements for low-capacity ventilation fans
- Updated fan efficiency requirements

The 2021 IECC also includes two new sections, Section C403.9 Large-diameter ceiling fans, which resulted in subsequent renumbering, and Section C403.14 Operable opening interlocking controls, described in the previous section.

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C403.4.2.3

Automatic Start and Stop

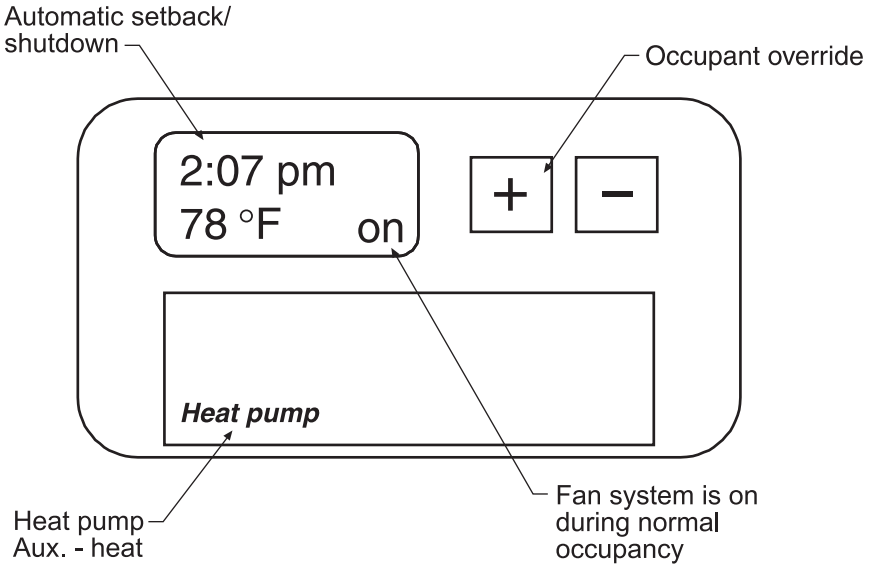
CHANGE TYPE: Modification

CHANGE SUMMARY: In addition to automatic start controls, HVAC systems with direct digital controls serving individual zones must have automatic stop controls.

2021 CODE: **C403.4.2.3 Automatic start and stop ~~(Mandatory).~~** Automatic start and stop controls shall be provided for each HVAC system. The automatic start controls shall be configured to automatically adjust the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. Automatic stop controls shall be provided for each HVAC system with direct digital control of individual zones. The automatic stop controls shall be configured to reduce the HVAC system's heating temperature setpoint and increase the cooling temperature setpoint by not less than 2°F (–16.6°C) before scheduled unoccupied periods based upon the thermal lag and acceptable drift in space temperature that is within comfort limits.

CHANGE SIGNIFICANCE: The 2018 IECC established requirements for automatic start controls. These controls automatically adjust the start time for warm up or cool down of the zone prior to occupancy so that the zone is at the appropriate temperature when it is scheduled to be occupied. Automatic stop controls, sometimes referred to as an optimum stop, are now required for HVAC systems with direct digital controls serving individual zones. The controls must be capable of decreasing the heating temperature setpoint by 2°F and increasing the cooling setpoint by 2°F for some time period before the scheduled unoccupied period where the temperature can drift within the comfort range using the adjusted setpoints. Typically this results in little heating or cooling for 30 to 60 minutes at the end of the occupied period.

This new provision is applicable to both IECC compliance paths.



Automatic start and stop are both required.

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C403.8.3
Fan Efficiency

CHANGE TYPE: Modification

CHANGE SUMMARY: The fan efficiency metric is updated to the Fan Energy Index, providing consistent fan efficiency requirements across the IECC and ASHRAE 90.1 and resulting in a more effective energy savings metric.

2021 CODE: **C403.8.3 Fan efficiency ~~(Mandatory)~~.** ~~Fans~~ Each fan and fan array shall have a fan ~~efficiency grade~~ energy index ~~(FEG)~~ (FEI) of not less than ~~67~~ 1.00 at the design point of operation, as determined in accordance with AMCA ~~205~~ 208 by an approved independent testing laboratory and labeled by the manufacturer. ~~The total efficiency of the fan~~ Each fan and fan array used for a variable-air-volume system shall have an FEI of not less than 0.95 at the design point of operation, ~~shall be within 15 percentage points of the maximum total efficiency of the fan.~~ as determined in accordance with AMCA 208 by an approved independent testing laboratory and labeled by the manufacturer. The FEI for fan arrays shall be calculated in accordance with AMCA 208 Annex C.

Exceptions: The following fans are not required to have a fan ~~efficiency grade~~: energy index:

1. Fans that are not embedded fans with motor nameplate horsepower of less than 1.0 hp (0.75 kW) or with a nameplate electrical input power of less than 0.89 kW.
2. Embedded fans that have~~1.Fans of 5 hp (3.7 kW) or less as follows:1.1.Individual fans with~~ a motor nameplate horsepower of 5 hp (3.7 kW) or less, ~~unless Exception 1.2 applies~~. or with a fan system electrical input power of 4.1 kW or less.
3. Multiple fans operated ~~1.2.Multiple fans~~ in series or parallel as the functional equivalent of a single fan that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less ~~and are operated as the functional equivalent of a single fan~~ or with a fan system electrical input power of 4.1 kW or less.
4. Fans that are part of equipment covered in Section C403.3.2.
5. Fans included in an equipment package certified by an approved agency for air or energy performance.
4. ~~Powered wall/roof ventilators.~~
5. ~~Fans outside the scope of AMCA 205.~~
6. Ceiling fans, which are defined as nonportable devices suspended from a ceiling or overhead structure for circulating air via the rotation of the blades.
7. Fans used for moving gases at temperatures above 425°F (250°C).
8. Fans used for operation in explosive atmospheres.
9. Reversible fans used for tunnel ventilation.
10. ~~6.~~ Fans that are intended to operate only during emergency conditions.
11. Fans outside the scope of AMCA 208.

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CHANGE SIGNIFICANCE: Supported by five new fan-related definitions – embedded fan, fan array, fan nameplate electrical input power, fan system electrical input power and Fan Energy Index (FEI) – this change applies a new fan energy metric, the FEI, to fans and fan arrays. The FEI is discussed in detail on page C-7 of this publication.

Key to the FEI is the reduction in the minimum covered fan size from 5 HP to 1 HP, which results in significant energy savings. Additionally, the FEI removes both the exemption for powered roof ventilators (PRVs) and the "sizing/selection window" of "15 percentage points from peak total efficiency." The inclusion of PRVs results in additional energy savings and the removal of the sizing/selection window makes the provision easier to enforce.

The inclusion of the FEI harmonizes the IECC with ASHRAE 90.1 and anticipated future federal regulations. The FEI was developed in response to the DOE rulemaking for commercial fans and blowers. The rulemaking is currently incomplete; however, updates to ASHRAE 90.1 and the IECC effectively apply the new metric. The FEI has been added to the DOE EnergyPlus software and to the DOE Fan System Assessment Tool.

The FEI does not apply to all fans; smaller fans, those that are part of equipment covered in Section C403.3.2 and other equipment packages, and ceiling fans are exempt, among others.

This new provision is applicable to both IECC compliance paths.

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C403.8.5

Low-Capacity Ventilation Fans

CHANGE TYPE: Addition

CHANGE SUMMARY: New requirements for low-capacity ventilation fans apply the efficiencies of ventilation fans typical of residential construction to mid-rise residential occupancies and small commercial buildings.

2021 CODE: **C403.8.5 Low-capacity ventilation fans.** Mechanical ventilation system fans with motors less than 1/12 hp (0.062 kW) in capacity shall meet the efficacy requirements of Table C403.8.5 at one or more rating points.

Exceptions:

1. Where ventilation fans are a component of a listed heating or cooling appliance.
2. Dryer exhaust duct power ventilators, domestic range hoods and domestic range booster fans that operate intermittently.

TABLE C403.8.5 Low-Capacity Ventilation Fan Efficacy[a]

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIRFLOW RATE MAXIMUM (CFM)
HRV or ERV	Any	1.2 cfm/watt	Any
In-line fan	Any	3.8 cfm/watt	Any
Bathroom, utility room	10	2.8 cfm/watt	< 90
Bathroom, utility room	90	3.5 cfm/watt	Any

For SI: 1 cfm/ft = 47.82 W.

a. Airflow shall be tested in accordance with HVI 916 and listed. Efficacy shall be listed or shall be derived from listed power and airflow. Fan efficacy for fully ducted HRV, ERV, balanced and in-line fans shall be determined at a static pressure not less than 0.2 inch w.c. Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure not less than 0.1 inch w.c.

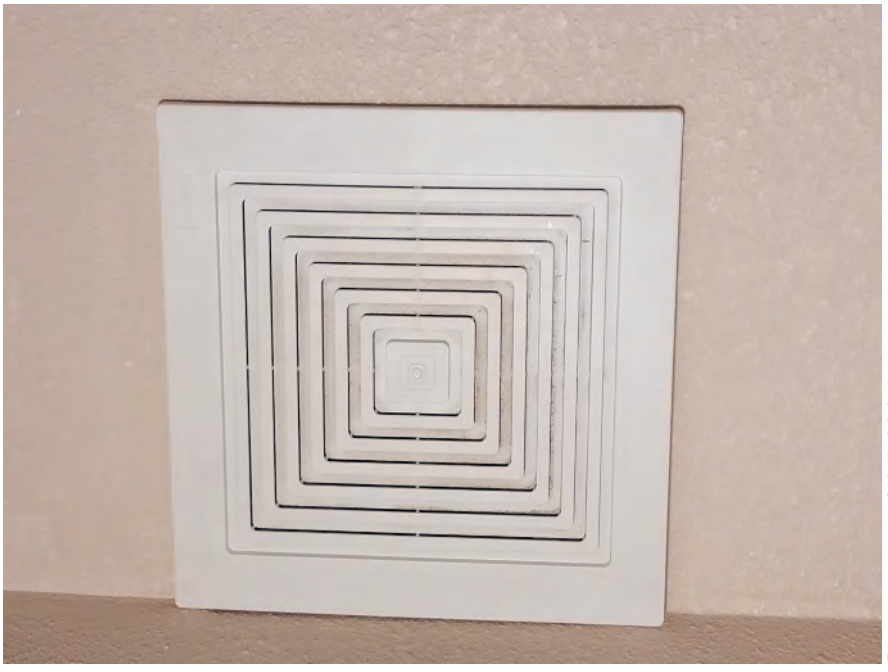


Photo courtesy of Kelly Makela

Low-capacity ventilation fans must meet efficiency requirements.

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CHANGE SIGNIFICANCE: Exhaust fan efficacies were introduced into the 2012 IECC for whole-house ventilation in low-rise residential buildings; however, these same requirements were not previously included in the commercial provisions of the IECC despite the application of such fans in some commercial projects. This change applies fan efficiency requirements typical of residential low-rise construction to the same small ventilation fans used in mid-rise residential occupancies and small commercial buildings.

Small ventilation fans are used for point-of-source contaminant exhaust and are frequently incorporated into the ventilation strategy for multiple-family buildings. Such fans are smaller than the threshold for fan size (1/12 hp) that is attached to the other commercial fan requirements.

This change adopts the table approach already utilized for these fans in the residential section of the code and updates the efficiency requirements.

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C405

Electrical Power and Lighting Systems

Lighting accounts for a significant amount of the energy consumption of a commercial building. Lighting fixtures have seen many advances in technology in recent years and new or improved lighting controls offer opportunities for saving energy without the need to change occupant behavior; together, lighting reductions are automatic and mostly unnoticed. Efficient lighting sources and controls maintain and may even improve interior and exterior illumination. Numerous studies suggest that daylighting improves employee satisfaction with working conditions and reduces absenteeism. Careful attention to lighting design and controls benefits building occupants and building owners.

The provisions in Section C405 apply to lighting systems in new buildings, additions, tenant finishes, alterations to existing lighting systems and any change in occupancy. Controls and minimum lamp efficiencies are required for interior and exterior lighting systems. Exceptions to the provisions include some historic buildings, the replacement of less than 10 percent of the existing interior luminaires and alterations that do not increase the required lighting power.

Significant changes to the electrical power and lighting systems provisions in the 2021 IECC include:

- Expansion and clarification of lighting control applications
- New provisions for plant growth lighting
- New provisions for automatic receptacle control
- New provisions for metering and monitoring

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C405.2.1.2

Occupant Sensor Controls in Warehouse Storage Areas

CHANGE TYPE: Clarification

CHANGE SUMMARY: Occupant sensor control functions are updated for warehouse storage areas in Section C405.2.1.2, providing further guidance on how occupant sensors should operate within warehouses.

2021 CODE: **C405.2.1.2 Occupant sensor control function in ~~warehouses~~ warehouse storage areas.** Lighting in warehouse storage areas shall be controlled as follows:

1. Lighting in each aisleway shall be controlled independently of lighting in all other aisleways and open areas.
2. Occupant sensors shall ~~In warehouses, the lighting in aisleways and open areas shall be controlled with occupant sensors that~~ automatically reduce lighting power within each controlled area to an unoccupied setpoint of not more ~~by not less~~ than 50 percent within 20 minutes after all occupants have left the controlled area. ~~when the areas are unoccupied.~~
3. Lights that are not turned off by occupant sensors shall be turned off by time-switch control complying with Section C405.2.2.1 ~~control lighting in each aisleway independently and shall not control lighting beyond the aisleway being controlled by the sensor.~~
4. A manual control shall be provided to allow occupants to turn off lights in the space.

CHANGE SIGNIFICANCE: The IECC provisions for occupancy sensor controls continue to evolve, providing further clarification for code users on the application of the technology. Warehouse spaces were added to the occupancy controls list of space types (Section C405.2.1) in the 2015 IECC, yet warehouses were excluded from the specific requirements of the main occupancy sensor control functions. Because of this, and the



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Occupant sensor controls are required in warehouse storage areas.

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unique control requirements, several considerations for how occupancy sensors should operate in the warehouse environment were overlooked or left out. This created confusion that is resolved with this change.

The revisions do not change the intent of the requirements. Instead, these clarifications reduce inconsistency and eliminate application and enforcement confusion associated with warehouse lighting controls. Similar to the enumerated items put into the 2018 IECC for open office plan spaces, this change enumerates how to apply lighting controls in warehouse storage area spaces as follows:

1. Item one simplifies language on independent control between aisleways and open areas.
2. Item two specifies the time delay or "time out" for occupants leaving the warehouse area and turning off or reducing the lighting is 20 minutes. This aligns with the time delay for all other occupancy sensor spaces (C405.2.1.1) and open-plan office spaces (405.2.1.3), and reduces lighting power.
3. Item three clarifies that the warehouse lighting must automatically turn off according to methods already presented in the code (occupancy sensor or time-switch controls) but leaves the choice of method to the building design professional.
4. Item four clarifies control is available for the end user to turn the lighting off.

This provision is applicable to both IECC compliance paths.

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C405.2.8

Parking Garage Lighting Control

CHANGE TYPE: Addition

CHANGE SUMMARY: A new provision for lighting in parking garages recognizes parking garages as a unique space and requires such spaces to have either occupant sensors or time-switch controls.

2021 CODE: **C405.2.8 Parking garage lighting control.** Parking garage lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. Additional lighting controls shall be provided as follows:

1. Lighting power of each luminaire shall be automatically reduced by not less than 30 percent when there is no activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be not larger than 3,600 square feet (334.5 m^2).

Exception: Lighting zones provided with less than 1.5 footcandles of illumination on the floor at the darkest point with all lights on are not required to have automatic light-reduction controls.

2. Where lighting for eye adaptation is provided at covered vehicle entrances and exits from buildings and parking structures, such lighting shall be separately controlled by a device that automatically reduces lighting power by at least 50 percent from sunset to sunrise.
3. The power to luminaires within 20 feet (6096 mm) of perimeter wall openings shall automatically reduce in response to daylight by at least 50 percent.

Exceptions:

1. Where the opening to-wall-ratio is less than 40 percent as viewed from the interior and encompassing the vertical distance from the driving surface to the lowest structural element.



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Parking garages must have lighting controls.

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2. Where the distance from the opening to any exterior daylight blocking obstruction is less than one-half the height from the bottom of the opening or fenestration to the top of the obstruction.
3. Where openings are obstructed by permanent screens or architectural elements restricting daylight entering the interior space.

CHANGE SIGNIFICANCE: This new control provision clarifies how to apply lighting requirements to parking garages. Previously, code users questioned whether parking garages should be treated as interior spaces, and, if so, how the control requirements applied to an area with different lighting needs than building interior spaces and how the daylight responsive controls of Section C405.2.4 applied.

This new provision recognizes parking garages as a unique space and provides explicit occupant lighting control requirements, daylight responsive control requirements and exceptions for lighting design in these spaces.

This provision is applicable to both IECC compliance paths.

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C405.4

Lighting for Plant Growth

CHANGE TYPE: Addition

CHANGE SUMMARY: A provision regulating lighting for plant growth and maintenance has been added to ensure indoor agriculture operations are energy efficient.

2021 CODE: **C405.4 Lighting for plant growth and maintenance.** Not less than 95 percent of the permanently installed luminaires used for plant growth and maintenance shall have a photon efficiency of not less than 1.6 µmol/J as defined in accordance with ANSI/ASABE S640.

CHANGE SIGNIFICANCE: Previous editions of the IECC have not addressed lighting requirements for indoor agriculture plant growth and maintenance, yet indoor growing operations are becoming increasingly common for both traditional farming crops and marijuana. Indoor agriculture energy usage is projected to grow substantially over the next several years due in part to the legalization of medicinal and recreational marijuana growth and sales. The Northwest Power and Conservation Council projects that indoor marijuana growing operations alone will add as much as 300 average megawatts by 2030. This is equivalent to 1.5 percent of total regional electricity demand. Other studies have shown that lighting for indoor agriculture has accounted for 45 percent of the electric load growth in some states.

This new provision and associated standard—ANSI/ASABE S640—require 95 percent of the lighting used for plant growth or maintenance to meet an efficiency metric of 1.6 µmol/J (micromoles per joule). The metric was developed in collaboration with the American Society of Agricultural and Biological Engineers specifically for lighting used for plant growth. It measures the number of photons emitted from the fixture per joule of energy consumed. This minimum photon efficiency is consistent with the Conservation Practice Standard Energy Efficient Lighting System Code 670 issued by the U.S. Department of Agriculture in January 2020.

This provision is applicable to both IECC compliance paths.



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Lighting for plant growth is regulated by the IECC.

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C405.11

Automatic Receptacle Control

CHANGE TYPE: Addition

CHANGE SUMMARY: New provisions require at least 50 percent of covered receptacles and 25 percent of branch circuit feeders to be automatically controlled receptacles.

2021 CODE: **C405.11 Automatic receptacle control.** The following shall have automatic receptacle control complying with Section C405.11.1:

1. At least 50 percent of all 125V, 15- and 20-amp receptacles installed in enclosed offices, conference rooms, rooms used primarily for copy or print functions, breakrooms, classrooms and individual workstations, including those installed in modular partitions and module office workstation systems.
2. At least 25 percent of branch circuit feeders installed for modular furniture not shown on the construction documents.

C405.11.1 Automatic receptacle control function. Automatic receptacle controls shall comply with the following:

1. Either split controlled receptacles shall be provided with the top receptacle controlled, or a controlled receptacle shall be located within 12 inches (304.8 mm) of each uncontrolled receptacle.
2. One of the following methods shall be used to provide control:
   - **2.1.** A scheduled basis using a time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be configured to provide an independent schedule for each portion of the building of not more



Controlled receptacles are now required.

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than 5,000 square feet (464.5 m^2) and not more than one floor. The occupant shall be able to manually override an area for not more than 2 hours. Any individual override switch shall control the receptacles of not more than 5,000 feet (1524 m).

2.2. An occupant sensor control that shall turn off receptacles within 20 minutes of all occupants leaving a space.

2.3. An automated signal from another control or alarm system that shall turn receptacles off within 20 minutes after determining that the area is unoccupied.

3. All controlled receptacles shall be permanently marked in accordance with NFPA 70 and be uniformly distributed throughout the space.

4. Plug-in devices shall not comply.

Exceptions: Automatic receptacles controls are not required for the following:

1. Receptacles specifically designated for equipment requiring continuous operation (24 hours per day, 365 days per year).
2. Spaces where an automatic control would endanger the safety or security of the room or building occupants.
3. Within a single modular office workstation, noncontrolled receptacles are permitted to be located more than 12 inches (304.8 mm), but not more than 72 inches (1828 mm) from the controlled receptacles serving that workstation.

CHANGE SIGNIFICANCE: The inclusion of provisions for controlled receptacles brings practices common outside of North America, and required in California and in ASHRAE 90.1, into the IECC.

At least 50 percent of the covered receptacles and 25 percent of branch circuit feeders must be automatically controlled receptacles. Methods for meeting these requirements include:

1. Using split wired receptacles that provide at least one controlled outlet
2. For any uncontrolled outlets, ensuring that at least one controlled outlet is located within 12 inches of the uncontrolled outlet

To avoid the unintentional loss of power to equipment and appliances, it is critical to note both the requirement – all controlled receptacles be permanently marked in accordance with NFPA 70 – and the application exceptions.

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C405.12
Energy Monitoring

CHANGE TYPE: Addition

CHANGE SUMMARY: Energy monitoring requirements are added to measure and retain the intended energy performance of a building.

2021 CODE: **C405.12 Energy monitoring.** New buildings with a gross conditioned floor area of 25,000 square feet (2322 m^2) or larger shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.12.1 through C405.12.5.

> **Exception:** R-2 occupancies and individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m^2) of conditioned floor area.

C405.12.1 Electrical energy metering. For all electrical energy supplied to the building and its associated site, including but not limited to site lighting, parking, recreational facilities and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C405.12.2.

C405.12.2 End-use metering categories. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category indicated in Table 405.12.2. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories indicated in Table 405.12.2 shall be permitted to be from a load that is not within that category.



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Energy monitoring supports efficient building operations.

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Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit shall not require end-use metering.
2. End-use metering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.
3. End-use metering shall not be required for an individual tenant space having a floor area not greater than 2,500 square feet (232 m^2) where a dedicated source meter complying with Section C405.12.3 is provided.

TABLE C405.12.2 Energy Use Categories

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process loads	Any single load that is not included in a HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

C405.12.3 Meters. Meters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C405.12.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC or other building systems that can monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of ± 2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections C405.12.4 and C405.12.5.

C405.12.4 Data acquisition system. A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for a minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly and yearly logged data for each end-use category required by Section C405.12.2.

C405.12.5 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting

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mechanism shall have the capability to graphically provide the energy consumption for each end-use category required by Section C405.12.2 at least every hour, day, month and year for the previous 36 months.

CHANGE SIGNIFICANCE: The 2021 IECC includes new requirements for energy monitoring. Energy monitoring provides a means to measure and retain the energy performance of a building. Although the IECC requires mechanical system and service water system commissioning, without a monitoring system in place, building owners and operators often do not know if energy efficiency measures have degraded, gone out of calibration, or are experiencing some other issue that is reducing the return on investment and increasing the payback period.

Electricity metering and monitoring is a management tool that uses a combination of hardware and software to gather data and turn them into useful and actionable information about a building, system or specific equipment. The requirements in this new section are intended to save energy by continually monitoring and reporting actionable energy consumption data to building owners and operators.

Monitoring subsystems provides key indications when changes have been made or systems are not operating to specification, which increases energy consumption. Examples of issues identified through monitoring include these:

1. Increased energy consumption in HVAC system loads may indicate failures in motors, drive systems, bearings or other system components.
2. Increased energy consumption from lighting loads may indicate there has been a failure of occupant sensors, lighting schedules are not working appropriately, lamps need to be replaced or cleaned or building occupants have installed additional lighting.
3. Increased energy consumption of the entire building may indicate the building envelope is degrading or configuration changes have been made that impact total building energy use.
4. Increased energy consumption of plug loads may indicate when computer equipment is left on during nonworking hours or when space heaters are used that compromise the efficiency of the facility due to setpoints on the HVAC system.

These new provisions are applicable to both IECC compliance paths.

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C406

Additional Efficiency Requirements

First introduced in the 2012 IECC, the additional efficiency provisions of Section C406 are required for commercial buildings using the Prescriptive Compliance option. The 2021 IECC includes a substantial revision to this section, increasing the number of options, introducing a points-based system and providing a climate zone-specific point value for each option.

The additional efficiency options do not take the building above the minimum requirements of the energy code, but instead ensure buildings complying prescriptively achieve the same level of efficiency as the Total Building Performance option. This provides flexibility for the building owner and designer to decide how best to make their building or system more efficient, keeping with the IECC's original intent of providing flexibility in order to conserve energy in buildings.

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C406

Additional Efficiency Requirements

CHANGE TYPE: Modification

CHANGE SUMMARY: When complying with the Prescriptive Compliance option, designers may select from 11 points-based additional energy efficiency options that now consider climate zone and occupancy type.

2021 CODE: **C406.1 Additional energy efficiency credit requirements.** ~~Buildings shall comply~~ New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of Section C406. Where a building contains multiple-use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Where not required by Section C405.12, include an energy monitoring system in accordance with C406.10.



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Additional energy efficiency requirements now consider climate and occupancy type.

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10. Where not required by Section C403.2.3, include a fault detection and diagnostics (FDD) system in accordance with Section C406.11.
11. Efficient kitchen equipment in accordance with Section C406.12.

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options from Tables C406.1(1) through C406.1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6, C406.7 or C406.10. ~~Alternatively, tenant spaces shall comply with Section C406.5 where the entire building is in compliance~~. Where the entire building complies using credits from Section C406.5, C406.8 or C406.9, tenant spaces shall be deemed to comply with this section.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

TABLE C406.1(1) Additional Energy Efficiency Credits for Group B Occupancies

	Climate Zone																
Section	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% cooling efficiency improvement	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% cooling efficiency improvement	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced lighting power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: On-site renewable energy	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: Dedicated outdoor air	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Efficient fossil fuel water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat pump water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced air infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6
C406.10: Energy monitoring	4	4	4	4	3	3	3	3	3	3	2	3	2	2	2	2	2
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

NA=Not Applicable.

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TABLE C406.1(2) Additional Energy Efficiency Credits for Group R and I Occupancies

Section	Climate Zone																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406.2.2: 5% cooling efficiency improvement	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406.2.4: 10% cooling efficiency improvement	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406.3: Reduced lighting power	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406.4: Enhanced digital lighting controls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: On-site renewable energy	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406.6: Dedicated outdoor air	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406.7.2: Recovered or renewable water heating	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Efficient fossil fuel water heater	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat pump water heater	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced envelope performance	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406.9: Reduced air infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10: Energy monitoring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.11: Fault detection and diagnostics system	1	1	1	1	1	1	NA	1	1	NA	1	1	NA	1	1	1	1

NA=Not Applicable.

TABLE C406.1(3) Additional Energy Efficiency Credits for Group E Occupancies

Section	Climate Zone																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% cooling efficiency improvement	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10% cooling efficiency improvement	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3: Reduced lighting power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
C406.5: On-site renewable energy	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5

(*Continued*)

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TABLE C406.1(3) (*Continued*)

Section	Climate Zone																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.6: Dedicated outdoor air	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: Recovered or renewable water heating[a]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.7.3: Efficient fossil fuel water heater[a]	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406.7.4: Heat pump water heater[a]	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: Enhanced envelope performance	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406.9: Reduced air infiltration	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3
C406.10: Energy monitoring	3	3	3	3	3	3	3	3	3	2	2	3	2	2	2	2	2
C406.11: Fault detection and diagnostics system	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2

NA=Not Applicable.
a. For schools with showers or full-service kitchens.

TABLE C406.1(4) Additional Energy Efficiency Credits for Group M Occupancies

Section	Climate Zone																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406.2.2: 5% cooling efficiency improvement	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406.2.4: 10% cooling efficiency improvement	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406.3: Reduced lighting power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406.4: Enhanced digital lighting controls	3	3	4	3	4	3	4	4	4	3	3	3	3	4	4	3	3
C406.5: On-site renewable energy	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406.6 : Dedicated outdoor air	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Efficient fossil fuel water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat pump water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406.9: Reduced air infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3
C406.10: Energy monitoring	4	5	5	5	5	4	4	4	4	3	3	4	3	4	4	4	3
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	2	2

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TABLE C406.1(5) Additional Energy Efficiency Credits for Other[a] Occupancies

Section	Climate Zone																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% cooling efficiency improvement	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10% cooling efficiency improvement	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3: Reduced lighting power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: On-site renewable energy	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6: Dedicated outdoor air	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.2: Recovered or renewable water heating[b]	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Efficient fossil fuel water heater[b]	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat pump water heater[b]	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced envelope performance	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406.9: Reduced air infiltration	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4
C406.10: Energy monitoring	3	3	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

NA=Not Applicable.
a. Other occupancy groups include all groups except for Groups B, E, I, M and R.
b. For occupancy groups listed in C406.7.1.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in ~~Tables C403.3.2(1) through C403.3.2(7) by~~ the tables in Section C403.3.2. ~~10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent.~~ Variable refrigerant flow systems ~~shall exceed~~ listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90.1 ~~by 10 percent.~~ in accordance with Sections C406.2.1, C406.2.2, C406.2.3 or C406.2.4 shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from C406.2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from C406.2.2, C406.2.4 or C406.2.5. Selected credits shall include a heating or cooling energy efficiency credit or both. Equipment not listed in Tables C403.3.2(1) through C403.3.2~~(7)~~ (9) and variable refrigerant flow systems not listed in the energy efficiency provisions of ASHRAE/IES 90.1 shall

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be limited to 10 percent of the total building system capacity for heating equipment where selecting Section C406.2.1 or C406.2.3 and cooling equipment where selecting Section C406.2.2, C406.2.4 or C406.2.5.

C406.2.1 Five-percent heating efficiency improvement. Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C406.2.2 Five-percent cooling efficiency improvement. Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER and IPLV.

C406.2.3 Ten-percent heating efficiency improvement. Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 Ten-percent cooling efficiency improvement. Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER and IPLV.

C406.2.5 More than ten percent cooling efficiency improvement. Where equipment exceeds the minimum annual cooling and heat rejection efficiency requirements by more than 10 percent, energy efficiency credits for cooling may be determined using Equation 4-12, rounded to the nearest whole number. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

$$EEC_{HEC} = EEC_{10} \times [1 + ((CEI - 10 \text{ percent}) \div 10 \text{ percent})]$$

(Equation 4-12)

Where:

EEC_{HEC} = Energy efficiency credits for cooling efficiency improvement.
EEC_{10} = Section C406.2.4 credits from Tables C406.1(1) through C406.1(5).
CEI = The lesser of: the improvement above minimum cooling and heat rejection efficiency requirements or 15 percent.

C406.3 Reduced lighting power. Buildings shall comply with Section C406.3.1 or C406.3.2, and dwelling units and sleeping units within the building shall comply with C406.3.3.

C406.3.1 Reduced lighting power by more than ten percent. The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

C406.3.2 Reduced lighting power by more than 15 percent. Where the total connected interior lighting power calculated in accordance with Section C405.3.1 is less than 85 percent of the total lighting power allowance calculated in accordance with Section C405.3.2, additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

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$AEEC_{LPA} = AEEC_{10} \times 10 \times (LPA - LPD) / LPA$ **(Equation 4-13)**

Where:

$AEEC_{LPA}$ = Section C406.3.2 additional energy efficiency credits.
$AEEC_{10}$ = Section C406.3.1 credits from Tables C406.1(1) through C406.1(5).
LPA = Total lighting power allowance calculated in accordance with Section C405.3.2.
LPD = Total connected interior lighting power calculated in accordance with Section C405.3.1.

C406.3.3 Lamp efficacy. Not less than 95 percent of the permanently installed lighting, excluding kitchen appliance light fixtures, serving dwelling units and sleeping units shall be provided by lamps with an efficacy of not less than 65 lumens per watt or luminaires with an efficacy of not less than 45 lumens per watt.

C406.5 On-site renewable energy. Buildings shall comply with Section C406.5.1 or C406.5.2.~~The total minimum ratings of on-site renewable energy systems shall be one of the following:~~

~~1. Not less than .86 Btu/h per square foot (5.4 W/m^2) or .25 watts per square foot (2.7 W/m^2) of conditioned floor area.~~
~~2. Not less than 2 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.~~

C406.5.1 Basic renewable credit. The total minimum ratings of on-site renewable energy systems, not including systems used for credits under Section C406.7.2, shall be one of the following:

1. Not less than 0.86 Btu/h per square foot (2.7 W/m^2) or 0.25 watts per square foot (2.7 W/m^2) of conditioned floor area.
2. Not less than 2 percent of the annual energy used within the building for building mechanical and service water-heating equipment and lighting regulated in Section C405.

C406.5.2 Enhanced renewable credit. Where the total minimum ratings of on-site renewable energy systems exceeds the rating in Section C406.5.1, additional energy efficiency credits shall be determined based on Equation 4-14, rounded to the nearest whole number.

$AEEC_{RRa} = AEEC_{2.5} \times RRa / RR_1$ **(Equation 4-14)**

Where:

$AEEC_{RRa}$ = Section C406.5.2 additional energy efficiency credits.
$AEEC_{2.5}$ = Section C406.5 credits from Tables C406.1(1) through C406.1(5).
RRa = Actual total minimum ratings of on-site renewable energy systems (in Btu/h, watts per square foot or W/m^2).
RR1 = Minimum ratings of on-site renewable energy systems required by Section C406.5.1 (in Btu/h, watts per square foot or W/m^2).

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C406.7.~~1~~2 ~~Load fraction.~~ Recovered or renewable water heating. The building service water-heating system shall have one or more of the following that are sized to provide not less than 30 ~~60~~ percent of the building's annual hot water requirements, or sized to provide ~~100~~ 70 percent of the building's annual hot water requirements if the building ~~shall otherwise~~ is required to comply with Section C403. 10~~9~~.5:

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment or process equipment.
2. On-site renewable energy water-heating systems.

C406.7.3 Efficient fossil fuel water heater. The combined input-capacity weighted-average equipment rating of all fossil fuel water-heating equipment in the building shall be not less than 95 percent Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with C404.2.1.

C406.7.4 Heat pump water heater. Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

C406.10 Energy Monitoring. Buildings shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C406.10.1 through C406.10.5.

C406.10.1 Electrical energy metering. For all electrical energy supplied to the building and its associated site, including but not limited to site lighting, parking, recreational facilities, and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C406.10.2.

C406.10.2 End-use metering categories. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category listed in Table 406.10.2. These meters shall have the capability to collect energy consumption data for the whole building or for each separately metered portion of the building. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories listed in Table 406.10.2 is permitted to be from a load not within the category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit does not require end-use metering.
2. End-use metering is not required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.

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TABLE 406.10.2 Energy Use Categories

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process loads	Any single load that is not included in an HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems and automatic doors.

C406.10.3 Meters. Meters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C406.10.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC or other building systems that can monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of ±2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections 406.10.4 and C406.10.5.

C406.10.4 Data acquisition system. A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for a minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly and yearly logged data for each end-use category required by Section C406.10.2.

C406.10.5 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the energy consumption for each end-use category required by Section C406.10.2 at least every hour, day, month and year for the previous 36 months.

C406.11 Fault detection and diagnostics system. A fault detection and diagnostics system shall be installed to monitor the HVAC system's performance and automatically identify faults. The system shall do all of the following:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance.

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2. Sample the HVAC system performance at least once every 15 minutes.
3. Automatically identify and report HVAC system faults.
4. Automatically notify authorized personnel of identified HVAC system faults.
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of the HVAC system performance.
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

C406.12 Efficient kitchen equipment. For buildings and spaces designated as Group A-2 or facilities that include a commercial kitchen with at least one gas or electric fryer, all fryers, dishwashers, steam cookers and ovens shall comply with all of the following:

1. Achieve performance levels in accordance with the equipment specifications listed in Tables C406.12(1) through C406.12(4) when rated in accordance with the applicable test procedure.
2. Be installed prior to the issuance of the Certificate of Occupancy.
3. Have associated performance levels listed on the construction documents submitted for permitting.

Energy efficiency credits for efficient kitchen equipment shall be independent of climate zone and determined based on Equation 4-15, rounded to the nearest whole number.

$$AEEC_K = 20 \times Area_K / Area_B \quad \textbf{(Equation 4-15)}$$

Where:

$AEEC_K$ = Section C406.10 additional energy efficiency credits.
$Area_K$ = Floor area of full-service kitchen (ft^2 or m^2).
$Area_B$ = Gross floor area of building (ft^2 or m^2).

TABLE C406.12(1) Minimum Efficiency Requirements: Commercial Fryers

Fryer Type	Heavy-Load Cooking Energy Efficiency	Idle Energy Rate	Test Procedure
Standard open deep-fat gas fryers	≥ 50%	≤ 9,000 Btu/h	ASTM F1361
Standard open deep-fat electric fryers	≥ 83%	≤ 800 watts	
Large-vat open deep-fat gas fryers	≥ 50%	≤ 12,000 Btu/h	ASTM F2144
Large-vat open deep-fat electric fryers	≥ 80%	≤ 1,100 watts	

For SI: 1 Btu/h = 0.293/W.

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TABLE C406.12(2) Minimum Efficiency Requirements: Commercial Steam Cookers

Fuel Type	Pan Capacity	Cooking Energy Efficiency[a]	Idle Energy Rate	Test Procedure
Electric steam	3-pan	50%	400 watts	ASTM F1484
	4-pan	50%	530 watts	
	5-pan	50%	670 watts	
	6-pan and larger	50%	800 watts	
Gas steam	3-pan	38%	6,250 Btu/h	
	4-pan	38%	8,350 Btu/h	
	5-pan	38%	10,400 Btu/h	
	6-pan and larger	38%	12,500 Btu/h	

a. Cooking energy efficiency is based on heavy load (potato) cooking capacity.

TABLE C406.12(3) Minimum Efficiency Requirements: Commercial Dishwashers

Machine Type	High-Temperature Efficiency Requirements		Low-Temperature Efficiency Requirements		Test Procedure
	Idle Energy Rate[a]	Water Consumption[b]	Idle Energy Rate[a]	Water Consumption[b]	–
Under counter	≤ 0.50 kW	≤ 0.86 GPR	≤ 0.50 kW	≤ 1.19 GPR	ASTM F1696 ASTM F1920
Stationary single-tank door	≤ 0.70 kW	≤ 0.89 GPR	≤ 0.60 kW	≤ 1.18 GPR	
Pot, pan and utensil	≤ 1.20 kW	≤ 0.58 GPR	≤ 1.00 kW	≤ 0.58 GPSF	
Single-tank conveyor	≤ 1.50 kW	≤ 0.70 GPR	≤ 1.50 kW	≤ 0.79 GPR	
Multiple-tank conveyor	≤ 2.25 kW	≤ 0.54 GPR	≤ 2.00 kW	≤ 0.54 GPR	
Single-tank flight type	Reported	GPH ≤ 2.975x + 55.00	Reported	GPH ≤ 2.975x + 55.00	
Multiple-tank flight type	Reported	GPH ≤ 4.96x + 17.00	Reported	GPH ≤ 4.96x + 17.00	

a. Idle results shall be measured with the door closed and represent the total idle energy consumed by the machine, including all tank heaters and controls. Booster heater (internal or external) energy consumption shall not be part of this measurement unless it cannot be separately monitored.
b. GPR = gallons per rack; GPSF = gallons per square foot of rack; GPH = gallons per hour; x = maximum conveyor belt speed (feet/minute) × conveyor belt width (feet).

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TABLE C406.12(4) Minimum Efficiency Requirements: Commercial Ovens

Fuel Type	Classification	Idle Rate	Cooking-Energy Efficiency, %	Test Procedure
		Convection Ovens		
Gas	Full-Size	≤ 12,000 Btu/h	≥ 46	ASTM F1496
Electric	Half-Size	≤ 1.0 Btu/h	≥ 71	
	Full-Size	≤ 1.60 Btu/h		
		Combination Ovens		
Gas	Steam Mode	≤ 200P[a]+6,511 Btu/h	≥ 41	ASTM F2861
	Convection Mode	≤ 150P[a]+5,425 Btu/h	≥ 56	
Electric	Steam Mode	≤ 0.133P[a]+0.6400 kW	≥ 55	
	Convection Mode	≤ 0.080P[a]+0.4989 kW	≥ 76	
		Rack Ovens		
Gas	Single	≤ 25,000 Btu/h	≥ 48	ASTM F2093
	Double	≤ 30,000 Btu/h	≥ 52	

For SI: 1 Btu/h = 0.293/W.
a. P = Pan Capacity: the number of steam table pans the combination oven is able to accommodate in accordance with ASTM F1495.

CHANGE SIGNIFICANCE: The additional efficiency options were introduced into the 2012 IECC as part of the Prescriptive Compliance path to achieve an additional 4 percent energy savings over the base prescriptive requirements of the code. The original language included three additional efficiency options: reduced lighting power density, increased HVAC efficiency and renewable energy. The options were expanded over the next iterations of the code, with eight equal-weighted options to select from included in the 2018 IECC. PNNL performed an analysis to determine the energy savings potential for each of the eight options by climate zone and found significant savings differences. To address this issue, PNNL developed a points-based option that ensures equity across the efficiency measure options, providing the basis for revisions to Section C406.

A total of ten credits (also referred to as points) are now required from Tables C406.1(1) through C406.1(5) and/or efficient kitchen equipment points calculated in accordance with Section C406.12. One point is assigned for each 0.25 percent of building energy cost savings. The credits can be accumulated across a total of 11 options.

In addition to the significance of the revised structure of the section, the following options are either new or significantly revised:

The previous HVAC additional efficiency measure of C406.2 was modified to include several credit options that apply to heating equipment, cooling equipment or both, with separate credits based on improvement in efficiency.

- Medium efficiency HVAC heating performance (C406.2.1) is a 5 percent improvement in efficiency over the existing minimum requirement.
- Medium efficiency HVAC cooling performance (C406.2.2) is a 5 percent improvement in efficiency over the existing minimum requirement.

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- High efficiency HVAC heating performance (C406.2.3) is a 10 percent improvement in efficiency over the existing minimum requirement.
- High efficiency HVAC cooling performance (C406.2.4) is a 10 percent improvement in efficiency over the existing minimum requirement.
- High efficiency HVAC cooling performance (C406.2.5) is more than a 10 percent improvement in efficiency over the existing minimum requirement.

The lighting power reduction option in C406.3 has been expanded to allow for additional credits as well. Previously, there was a single option to reduce lighting power density by 10 percent; the 2021 IECC now provides options for reducing lighting power by 15 percent and installing 95 percent high efficacy lighting in dwelling and sleeping units.

The on-site renewable energy option in Section C406.5 has been modified to include two levels of credits for renewable energy. The basic credit is achieved with .25 watts/ft^2 of conditioned floor area or at least 2 percent of the mechanical, service water heating and lighting annual energy. Enhanced credit is achieved with increased on-site renewable energy systems.

Code users should note the correlated revised definition:

> **ON-SITE RENEWABLE ENERGY.** Energy derived from renewable energy resources harvested at the building project site.

The 2018 IECC language provided for energy recovery in Section C406.7 has been revised in the 2021 IECC to provide credit for high efficiency gas and electric water heaters in addition to heat recovery. These credits are available to seven building occupancy types as well as buildings for which service hot water heating accounts for 10 or more percent of the total building energy loads.

The 2021 IECC includes energy monitoring requirements in Section C405.12. The requirement does not apply to buildings less than 25,000 square feet, and R-2 occupancies and individual tenant spaces are exempt if the space has its own utility services and meters and has less than 5,000 square feet of conditioned floor area. Section C406.10 provides additional efficiency credit options for buildings not otherwise required to have monitoring by Section C405.12.

The energy efficiency of a new building's HVAC system will degrade over time when equipment is poorly maintained, failing or improperly controlled. The new fault detection and diagnostics (FDD) requirement in C406.11 will reduce that degradation by detecting HVAC system faults and notifying building operators so that actions may be taken to reduce the energy consumption of the building. Additionally, FDD systems are being utilized to drive operational efficiency, make better use of maintenance personnel and resolve comfort issues.

The final option of the revised Section C406 is the installation of efficient kitchen equipment in Group A-2 or facilities that have a commercial kitchen with at least one gas or electric fryer (C406.12). Kitchen equipment accounts for a large share of building energy use in restaurants, schools, dormitories, hotels and other facilities with full-service kitchens. More efficient equipment saves energy by improving the heat transfer in

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the cooking process, either through better equipment insulation or other innovations in the appliances. This option is different from the other 10 in that the value of the credit is not determined using Tables C406.1(1) through C406.1(5) and instead is calculated using Equation 4-15.

The additional efficiency credit approach retains designer and builder flexibility, and using points more closely aligns the various credit options across climate zones. In some cases, however, the options also require additional documentation and review by code officials.

Section C406 and the new and revised options included within are applicable only to the Prescriptive Compliance path.

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C407

Total Building Performance

The Total Building Performance provisions of Section C407 comprise the second energy code compliance option of the IECC. This compliance method uses computer software to predict and compare the annual energy cost of the proposed design to the standard design of the building using the components listed in Table C407.4.1(1). Total Building Performance allows tradeoffs between the building envelope, HVAC systems and lighting systems to achieve an overall building energy conservation result equal to or better than that of the other code compliance paths.

The significant change to the Total Building Performance option is the addition of a new, comprehensive table of required provisions.

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C407.2

Performance-Based Compliance

CHANGE TYPE: Modification

CHANGE SUMMARY: Code requirements applicable to the Total Building Performance compliance path are outlined in a new, user-friendly table to reduce code application confusion. The proposed design for projects complying with Total Building Performance must have an annual energy cost less than or equal to 85 percent of the standard reference design.

2021 CODE: **C407.2 Mandatory requirements.** ~~Compliance with this section requires compliance with Sections C402.2.7, C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405 C405.1, C405.2, C405.4 through C405.9, and C408.~~ Compliance based on total building performance requires that a proposed design meet all of the following: ~~building (proposed design) be shown to have~~

1. The requirements of the sections indicated within Table C407.2.
2. An annual energy cost that is less than or equal to 85 percent of the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's State Energy ~~Price and Expenditure Report~~ Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with on-site renewable energy shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the standard reference design and the proposed design.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.



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Requirements for Total Building Performance compliance are clarified.

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TABLE C407.2 Requirements for Total Building Performance

SECTION[a]	TITLE
	Envelope
C402.5	Air leakage—thermal envelope
	Mechanical
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commissioning

a. Reference to a code section includes all the relative subsections except as indicated in the table.

CHANGE SIGNIFICANCE: The labels *prescriptive* and *mandatory* were introduced in the 2009 IECC and, despite never being defined, were applied to various section and subsection titles throughout the IECC, creating confusion for users of the code. The terms were used inconsistently and because the labels themselves were not requirements, the intent behind the designation was not enforceable.

Among long-time code users, it is generally understood that *mandatory* was intended to mean "non-tradeable" when using performance compliance options; that is, where the procedures or systems described within the 'mandatory' section were included as part of the design, the requirements of that section must be met and cannot be traded off. *Prescriptive*, on the other hand, was intended to mean required when using the prescriptive path but "tradeable" when using the performance path. However, this understanding was not explicitly based on code language, and new users to the code expressed confusion about the use of the terms.

The 2021 IECC eliminates the terms mandatory and prescriptive, and instead, all requirements applicable to the Total Building Performance compliance path are now located in Section C407. Table C407.2 includes all required provisions for this compliance path.

This provision is applicable to the Total Building Performance compliance option only.

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PART 4

Commercial Energy Provisions: Commercial Appendices

- **Appendix CA** Board of Appeals – Commercial
- **Appendix CB** Solar-Ready Zone – Commercial
- **Appendix CC** Zero Energy Commercial Building Provisions

Appendices to the *International Energy Conservation Code* (IECC) provide options for jurisdictions to expand the requirements of the IECC. These options are not mandatory unless specifically referenced in the adopting ordinances. The 2021 IECC introduces two new commercial appendices - Appendix CA provides guidance for establishing a board of appeals and Appendix CC outlines provisions for zero energy commercial buildings. The existing solar-ready appendix is also modified. ■

Appendix CA

Board of Appeals – Commercial

CB103.7

Electrical Energy Storage System-Ready Area

Appendix CC

Zero Energy Commercial Building Provisions

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CHANGE TYPE: Addition

CHANGE SUMMARY: A new Appendix CA provides guidance for establishing a board of appeals, including criteria for membership and instruction for developing rules and procedures.

2021 CODE:

Appendix CA

Board of Appeals – Commercial

APPENDIX CA
BOARD OF APPEALS—COMMERCIAL

SECTION CA101
GENERAL

CA101.1 Scope. A board of appeals shall be established within the jurisdiction for the purpose of hearing applications for modification of the requirements of this code pursuant to the provisions of Section C110. The board shall be established and operated in accordance with this section, and shall be authorized to hear evidence from appellants and the code official pertaining to the application and intent of this code for the purpose of issuing orders pursuant to these provisions.

CA101.2 Application for appeal. Any person shall have the right to appeal a decision of the code official to the board. An application for appeal shall be based on a claim that the intent of this code or the rules legally adopted hereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The application shall be filed on a form obtained from the code official within 20 days after the notice was served.

CA101.2.1 Limitation of authority. The board shall not have authority to waive requirements of this code or interpret the administration of this code.



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A board of appeals reviews evidence from appellants and code officials.

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CA101.2.2 Stays of enforcement. Appeals of notice and orders, other than Imminent Danger notices, shall stay the enforcement of the notice and order until the appeal is heard by the board.

CA101.3 Membership of board. The board shall consist of five voting members appointed by the chief appointing authority of the jurisdiction. Each member shall serve for [INSERT NUMBER OF YEARS] years or until a successor has been appointed. The board members' terms shall be staggered at intervals, so as to provide continuity. The code official shall be an ex officio member of said board but shall not vote on any matter before the board.

CA101.3.1 Qualifications. The board shall consist of five individuals, who are qualified by experience and training to pass on matters pertaining to building construction and are not employees of the jurisdiction.

CA101.3.2 Alternate members. The chief appointing authority is authorized to appoint two alternate members who shall be called by the board chairperson to hear appeals during the absence or disqualification of a member. Alternate members shall possess the qualifications required for board membership, and shall be appointed for the same term or until a successor has been appointed.

CA101.3.3 Vacancies. Vacancies shall be filled for an unexpired term in the same manner in which original appointments are required to be made.

CA101.3.4 Chairperson. The board shall annually select one of its members to serve as chairperson.

CA101.3.5 Secretary. The chief appointing authority shall designate a qualified clerk to serve as secretary to the board. The secretary shall file a detailed record of all proceedings which shall set forth the reasons for the board's decision, the vote of each member, the absence of a member and any failure of a member to vote.

CA101.3.6 Conflict of interest. A member with any personal, professional or financial interest in a matter before the board shall declare such interest and refrain from participating in discussions, deliberations and voting on such matters.

CA101.3.7 Compensation of members. Compensation of members shall be determined by law.

CA101.3.8 Removal from the board. A member shall be removed from the board prior to the end of their terms only for cause. Any member with continued absence from regular meeting of the board may be removed at the discretion of the chief appointing authority.

CA101.4 Rules and procedures. The board shall establish policies and procedures necessary to carry out its duties consistent with the provisions of this code and applicable state law. The procedures shall not require compliance with strict rules of evidence, but shall mandate that only relevant information be presented.

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CA101.5 Notice of meeting. The board shall meet upon notice from the chairperson, within 10 days of the filing of an appeal or at stated periodic intervals.

CA101.5.1 Open hearing. All hearings before the board shall be open to the public. The appellant, the appellant's representative, the code official and any person whose interests are affected shall be given an opportunity to be heard.

CA101.5.2 Quorum. Three members of the board shall constitute a quorum.

CA101.5.3 Postponed hearing. When five members are not present to hear an appeal, either the appellant or the appellant's representative shall have the right to request a postponement of the hearing.

CA101.6 Legal counsel. The jurisdiction shall furnish legal counsel to the board to provide members with general legal advice concerning matters before them for consideration. Members shall be represented by legal counsel at the jurisdiction's expense in all matters arising from service within the scope of their duties.

CA101.7 Board decision. The board shall only modify or reverse the decision of the code official by a concurring vote of three or more members.

CA101.7.1 Resolution. The decision of the board shall be by resolution. Every decision shall be promptly filed in writing in the office of the code official within three days and shall be open to the public for inspection. A certified copy shall be furnished to the appellant or the appellant's representative and to the code official.

CA101.7.2 Administration. The code official shall take immediate action in accordance with the decision of the board.

CA101.8 Court review. Any person, whether or not a previous party of the appeal, shall have the right to apply to the appropriate court for a writ of certiorari to correct errors of law. Application for review shall be made in the manner and time required by law following the filing of the decision in the office of the chief administrative officer.

CHANGE SIGNIFICANCE: Appendix CA mirrors the requirements of the 2018 *International Building Code* (IBC), 2018 *International Fire Code* (IFC) and 2021 *International Residential Code* (IRC), providing a consistent set of requirements for a board of appeals across the family of I-Codes. This appendix offers a framework for jurisdictions to establish a functional board of appeals, outlining the rights and responsibilities of the appellant, code official and board members. The provisions contained in this appendix are not mandatory unless specified as such in the jurisdiction's adopting ordinance.

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CB103.7

Electrical Energy Storage System-Ready Area

CHANGE TYPE: Addition

CHANGE SUMMARY: Appendix CB adds a provision for the design and construction of a system-ready area for electrical energy storage.

2021 CODE: **CB103.7 Electrical energy storage system-ready area.** The floor area of the electrical energy storage system-ready area shall be not less than 2 feet (610 mm) in one dimension and 4 feet (1219 mm) in another dimension, and located in accordance with Section 1207 of the International Fire Code. The location and layout diagram of the electrical energy storage system-ready area shall be indicated on the construction documents.

CHANGE SIGNIFICANCE: The Solar-Ready Zone appendices to the IECC are useful for jurisdictions seeking to add solar-ready provisions to state or local codes. These appendices provide requirements for reserving sections of the roof or building overhang for future solar photovoltaics or solar thermal systems. Many jurisdictions considering the Solar-Ready Zone appendices are facing current or future constraints on electric grid capacity in their efforts to accommodate existing and new distributed solar generation resources; as such, policy objectives are emerging to support the storage of energy produced by solar panels and shift the temporal impact of such energy on the grid.

The addition of Section CB103.7 ensures that there are design and space considerations for a standard-sized battery rack and for connections to the electrical panels. As with the rationale for solar-readiness, it is generally much more cost-effective at the time of new construction to design for future installation of this equipment than it is to retrofit later.



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Buildings in jurisdictions adopting this appendix must be energy storage ready.

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Section CB103.7 also cites the *International Fire Code* (IFC) to ensure there is sufficient clearance around the battery rack to meet life/safety concerns. The IFC is also included in Chapter 6 as a referenced code. The provisions contained in this appendix are not mandatory unless specified as such in the jurisdiction's adopting ordinance.

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Appendix CC

Zero Energy Commercial Building Provisions

CHANGE TYPE: Addition

CHANGE SUMMARY: Appendix CC provides a model for states and jurisdictions to require renewable energy systems capable of achieving net zero carbon.

2021 CODE:

APPENDIX CC
ZERO ENERGY COMMERCIAL BUILDING PROVISIONS

SECTION CC101
GENERAL

CC101.1 Purpose. The purpose of this appendix is to supplement the International Energy Conservation Code and require renewable energy systems of adequate capacity to achieve net zero carbon.

CC101.2 Scope. This appendix applies to new buildings that are addressed by the International Energy Conservation Code.

Exceptions:

1. Detached one- and two-family dwellings and townhouses as well as Group R-2 buildings three stories or less in height above grade plane, manufactured homes (mobile dwellings), and manufactured houses (modular dwellings).
2. Buildings that use neither electricity nor fossil fuel.

SECTION CC102
DEFINITIONS

CC102.1 Definitions. The definitions contained in this section supplement or modify the definitions in the International Energy Conservation Code.



Photo courtesy of KenWiedemann/E+/Getty Images

On-site renewables.

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ADJUSTED OFF-SITE RENEWABLE ENERGY. The amount of energy production from off-site renewable energy systems that may be used to offset building energy.

BUILDING ENERGY. All energy consumed at the building site as measured at the site boundary. Contributions from on-site or off-site renewable energy systems shall not be considered when determining the building energy.

ENERGY UTILIZATION INTENSITY (EUI). The site energy for either the baseline building or the proposed building divided by the gross conditioned floor area plus any semiheated floor area of the building. For the baseline building, the EUI can be divided between regulated energy use and unregulated energy use.

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system not located on the building project.

ON-SITE RENEWABLE ENERGY SYSTEM. Renewable energy systems on the building project.

RENEWABLE ENERGY SYSTEM. Photovoltaic, solar thermal, geothermal energy and wind systems used to generate energy.

SEMIHEATED SPACE. An enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h×ft^2 of floor area but is not a conditioned space.

ZERO ENERGY PERFORMANCE INDEX (ZEPI PB/EE). The ratio of the proposed building EUI without renewables to the baseline building EUI, expressed as a percentage.

SECTION CC 103
MINIMUM RENEWABLE ENERGY

CC103.1 Renewable Energy. On-site renewable energy systems shall be installed, or off-site renewable energy shall be procured to offset the building energy as calculated in accordance with Equation CC-1.

$$RE_{onsite} + RE_{offsite} \geq E_{building} \qquad \textbf{(Equation CC-1)}$$

where:
RE_{onsite} = Annual site energy production from on-site renewable energy systems (see Section CC103.2).
$RE_{offsite}$ = Adjusted annual site energy production from off-site renewable energy systems that may be credited against building energy use (see Section CC103.3).
$E_{building}$ = Building energy use without consideration of renewable energy systems.

When Section C401.2.1(1) is used for compliance with the International Energy Conservation Code, building energy shall be determined by multiplying the gross conditioned floor area plus the gross semiheated floor area of the proposed building by an EUI selected from Table CC103.1. Use a weighted average for mixed-use buildings.

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When Section C401.2.1, Item 2 or Section C401.2.2 is used for compliance with the International Energy Conservation Code, building energy shall be determined from energy simulations.

TABLE CC103.1 Energy Utilization Intensity for Building Types and Climates (kBtu/ft² – yr)

	Climate Zone																
Building Area Type	0A/ 1A	0B/ 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
	kBtu/ft²-yr																
Healthcare/hospital (I-2)	119	120	119	113	116	109	106	116	109	106	118	110	105	126	116	131	142
Hotel/motel (R-1)	73	76	73	68	70	67	65	69	66	65	71	68	65	77	72	81	89
Multiple-family (R-2)	43	45	41	41	43	42	36	45	43	41	47	46	41	53	48	53	59
Office (B)	31	32	30	29	29	28	25	28	27	25	29	28	25	33	30	32	36
Restaurant (A-2)	389	426	411	408	444	420	395	483	437	457	531	484	484	589	538	644	750
Retail (M)	46	50	45	46	44	44	37	48	44	44	52	50	46	60	52	64	77
School (E)	42	46	42	40	40	39	36	39	40	40	39	43	37	44	40	45	54
Warehouse (S)	9	12	9	11	12	11	10	17	13	14	23	17	15	32	23	32	32
All others	55	58	54	53	53	51	48	54	52	51	57	54	50	63	57	65	73

CC103.2 Calculation of on-site renewable energy. The annual energy production from on-site renewable energy systems shall be determined using the PVWatts software or other software approved by the code official.

CC103.3 Off-Site renewable energy. Off-site energy shall comply with Sections CC103.3.1 and CC103.3.2.

CC103.3.1 Qualifying off-site procurement methods. The following are considered qualifying off-site renewable energy procurement methods:

1. Community renewables: an offsite renewable energy system for which the owner has purchased or leased renewable energy capacity along with other subscribers.
2. Renewable energy investment fund: an entity that installs renewable energy capacity on behalf of the owner.
3. Virtual power purchase agreement: a power purchase agreement for off-site renewable energy where the owner agrees to purchase renewable energy output at a fixed price schedule.
4. Direct ownership: an offsite renewable energy system owned by the building project owner.
5. Direct access to wholesale market: an agreement between the owner and a renewable energy developer to purchase renewable energy.
6. Green retail tariffs: a program by the retail electricity provider to provide 100-percent renewable energy to the owner.

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7. Unbundled Renewable Energy Certificates (RECs): certificates purchased by the owner representing the environmental benefits of renewable energy generation that are sold separately from the electric power.

CC103.3.2 Requirements for all procurement methods. The following requirements shall apply to all off-site renewable energy procurement methods:

1. The building owner shall sign a legally binding contract to procure qualifying off-site renewable energy.
2. The procurement contract shall have duration of not less than 15 years and shall be structured to survive a partial or full transfer of ownership of the property.
3. RECs and other environmental attributes associated with the procured off-site renewable energy shall be assigned to the building project for the duration of the contract.
4. The renewable energy generating source shall include one or more of the following: photovoltaic systems, solar thermal power plants, geothermal power plants and wind turbines.
5. The generation source shall be located where the energy can be delivered to the building site by the same utility or distribution entity, the same independent system operator (ISO) or regional transmission organization (RTO), or within integrated ISOs (electric coordination council).
6. The off-site renewable energy producer shall maintain transparent accounting that clearly assigns production to the building. Records on power sent to or purchased by the building shall be retained by the building owner and made available for inspection by the code official upon request.

CC103.3.3 Adjusted off-site renewable energy. The process for calculating the adjusted off-site renewable energy is shown in the Equation CC-2.

$$RE_{offsite} = \sum_{i=1}^{n} PF_i \cdot RE_i = PF_1 \cdot RE_1 + PF_2 \cdot RE_2 + \cdots + PF_n \cdot RE_n \quad \textbf{(Equation CC-2)}$$

where:

$RE_{offsite}$ = Adjusted off-site renewable energy.

PF_i = Procurement factor for the i^{th} renewable energy procurement method or class taken from Table CC103.3.3.

RE_i = Annual energy production for the i^{th} renewable energy procurement method or class.

n = The number of renewable energy procurement options or classes considered.

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TABLE CC103.3.3 Default Off-Site Renewable Energy Procurement Methods, Classes and Coefficients

Class	Procurement Factor (PF)	Procurement Options	Additional Requirements (see also Section CC103.3.2)
1	0.75	Community Solar	—
		REIFs	Entity must be managed to prevent fraud or misuse of funds.
		Virtual PPA	—
		Self-Owned Off-Site	Provisions shall prevent the generation from being sold separately from the building.
2	0.55	Green Retail Tariffs	The offering shall not include the purchase of unbundled RECs.
		Direct Access	The offering shall not include the purchase of unbundled RECs.
3	0.20	Unbundled RECs	The vintage of the RECs shall align with building energy use.

CHANGE SIGNIFICANCE: The relationship between renewable energy systems and code compliance has changed throughout the years. The 2003 IECC allowed full attribution of on-site renewable energy in the performance compliance path. More recently, however, the amount of renewable energy attributable to compliance has been limited. For example, the 2018 IECC includes the use of renewable energy as an additional efficiency package in C406, and on-site renewable energy is limited to 5 percent of the total energy cost in C407 Total Building Performance. Similarly, additional backstops compensate for the use of on-site renewables in the R406 Energy Rating Index compliance alternative for residential projects.

Appendix CC is based on Architecture 2030, which focuses on carbon emissions reduction and couples onsite and/or off-site renewable energy with energy efficiency measures resulting in Zero-Net-Carbon (ZNC) buildings. Architecture 2030 defines a ZNC building as, "a highly energy efficient building that produces on-site, or procures, enough carbon-free renewable energy to meet building operations energy consumption annually." Like Architecture 2030, Appendix CC requires compliance with the minimum provisions of the IECC and then provides calculations to determine the minimum renewable energy necessary to offset building energy use.

As such, Appendix CC once again fully recognizes the input of renewable energy for commercial projects; however, it does not expand the attribution of renewable energy in minimum code compliance.

Appendix CC provides jurisdictions an option for establishing net-zero carbon targets. The provisions contained in this appendix are not mandatory unless specified as such in the jurisdiction's adopting ordinance.

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PART 5

Residential Energy Provisions: Administration

Chapters 1 and 2



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- **Chapter 1** Scope and Administration
- **Chapter 2** Definitions

The administration section of the *International Energy Conservation Code* (IECC) covers the general scope, intent, applicability and enforcement of the IECC. Section R101.2 establishes the criteria for buildings that are regulated by the IECC Residential provisions. Buildings outside the scope of Section R101.2 are regulated by the Commercial provisions of the IECC. The administration provisions of Chapter 1 cover the applicability of the code to mixed-use buildings; alternative materials; design and methods of construction; construction documents; inspection fees; referenced standards and stop work orders.

Definitions used throughout the IECC are found in Chapter 2. The definitions contained within the IECC are intended to reflect the special meaning of such terms within the scope of the code. As terms can often have multiple meanings in their ordinary day-to-day use or within the various disciplines of the construction industry, it is important that their meanings be understood within the context of the IECC. ■

R103.1

Digital Plans

R103.2

Information on Construction Documents

R202

Definition of High-Efficacy Light Sources

R202

Definition of Renewable Energy Certificate

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R103.1

Digital Plans

CHANGE TYPE: Clarification

CHANGE SUMMARY: Provisions related to energy code documentation clarify that construction documents and supporting data may be submitted digitally.

2021 CODE: **R103.1 General.** Construction documents, technical reports and other supporting data shall be submitted in one or more sets, or in a digital format where allowed by the code official, with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the code official is authorized to require necessary construction documents to be prepared by a registered design professional.

> **Exception:** The code official is authorized to waive the requirements for construction documents or other supporting data if the code official determines they are not necessary to confirm compliance with this code.

CHANGE SIGNIFICANCE: This provision was first drafted when blueprints were the standard, and construction plans and documentation were submitted on paper. As more jurisdictions move to an online, digital submittal process, the construction documents provisions proved confusing because the requirement for "one or more sets" implied to some that paper copies are still required. This code change clarifies that the code official may choose to accept digital submittals in lieu of paper documentation. The digital format facilitates a comprehensive electronic permitting, plan review and inspection system, and includes these benefits:

- Streamlined online submittals, payments, reviews and inspection scheduling
- Standardized building site information
- Readily available project status and information
- Real-time inspection results from the field.



Photo courtesy of Wendy Talarico

Digital plan review.

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R103.2

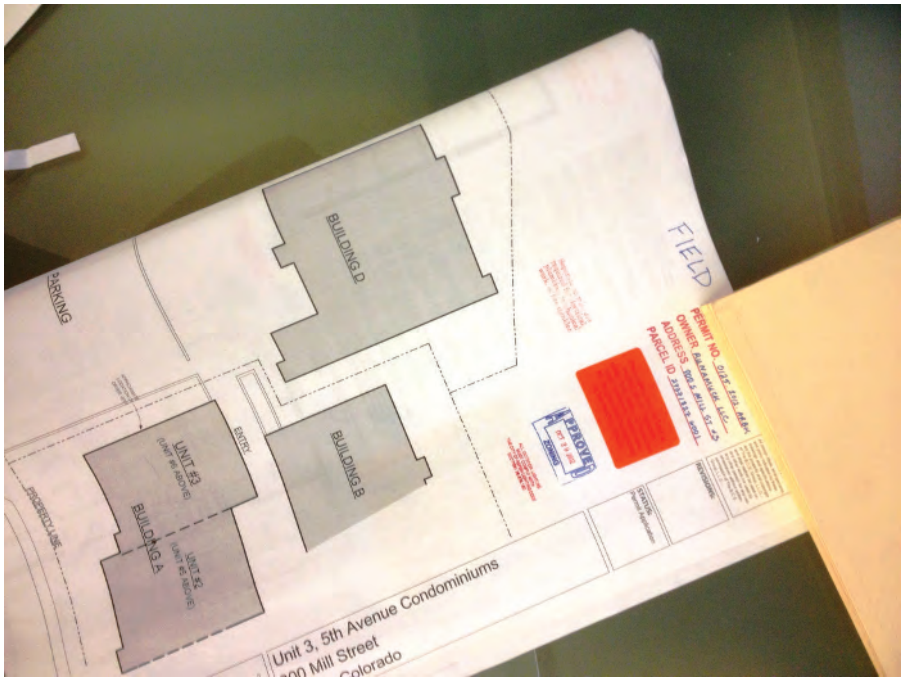
Information on Construction Documents

CHANGE TYPE: Modification

CHANGE SUMMARY: The information required on the construction documents has been expanded to include an indication of the energy compliance path used.

2021 CODE: R103.2 Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include the following as applicable:

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation and location.
9. Air sealing details.



Energy compliance path must be noted on construction documents.

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CHANGE SIGNIFICANCE: Identification of the compliance path is essential for the plan reviewer to determine if the project demonstrates compliance with the specific energy requirements. When this information is not provided on the construction documents and plans examiners are required to investigate, the review process is lengthened. This extension may be in the form of a review comment or the time it takes to retrieve the information by email or phone. Providing this information at submittal allows the plans examiner to review the plans according to the intended energy compliance path selected by the architect or designer.

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R202

Definition of High-Efficacy Light Sources

CHANGE TYPE: Modification

CHANGE SUMMARY: The revised definition of high-efficacy light sources increases efficacy to 65 lumens per watt for lamps and 45 lumens per watt for luminaires.

2021 CODE: ~~**HIGH-EFFICACY LAMPS.**~~ **HIGH-EFFICACY LIGHT SOURCES.** ~~Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or other lamps~~ Any lamp with an efficacy of not less than ~~the following:~~ 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.

~~1. 60 lumens per watt for lamps over 40 watts~~

~~2. 50 lumens per watt for lamps over 15 watts to 40 watts.~~

~~3. 40 lumens per watt for lamps 15 watts or less.~~

CHANGE SIGNIFICANCE: High-efficacy lamps were first defined in the 2009 IECC when the LED market was in its infancy. Since then, lighting technologies have evolved and lighting standards have changed such that many of the technologies defined by the 2009 IECC are no longer compliant. The 2021 IECC updates the definition of high-efficacy light sources to capture these market changes and to provide separate thresholds for lamps and luminaires.



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High-efficacy light sources are required in all permanently installed lighting fixtures.

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R202

Definition of Renewable Energy Certificate

CHANGE TYPE: Addition

CHANGE SUMMARY: A new definition for Renewable Energy Certificate ensures homeowners can provide legal documentation of their ownership of the credits for renewable energy.

2021 CODE: **RENEWABLE ENERGY CERTIFICATE (REC).** An instrument that represents the environmental attributes of one megawatt hour of renewable energy; also known as an energy attribute certificate (EAC).

CHANGE SIGNIFICANCE: Renewable Energy Certificates (RECs) represent the environmental attributes of renewable energy. As the on-site renewable market continues to evolve, RECs capture the current market value of solar power and other renewable energy used for residential projects.

The 2021 IECC requires homeowners using on-site renewable energy for compliance with the Energy Rating Index to own the RECs for the home. This requirement ensures the environmental attributes of the RECs are counted toward one home only. According to the Federal Trade Commission, when the installer, leasing company, financial agent or other entity in the renewable energy transaction owns the REC, the power produced by the system does not qualify as renewable energy. This is because the REC may be sold to more than one party, resulting in a double-counting of the environmental attributes of the system.



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On-site renewable energy.

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PART 6

Residential Energy Provisions: General Requirements

Chapter 3



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■ **Chapter 3** General Requirements

Chapter 3 provides foundational requirements for provisions in Chapters 4 and 5.

Climate zone designations in Chapter 3 are used as a reference for the building envelope and mechanical provisions that are climate-specific. The code establishes many requirements, such as wall and roof insulation *R*-values and window and door thermal transmittance (*U*-factors), that affect the mechanical systems based on the climate where the building is located.

In addition, Chapter 3 provides interior design conditions that are used as a basis for assumptions in heating and cooling load calculations and basic material requirements for insulation and fenestration. Requirements for labeling and product rating are also provided; these are foundational to the envelope requirements of Chapter 4. Finally, Chapter 3 provides specifications for insulation installation that help ensure the effectiveness of the insulation. ■

R301.3

Climate Zone Definitions

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R301.3

Climate Zone Definitions

CHANGE TYPE: Modification

CHANGE SUMMARY: The climate zone provisions have been comprehensively updated and include a new Climate Zone 0. Ten percent of U.S. counties are now in a new climate zone.

2021 CODE TEXT: **R301.3 ~~International climate zones~~ Climate zone definitions.** ~~The climate zone for any location outside the United States shall be determined by applying Table R301.3(1) and then Table R301.3(2).~~ To determine the climate zones for locations not listed in this code, use the following information to determine climate zone numbers and letters in accordance with Items 1 through 5.

1. Determine the thermal climate zone, 0 through 8, from Table R301.3 using the heating (HDD) and cooling degree-days (CDD) for the location.
2. Determine the moisture zone (Marine, Dry or Humid) in accordance with Items 2.1 through 2.3.
   - 2.1. If monthly average temperature and precipitation data are available, use the Marine, Dry, and Humid definitions to determine the moisture zone (C, B or A).
   - 2.2. If annual average temperature information (including degree-days) and annual precipitation (i.e., annual mean) are available, use Items 2.2.1 through 2.2.3 to determine the moisture zone. If the moisture zone is not Marine, then use the Dry definition below to determine whether Dry or Humid:
     - 2.2.1. If thermal climate zone is 3 and CDD50°F ≤ 4,500 (CDD10°C ≤2500), climate zone is Marine (3C).
     - 2.2.2. If thermal climate zone is 4 and CDD50°F ≤ 2,700 (CDD10°C ≤ 1500), climate zone is Marine (4C).
     - 2.2.3. If thermal climate zone is 5 and CDD50°F ≤ 1,800 (CDD10°C ≤ 1000), climate zone is Marine (5C).





The IECC provisions are climate specific.

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2.3. If only degree-day information is available, use Items 2.3.1 through 2.3.3 to determine the moisture zone. If the moisture zone is not Marine, then it is not possible to assign Humid or Dry moisture zone for this location.

2.3.1. If thermal climate zone is 3 and CDD50°F ≤ 4,500 (CDD10°C ≤ 2500), climate zone is Marine (3C).

2.3.2. If thermal climate zone is 4 and CDD50°F ≤ 2,700 (CDD10°C ≤ 1500), climate zone is Marine (4C).

2.3.3. If thermal climate zone is 5 and CDD50°F ≤ 1,800 (CDD10°C ≤ 1000), climate zone is Marine (5C).

3. Marine (C) Zone definition: Locations meeting all the criteria in Items 3.1 through 3.4.

3.1. Mean temperature of coldest month between 27°F (–3°C) and 65°F (18°C).

3.2. Warmest month mean < 72°F (22°C).

3.3. Not fewer than four months with mean temperatures over 50°F (10°C).

3.4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

4. Dry (B) definition: Locations meeting the criteria in Items 4.1 through 4.4.

4.1. Not Marine (C).

4.2. If 70 percent or more of the precipitation, P, occurs during the high sun period, defined as April through September in the Northern Hemisphere and October through March in the Southern Hemisphere, then the dry/humid threshold is in accordance with Equation 3-1.

$P < 0.44 \times (T - 7)$

[$P < 20.0 \times (T + 14)$ in SI units] (Equation 3-1)

where:

P = Annual precipitation, inches (mm).
T = Annual mean temperature, °F (°C).

4.3. If between 30 and 70 percent of the precipitation, P, occurs during the high sun period, defined as April through September in the Northern Hemisphere and October through March in the Southern Hemisphere, then the dry/humid threshold is in accordance with Equation 3-2.

$P < 0.44 \times (T - 19.5)$

[$P < 20.0 \times (T + 7)$ in SI units] (Equation 3-2)

where:

P = Annual precipitation, inches (mm).

T = Annual mean temperature, °F (°C).

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4.4. If 30 percent or less of the precipitation, P, occurs during the high sun period, defined as April through September in the Northern Hemisphere and October through March in the Southern Hemisphere, then the dry/humid threshold is in accordance with Equation 3-3.

$$P < 0.44 \times (T - 32)$$

[$P < 20 \times T$ in SI units] (Equation 3-3)

where:

P = Annual precipitation, inches (mm).

T = Annual mean temperature, °F (°C).

5. Humid (A) definition: Locations that are not Marine (C) or Dry (B).

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TABLE R301.1 Climate Zones, Moisture Regimes, and Warm Humid Designations by State, County and Territory[a]

US STATES

ALABAMA
~~3A~~ 2A Coffee*
~~3A~~ 2A Covington*
~~3A~~ 2A Dale*
~~3A~~ 2A Escambia*
~~3A~~ 2A Geneva*
~~3A~~ 2A Henry*
~~3A~~ 2A Houston*

ALASKA
~~8~~ 7 Bethel
~~7~~ 8 Denali
~~8~~ 7 Dillingham
~~7~~ 6A Haines
~~7~~ 6A Juneau
~~7~~ 5C Ketchikan Gateway
~~7~~ 6A Kodiak Island
~~7~~ 5C Prince of Wales Outer Ketchikan
~~7~~ 5C Sitka
~~7~~ 6A Skagway-Hoonah-Angoon
~~7~~ 6A Wrangell-Petersburg

ARIZONA

ARKANSAS

CALIFORNIA

COLORADO
~~5B~~ 4B Bent
~~6B~~ 5B Custer
~~5B~~ 4B Prowers

CONNECTICUT

DELAWARE

DISTRICT OF COLUMBIA

FLORIDA
~~2A~~ 1A Palm Beach*

GEORGIA
~~4A~~ 3A Banks
~~3A~~ 2A Calhoun*
~~4A~~ 3A Catoosa
~~4A~~ 3A Chattooga
~~3A~~ 2A Coffee*
~~4A~~ 3A Dade
~~4A~~ 3A Dawson
~~3A~~ 2A Dougherty*
~~3A~~ 2A Early*
~~4A~~ 3A Fannin
~~4A~~ 3A Floyd
~~4A~~ 3A Franklin
~~4A~~ 3A Gilmer
~~4A~~ 3A Gordon
~~4A~~ 3A Habersham
~~4A~~ 3A Hall
~~4A~~ 3A Lumpkin
~~4A~~ 3A Murray
~~4A~~ 3A Pickens
~~4A~~ 3A Rabun
~~4A~~ 3A Stephens
~~3A~~ 2A Tift*
~~4A~~ 3A Towns
~~4A~~ 3A Union
~~4A~~ 3A Walker
~~4A~~ 3A White
~~4A~~ 3A Whitfield
~~3A~~ 2A Worth*

HAWAII

IDAHO

ILLINOIS
~~5A~~ 4A Calhoun
~~5A~~ 4A Clark
~~5A~~ 4A Coles
~~5A~~ 4A Cumberland
~~5A~~ 4A Greene
~~5A~~ 4A Jersey

INDIANA
~~5A~~ 4A Bartholomew
~~5A~~ 4A Clay
~~5A~~ 4A Decatur
~~5A~~ 4A Fayette
~~5A~~ 4A Franklin
~~5A~~ 4A Hendricks
~~5A~~ 4A Johnson
~~5A~~ 4A Marion
~~5A~~ 4A Morgan
~~5A~~ 4A Owen
~~5A~~ 4A Putnam
~~5A~~ 4A Rush
~~5A~~ 4A Shelby
~~5A~~ 4A Union
~~5A~~ 4A Vigo

IOWA
~~6A~~ 5A Allamakee
~~6A~~ 5A Bremer
~~6A~~ 5A Buchanan
~~6A~~ 5A Buena Vista
~~6A~~ 5A Butler
~~6A~~ 5A Calhoun
~~6A~~ 5A Cherokee
~~6A~~ 5A Chickasaw
~~6A~~ 5A Clayton
~~6A~~ 5A Delaware
~~6A~~ 5A Fayette
~~6A~~ 5A Floyd
~~6A~~ 5A Franklin
~~6A~~ 5A Grundy
~~6A~~ 5A Hamilton
~~6A~~ 5A Hardin
~~6A~~ 5A Howard
~~6A~~ 5A Humboldt
~~6A~~ 5A Ida
~~6A~~ 5A Plymouth
~~6A~~ 5A Pocahontas
~~6A~~ 5A Sac
~~6A~~ 5A Webster
~~6A~~ 5A Winneshiek
~~6A~~ 5A Wright

KANSAS
~~5A~~ 4A Cloud
~~5A~~ 4A Ellis
~~5A~~ 4A Graham
~~5A~~ 4A Hamilton
~~5A~~ 4A Lane
~~5A~~ 4A Mitchell
~~5A~~ 4A Ness
~~5A~~ 4A Osborne
~~5A~~ 4A Rooks
~~5A~~ 4A Trego

(*continued*)

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TABLE R301.1 (*continued*)

KENTUCKY

LOUISIANA

MAINE

MARYLAND
~~4A~~ 5A Allegany

MASSACHUSETTS

MICHIGAN
~~7~~ 6A Baraga
~~7~~ 6A Chippewa
~~7~~ 6A Gogebic
~~7~~ 6A Houghton
~~6A~~ 5A Huron
~~7~~ 6A Iron
~~7~~ 6A Luce
~~7~~ 6A Mackinac
~~6A~~ 7 Marquette
~~7~~ 6A Ontonagon
~~6A~~ 5A Sanilac
~~7~~ 6A Schoolcraft

MINNESOTA
~~7~~ 6A Becker
~~7~~ 6A Clay
~~6A~~ 5A Fillmore
~~7~~ 6A Grant
~~6A~~ 5A Houston
~~7~~ 6A Kanabec
~~7~~ 6A Mille Lacs
~~7~~ 6A Otter Tail
~~7~~ 6A Wilkin
~~6A~~ 5A Winona

MISSISSIPPI
~~3A~~ 2A George*

MISSOURI
~~5A~~ 4A Buchanan
~~5A~~ 4A Caldwell
~~5A~~ 4A Chariton
~~5A~~ 4A Clinton
~~4A~~ 3A Dunklin
~~4A~~ 3A Pemiscot

MONTANA

NEBRASKA

NEVADA
~~5B~~ 4B Carson City (city)
~~5B~~ 4B Douglas
~~5B~~ 4B Esmeralda
~~5B~~ 4B Lincoln
~~5B~~ 4B Lyon
~~5B~~ 4B Mineral
~~5B~~ 4B Nye

NEW HAMPSHIRE
~~6A~~ 5A Merrimack

NEW JERSEY
~~5A~~ 4A Mercer

NEW MEXICO
~~5B~~ 4B Catron
~~4B~~ 3B Sierra

NEW YORK
~~6A~~ 5A Allegany
~~6A~~ 5A Broome
~~6A~~ 5A Cattaraugus
~~6A~~ 5A Schoharie
~~6A~~ 5A Schuyler
~~6A~~ 5A Steuben
~~6A~~ 5A Tompkins
~~6A~~ 5A Wyoming

NORTH CAROLINA
~~4A~~ 3A Alamance
~~4A~~ 3A Alexander
~~4A~~ 3A Bertie
~~4A~~ 3A Caswell
~~4A~~ 3A Catawba
~~4A~~ 3A Chatham
~~4A~~ 3A Cherokee
~~4A~~ 3A Clay
~~4A~~ 3A Cleveland
~~4A~~ 3A Davie
~~4A~~ 3A Durham
~~4A~~ 3A Forsyth
~~4A~~ 3A Franklin
~~4A~~ 3A Gates
~~4A~~ 3A Granville
~~4A~~ 3A Guilford
~~4A~~ 3A Halifax
~~4A~~ 3A Harnett
~~4A~~ 3A Hertford
~~4A~~ 3A Iredell
~~4A~~ 3A Lee
~~4A~~ 3A Lincoln
~~5A~~ 4A Mitchell
~~4A~~ 3A Nash
~~4A~~ 3A Northampton
~~4A~~ 3A Orange
~~4A~~ 3A Person
~~4A~~ 3A Polk
~~4A~~ 3A Rockingham
~~4A~~ 3A Rutherford
~~4A~~ 3A Vance
~~4A~~ 3A Wake
~~4A~~ 3A Warren
~~4A~~ 3A Wilkes

NORTH DAKOTA
~~7~~ 6A Barnes
~~7~~ 6A Cass
~~7~~ 6A Eddy
~~7~~ 6A Foster
~~7~~ 6A Griggs
~~7~~ 6A Kidder
~~7~~ 6A McLean
~~7~~ 6A Mountrail
~~7~~ 6A Sheridan
~~7~~ 6A Steele
~~7~~ 6A Stutsman
~~7~~ 6A Traill
~~7~~ 6A Wells
~~7~~ 6A Williams

OHIO
~~5A~~ 4A Athens
~~5A~~ 4A Butler
~~5A~~ 4A Clinton
~~5A~~ 4A Fayette
~~5A~~ 4A Franklin
~~5A~~ 4A Greene
~~5A~~ 4A Highland
~~5A~~ 4A Hocking
~~5A~~ 4A Jackson
~~5A~~ 4A Madison
~~5A~~ 4A Meigs
~~5A~~ 4A Pickaway
~~5A~~ 4A Ross
~~5A~~ 4A Vinton
~~5A~~ 4A Warren

OKLAHOMA
~~3A~~ 4A Alfalfa
~~3A~~ 4A Craig
~~3A~~ 4A Delaware
~~3A~~ 4A Ellis
~~3A~~ 4A Garfield
~~3A~~ 4A Grant
~~3A~~ 4A Harper
~~3A~~ 4A Kay

(*continued*)

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TABLE R301.1 (*continued*)

~~3A~~ 4A Major
~~3A~~ 4A Nowata
~~3A~~ 4A Osage
~~3A~~ 4A Ottawa
~~3A~~ 4A Washington
~~3A~~ 4A Woods
~~3A~~ 4A Woodward

OREGON

PENNSYLVANIA
~~5A~~ 4A Adams
~~5A~~ 4A Berks
~~6A~~ 5A Cameron
~~6A~~ 5A Clearfield
~~5A~~ 4A Cumberland
~~5A~~ 4A Dauphin
~~6A~~ 5A Elk
~~5A~~ 4A Franklin
~~5A~~ 4A Lancaster
~~5A~~ 4A Lebanon
~~6A~~ 5A McKean
~~5A~~ 4A Perry
~~6A~~ 5A Potter
~~6A~~ 5A Susquehanna
~~6A~~ 5A Tioga
~~6A~~ 5A Wayne

RHODE ISLAND

SOUTH CAROLINA
~~3A~~ 2A Beaufort*
~~3A~~ 2A Jasper*

SOUTH DAKOTA
~~6A~~ 5A Haakon
~~6A~~ 5A Brule
~~6A~~ 5A Jones
~~6A~~ 5A Lyman
~~6A~~ 5A Stanley

TENNESSEE
~~4A~~ 3A Bedford
~~4A~~ 3A Coffee
~~4A~~ 3A Davidson
~~4A~~ 3A Decatur
~~4A~~ 3A Franklin
~~4A~~ 3A Gibson
~~4A~~ 3A Giles
~~4A~~ 3A Grundy
~~4A~~ 3A Hamilton
~~4A~~ 3A Hickman
~~3A~~ 4A Lake
~~4A~~ 3A Lawrence
~~4A~~ 3A Lewis
~~4A~~ 3A Lincoln
~~4A~~ 3A Marion
~~4A~~ 3A Marshall
~~4A~~ 3A Maury
~~4A~~ 3A Moore
~~4A~~ 3A Perry
~~4A~~ 3A Rutherford
~~4A~~ 3A Wayne
~~4A~~ 3A Williamson

TEXAS
~~2A~~ 1A Cameron*
~~3A~~ 2A Dallas*
~~3A~~ 2A Ellis*
~~2A~~ 1A Hidalgo*
~~3A~~ 2A Johnson*
~~3A~~ 2A Navarro*
~~3A~~ 2A Tarrant*
~~2A~~ 1A Willacy*

UTAH
~~6B~~ 5B Box Elder
~~6B~~ 5B Cache
~~6B~~ 5B Carbon

VERMONT

VIRGINIA
4A (all except as follows:)
5A Alleghany
5A Bath
3A Brunswick
3A Chesapeake
5A Clifton Forge
5A Covington
3A Emporia
3A Franklin
3A Greensville
3A Halifax
3A Hampton
5A Highland
3A Isle of Wight
3A Mecklenburg
3A Newport News
3A Norfolk
3A Pittsylvania
3A Portsmouth
3A South Boston
3A Southampton
3A Suffolk
3A Surry
3A Sussex
3A Virginia Beach

WASHINGTON
~~4C~~ 5C Clallam
~~4C~~ 5C Island
~~4C~~ 5C Kitsap
~~6B~~ 5B Okanogan
~~4C~~ 5C San Juan

WEST VIRGINIA
~~5A~~ 4A Doddridge
~~5A~~ 4A Fayette
~~5A~~ 4A Greenbrier
~~5A~~ 4A Lewis
~~5A~~ 4A Nicholas
~~5A~~ 4A Raleigh
~~5A~~ 4A Summers
~~5A~~ 4A Upshur
~~5A~~ 4A Webster

WISCONSIN
~~6A~~ 5A Adams
~~7~~ 6A Ashland
~~7~~ 6A Bayfield
~~7~~ 6A Burnett
~~6A~~ 5A Calumet
~~6A~~ 5A Columbia
~~6A~~ 5A Crawford
~~6A~~ 5A Dane
~~6A~~ 5A Dodge
~~7~~ 6A Douglas
~~7~~ 6A Florence
~~6A~~ 5A Fond du Lac
~~7~~ 6A Forest
~~6A~~ 5A Grant
~~6A~~ 5A Green
~~6A~~ 5A Green Lake
~~6A~~ 5A Iowa
~~7~~ 6A Iron
~~6A~~ 5A Jefferson
~~6A~~ 5A Juneau
~~6A~~ 5A Kenosha
~~6A~~ 5A La Crosse
~~6A~~ 5A Lafayette
~~7~~ 6A Langlade
~~7~~ 6A Lincoln
~~6A~~ 5A Milwaukee
~~6A~~ 5A Monroe
~~7~~ 6A Oneida

(*continued*)

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TABLE R301.1 (*continued*)

~~6A~~ 5A Outagamie
~~6A~~ 5A Ozaukee
~~7~~ 6A Price
~~6A~~ 5A Racine
~~6A~~ 5A Richland
~~6A~~ 5A Rock
~~6A~~ 5A Sauk
~~7~~ 6A Sawyer
~~7~~ 6A Taylor
~~6A~~ 5A Vernon
~~7~~ 6A Vilas
~~6A~~ 5A Walworth
~~7~~ 6A Washburn
~~6A~~ 5A Washington
~~6A~~ 5A Waukesha
~~6A~~ 5A Waushara
~~6A~~ 5A Winnebago

WYOMING
~~6B~~ 5B Laramie

US TERRITORIES
AMERICAN SAMOA

GUAM

NORTHERN MARIANA ISLANDS

PUERTO RICO
1A (all except as follows:)*
2B Barraquitas
2B Cayey

VIRGIN ISLANDS

a. Key: A – Moist, B – Dry, C – Marine. Absence of moisture designation indicates moisture regime is irrelevant.
Asterisk (*) indicates a Warm Humid location.
Note: Only counties assigned a new climate zone are shown here. Please refer to Table R301.1 for the full list of counties.

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~~TABLE R301.3(1)~~ ~~International Climate Zone Definitions~~

~~MAJOR CLIMATE TYPE DEFINITIONS~~
~~Marine (C) Definition—Locations meeting all four criteria:~~ ~~1. Mean temperature of coldest month between –3°C (27°F) and 18°C (65°F).~~ ~~2. Warmest month mean < 22°C (72°F).~~ ~~3. At least four months with mean temperatures over 10°C (50°F).~~ ~~4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.~~
~~Dry (B) Definition—Locations meeting the following criteria:~~ ~~Not marine and $P_{in} < 0.44 \times (TF - 19.5)$ [$P_{cm} < 2.0 \times (TC + 7)$ in SI units]~~ ~~where:~~ ~~P_{in} = Annual precipitation in inches (cm)~~ ~~T = Annual mean temperature in °F (°C)~~
~~Moist (A) Definition—Locations that are not marine and not dry.~~
~~Warm-humid Definition—Moist (A) locations where either of the following wet-bulb temperature conditions shall occur during the warmest~~ ~~six consecutive months of the year:~~ ~~1. 67°F (19.4°C) or higher for 3,000 or more hours; or~~ ~~2. 73°F (22.8°C) or higher for 1,500 or more hours.~~

~~For SI: °C = [(°F) – 32]/1.8, 1 inch = 2.54 cm.~~

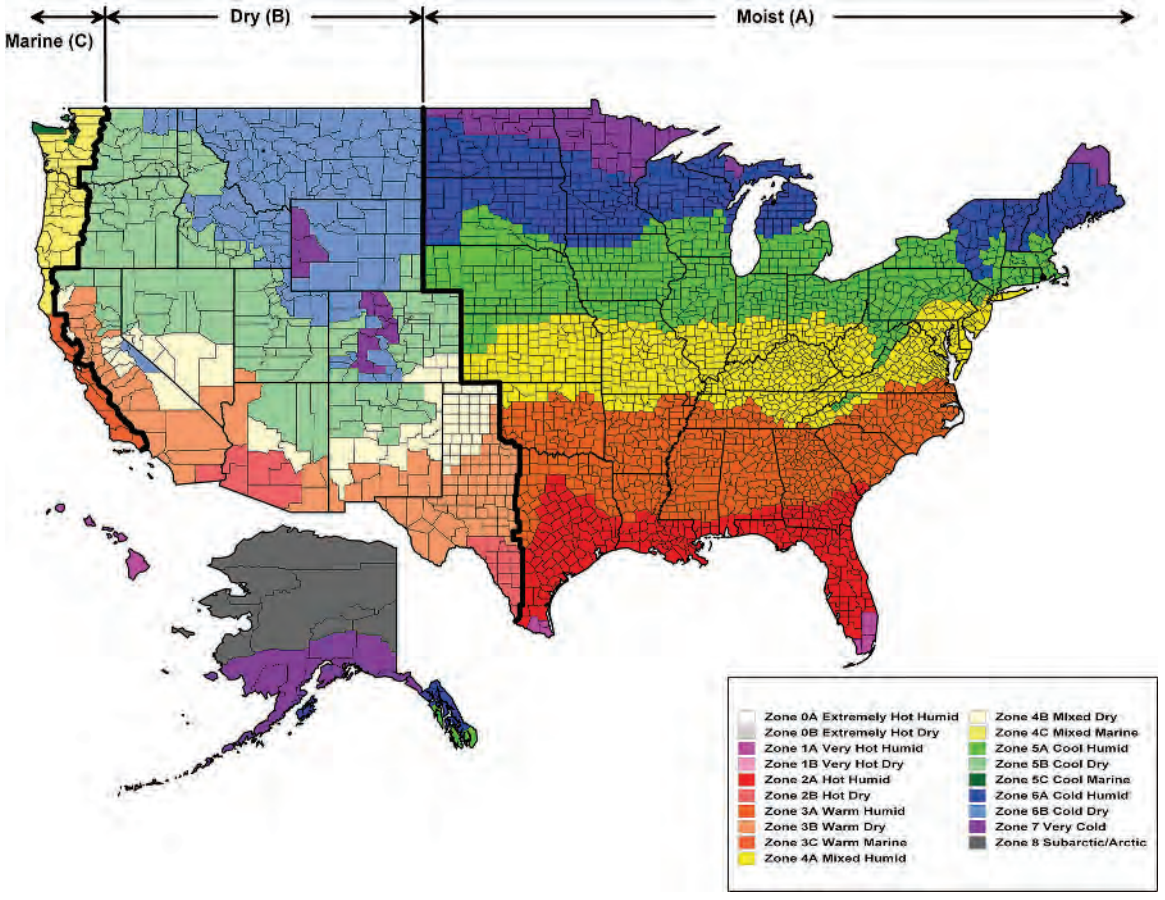


Figure R301.1 Climate Zones.

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TABLE ~~R301.3(2)~~ R301.3 Thermal Climate Zone Definitions

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
0	10,800 < CDD50°F	6000 < CDD10°C
1	9,000 < CDD50°F < 10,800	5000 < CDD10°C < 6000
2	6,300 < CDD50°F ≤ 9,000	3500 < CDD10°C ≤ 5000
~~3A and 3B~~ 3	~~4,500 <~~ CDD50°F ≤ 6,300 AND HDD65°F ≤ ~~5,400~~ 3,600	CDD10°C < 3500 AND HDD18°C ≤ ~~3000~~ 2000
~~4A and 4B~~ 4	CDD50°F ≤ ~~4,500~~ 6,300 AND 3,600 < HDD65°F ≤ 5,400	CDD10°C < ~~2500~~ 3500 AND 2000 < HDD18°C ≤ 3000
~~3C~~	~~HDD65°F ≤ 3,600~~	~~HDD18°C ≤ 2000~~
~~4C~~	~~3,600 < HDD65°F ≤ 5,400~~	~~2000 < HDD18°C ≤ 3000~~
5	CDD50°F < 6,300 AND 5,400 < HDD65°F ≤ 7,200	CDD10°C < 3500 AND 3000 < HDD18°C ≤4000
6	7,200 < HDD65°F ≤ 9,000	4000 < HDD18°C ≤5000
7	9,000 < HDD65°F ≤ 12,600	5000 < HDD18°C ≤ 7000
8	12,600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F) – 32]/1.8.

CHANGE SIGNIFICANCE: The climate zone provisions in Chapter 3, from Section R301.3 through the climate zone tables and map, have undergone a significant update. This update corresponds with ASHRAE Standard 169-2013, which is referenced in the 2018 IgCC, ASHRAE 90.1 and ASHRAE 90.2. ICC has a licensing agreement with ASHRAE to include the climate zone map, definitions and tables for consistency with ASHRAE Standard 169 and other key codes and standards.

These two key updates are relevant to most code users:

- Updates to the climate zone designations in Table R301.1 for approximately 10 percent of the counties in the United States. In general, the counties were assigned a warmer climate zone.
- Updates to Figure R301.1, the climate zone map, to reflect the changes in county climate zone designations.

The number of climate zones increased to include Climate Zone 0, representing the hottest of climates. Climate Zone 0 is a subset of the previous Climate Zone 1, which included all locations with more than 9,000 Cooling Degree Days (CDDs). Climate Zone 1 now tops out at 10,800 CDDs, and Climate Zone 0 is for those locations with more. Cities in Climate Zone 0 include extremely hot locations such as Mumbai (Bombay), Jakarta and Abu Dhabi. There are no cities in the United States in Climate Zone 0. Several code changes introduce specific provisions for Climate Zone 0. Because Climate Zone 0 is a subset of the former Climate Zone 1, references throughout the IECC to CZ 1 have been edited to CZ 0 and 1.

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Code users needing to calculate the moisture zone (marine, dry or humid) will find Section R301.3 entirely revised. Calculations are in three categories: (a) when monthly average temperature and precipitation data are available, (b) when annual average temperature, degree days and precipitation data are available, and (c) when only degree day information is available.

R301.3(1) has been eliminated and R301.3(2) renumbered to R301.3. Section R301.3 now includes Climate Zone 0 and the revised heating and cooling degree day thresholds for climate zones. Table R301.3 Thermal Climate Zone Definitions has also been revised to include Climate Zone 0 and the adjusted degree days for other climate zones.

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PART 7

Residential Energy Provisions: Energy Efficiency Requirements

Chapters 4 and 5

- **Chapter 4** Residential Energy Efficiency
- **Chapter 5** Existing Buildings
  No changes addressed

Chapters 4 and 5 of the *International Energy Conservation Code* (IECC) contain the bulk of the design and construction provisions for residential buildings. The definition of a *residential building* is unique to this code. The IECC defines *residential buildings* as detached one- and two-family dwellings and multiple single-family dwellings as well as R-2, R-3 or R-4 buildings three stories or less in height. All other buildings are regulated by the energy conservation requirements in the IECC—Commercial provisions. The applicable portions of a residential building must comply with the provisions in chapters 4 and 5 for energy efficiency.

Chapter 4 defines the requirements for the entire building system, including the building envelope and mechanical, service water heating and electrical power and lighting systems. Chapter 4 also includes required additional efficiency options and alternative compliance paths.

Chapter 5 addresses construction on existing buildings – additions, alterations and changes to occupancy – correlating to the requirements of Chapter 4. ■

R401.2
Compliance Paths

R401.3
Certificate

R402
Building Envelope

R402.1.2
Insulation and Fenestration Criteria

TABLE R402.1.2
Insulation and Fenestration *U*-Factors

TABLE R402.1.3
Insulation Minimum *R*-Values and Fenestration Requirements by Component

R402.2.8
Basement Walls

R402.4.1.2
Air Leakage Testing

R402.5
Maximum Fenestration *U*-Factor and SHGC

R403
Systems

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R403.3.1-R403.3.3.1
Duct Location and Insulation

R403.3.5
Duct Testing

R403.6.3
Mechanical Ventilation System Testing

R404
Electrical Power and Lighting Systems

R404.1.1
Exterior Lighting

R404.2
Interior Lighting Controls

R404.3
Exterior Lighting Controls

R405
Total Building Performance

R405.2
Performance-Based Compliance

R405.3.2
Compliance Report

R406
Energy Rating Index Compliance Alternative

R406.2
ERI Compliance

R406.3
Building Thermal Envelope

406.7.3
Renewable Energy Certificate Documentation

407
Tropical Climate Region

R408
Additional Efficiency Package Options

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R401.2

Compliance Paths

CHANGE TYPE: Modification

CHANGE SUMMARY: Compliance path options for the residential provisions of the IECC are named and the sections required for each option are outlined.

2021 CODE: **R401.2 ~~Compliance~~ Application.** ~~Projects~~ Residential buildings shall comply with Section R401.2.5 and either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4. ~~one of the following~~:

~~**1.** Sections R401 through R404.~~

~~**2.** Section R405 and the provisions of Sections R401 through R404 indicated as "Mandatory."~~

~~**3.** The energy rating index (ERI) approach in Section R406.~~

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

R401.2.1 Prescriptive Compliance Option. The Prescriptive Compliance Option requires compliance with Sections R401 through R404.



Residential projects must comply with one of four compliance options.

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R401.2.2 Total Building Performance Option. The Total Building Performance Option requires compliance with Section R405~~, and the provisions of Sections R401 through R404 indicated as "Mandatory".~~

R401.2.3 Energy Rating Index Option. The Energy Rating Index (ERI) Option requires compliance with Section R406.

R401.2.4 Tropical Climate Region Option. The Tropical Climate Region option requires compliance with Section R407.

R401.2.5 Additional energy efficiency. This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.
2. For buildings complying with Section R401.2.2, the building shall meet one of the following:
   - **2.1.** One of the additional efficiency package options in Section R408.2 shall be installed without including such measures in the proposed design under Section R405; or
   - **2.2.** The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.
3. For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.

The option selected for compliance shall be identified in the certificate required by Section R401.3.

CHANGE SIGNIFICANCE: Beginning in the 2006 IECC, Section R401.2 identified two options for compliance with the technical provisions included in Chapter 4 of the IECC. The options are not formally named within the code but have commonly been referred to as the prescriptive and performance compliance paths. A third compliance path, the Energy Rating Index, was added to the 2015 IECC along with a simplified compliance approach for certain dwelling units located in the equatorial Tropical Region; the latter was not listed with the other compliance paths in Section R401.2.

Section R401.2 has been revised to clarify and name the four compliance paths for residential projects. Naming the compliance options (Prescriptive, Total Building Performance, Energy Rating Index and Tropical Climate Region) formalizes the way in which the paths are identified and adds clarity for training, education and new code users. Referring to the four paths as options reinforces that it is the designer's choice as to which path is followed.

The terms *prescriptive* and *mandatory* in provision titles throughout Chapter 4 are also eliminated, reducing confusion about the application of the code requirements labeled as such. This corresponds to the creation

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of project requirement tables in Sections R405 and R406; all requirements associated with these compliance paths are now contained within the respective sections.

Additionally, the requirements for Tropical Climate Region compliance have been relocated to the new Section R407.

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CHANGE TYPE: Modification

R401.3
Certificate

CHANGE SUMMARY: Requirements for the certificate are expanded to include the code edition and compliance path for the project as well as information related to photovoltaic systems and Energy Rating Index scores, if applicable.

Energy Efficiency Certificate

Code edition	
Compliance path	

Insulation Rating		*R* -Value		*R* -Value
Ceiling/Roof		*R*-		*R*-
Walls	Frame	*R*-	Mass	*R*-
	Basement	*R*-	Crawl space	*R*-
Floors	Over unconditioned space	*R*-	Slab edge	*R*-
Ducts	Attic	*R*-	Other	*R*-

Air Leakage Test Results

Envelope testing ☐ **ACH** _____**Pa.** **Duct testing** ☐ **cfm/100 ft²**

Fenestration Rating	**NFRC *U*-Factor**	**NFRC SHGC**
Window	*U*-	
Opaque door	*U*-	
Skylight	*U*-	
Weighted average	*U*-	

Equipment Performance	**Type**	**Efficiency**		**Size**
Heating system			AFUE	
Cooling system			SEER	
Water heater			EF	

Indicate if the following have been installed (an efficiency shall not be listed)

☐ electric furnace ☐ gas-fire unvented room heater ☐ baseboard electric heater

Additional Energy Efficiency (check one)

☐ **Proposed design had an annual energy cost ≤ 95% of that of the reference design**

☐ **Energy Rating Index score is at least 5% less than ERI target**

☐ **Additional efficiency package option is installed (specify option)**

Photovoltaic Panel System		**Energy Rating Index Score**	
Array capacity		**with PV**	
Inverter efficiency		**without PV**	
Panel tilt			
Orientation			

Designer/builder **Date**

This Certificate is to be posted in accordance with Section R401.3 of the International Energy Conservation Code.

The Certificate must now include compliance path, among other new items.

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2021 CODE: **R401.3 Certificate ~~(Mandatory)~~.** A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall indicate the following:

1. The predominant *R*-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors and ducts outside conditioned spaces.
2. *U*-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for ~~each~~ any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.
3. The results from any required duct system and building envelope air leakage testing performed on the building.
4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.
5. Where onsite photovoltaic panel systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.
6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.
7. The code edition under which the structure was permitted, and the compliance path used.

CHANGE SIGNIFICANCE: The updates to the certificate reflect changes made to the IECC in recent code cycles and include information that is beneficial for compliance purposes and for future homeowners performing maintenance or replacing equipment. In addition to detail on thermal envelope efficiency and HVAC equipment size, the certificate now requires the compliance path and code version under which the project was permitted, details on renewable energy systems installed and information related to the Energy Rating Index score, if applicable. The information required for the certificate is readily available at construction and on project documentation, and it will take very little effort to transfer it onto the permanent certificate. However, such information may be difficult or impossible to determine in the future.

This provision is applicable to all compliance paths.

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R402
Building Envelope

Section R402 provides building thermal envelope provisions for residential buildings, including limitations on air infiltration, or air leakage. The building envelope is important to building energy efficiency. When it is cold outside, heat loss and air leakage through the building envelope add to the heating load. On hot days, solar gains through windows, heat gain through opaque assemblies and the infiltration of hot or humid air contribute to the cooling load. The building envelope requirements of Section R402 are intended to reduce these heat gains and losses through the building envelope.

The residential envelope provisions have seen few changes since the 2012 IECC. Significant changes to the building envelope in the 2021 IECC include:

- Increased insulation requirements
- Reduced fenestration *U*-factors and solar heat gain coefficients (SHGCs)
- Increased air leakage requirements
- Revised duct testing requirements.



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Efficient building envelopes reduce heat gains and losses.

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R402.1.2

Insulation and Fenestration Criteria

CHANGE TYPE: Modification

CHANGE SUMMARY: The assembly *U*-Factor is established as the primary insulation metric, and *R*-Value is an alternative.

2021 CODE: **R402.1.2 Insulation and fenestration criteria.** The building thermal envelope shall meet the requirements of Table R402.1.2, based on the climate zone specified in Chapter 3. Assemblies shall have a *U*-factor equal to or less than that specified in Table R402.1.2. Fenestration shall have a *U*-factor and glazed fenestration SHGC equal to or less than that specified in Table R402.1.2.

R402.1.3 R-value alternative. Assemblies with *R*-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the *U*-factor in Table R402.1.2.

CHANGE SIGNIFICANCE: Since the 2006 IECC, *R*-values have been the primary metric for envelope efficiencies, with assembly *U*-factors serving as an alternative compliance metric. The 2021 IECC focuses envelope efficiency on *U*-factors which define the performance of entire assemblies. The *R*-value approach is retained, providing predetermined solutions based on the *U*-factor requirements. This reorientation ensures the *R*-values used are a derivative of the intended performance levels represented by the assembly *U*-factors. The SHGC values (and footnotes) are consistent with those in the previous *R*-value table.

These provisions are applicable to the Prescriptive Compliance path.



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U-factor is used to measure thermal transmittance of fenestration and envelope assemblies.

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Table R402.1.2

Insulation and Fenestration *U*-Factors

CHANGE TYPE: Modification

CHANGE SUMMARY: The ceiling and framed wall assembly *U*-factors in Table R402.1.2 have been decreased.

2021 CODE: Table R402.1.2.

CHANGE SIGNIFICANCE: The 2021 IECC increases efficiencies for ceilings, wood frame walls and fenestration. Specifically, the ceiling *U*-factors for Climate Zones 2 and 3 are decreased to align with the 2018 IECC requirements for Climate Zone 4 and higher; similarly, ceiling *U*-factors are decreased for Climate Zones 4 through 8, increasing efficiency beyond what was achieved in previous code versions. The *U*-factor requirements for wood frame walls in Climate Zones 4 and 5 are decreased as well, aligning with the 2018 IECC requirements for Climate Zones 6 through 8. Improved efficiencies in fenestration *U*-factors for Climate Zones 3 and 4 are also achieved. Finally, SHGC values are copied from the *R*-value table to the *U*-factor table, with requirements added for Climate Zone 5 that are consistent with the 2018 IECC requirements for Climate Zone 4 (0.40).

Table R402.1.2 introduces a footnote that provides an exception to the prescriptive *U*-factors for fenestration installed at high altitudes (above 4,000 feet in elevation) and in regions that require fenestration to be resistant to windborne debris in Climate Zones 3 through 8.

This table is applicable to the Prescriptive compliance path.



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U-factors have been decreased for greater efficiency.

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TABLE ~~R402.1.4~~ R402.1.2 ~~Equivalent~~ Maximum Assembly *U*-Factors[a] and Fenestration Requirements

CLIMATE ZONE	FENESTRATION *U*-FACTOR[f]	SKYLIGHT *U*-FACTOR	GLAZED FENESTRATION SHGC[d,e]	CEILING *U*-FACTOR	WOOD FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	~~0.030~~ 0.026	0.084	0.165	0.064	0.360	0.477
3	~~0.32~~ .30	0.55	0.25	~~0.030~~ 0.026	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	~~0.32~~ .30	0.55	0.40	~~0.026~~ 0.024	~~0.060~~ 0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	~~0.026~~ 0.024	~~0.060~~ 0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	~~0.026~~ 0.024	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	~~0.026~~ 0.024	0.045	0.057	0.028	0.050	0.055

For SI: 1 foot = 304.8 mm.

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.

d. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

e. There are no SHGC requirements in the Marine Zone.

f. A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the International Residential Code.

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CHANGE TYPE: Modification

CHANGE SUMMARY: The *R*-value table has been restructured and the efficiencies for most components have been increased.

2021 CODE: Table R402.1.3.

CHANGE SIGNIFICANCE: Efficiencies are increased for ceilings, wood frame walls, basement walls, crawlspace walls, slabs on grade and fenestration. Ceiling *R*-value requirements for Climate Zones 2 and 3 are increased to align with the 2018 IECC requirements for Climate Zone 4 and higher, and the efficiencies in Climate Zones 4 through 8 are similarly increased.

Insulation *R*-values for wood frame walls increased in Climate Zones 4 and 5, aligning with the 2018 IECC requirements for Climate Zone 6.

Basement and crawlspace wall requirements are amended for clarity and the alternative compliance option (13 & 5ci) is moved from the footnote to the table. The clarification is made by adding a "ci" designator for the continuous insulation components in the table. This is also carried through in footnote c. The footnote is further clarified by consistently referring to "wall" rather than "basement" or "home" with no mention of "crawlspace." The footnote applies to basement and crawlspace walls as noted in the heading of the table columns. The word "surface" is added to clarify that where continuous insulation is used, it should be applied to the surface of the foundation wall (and any additional cavity insulation applied to the interior side of the continuous insulation).

Slab on grade insulation efficiency has been increased for Climate Zones 3 through 5. The slab *R*-value requirements had not been improved in any climate zone since the 2006 IECC or before.

Table R402.1.3

Insulation Minimum *R*-Values and Fenestration Requirements by Component



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R-values have been increased for greater efficiency.

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~~TABLE R402.1.2~~ TABLE R402.1.3 Insulation Minimum *R*-values and Fenestration Requirements By Component[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b,i]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b,e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE[g]	MASS WALL *R*-VALUE[h]	FLOOR *R*-VALUE	BASEMENT[c,g] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c,g] WALL *R*-VALUE
0	NR	0.75	0.25	30	13 or 0 & 10ci [g]	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 & 10ci[g]	3/4	13	0	0	0
2	0.40	0.65	0.25	~~38~~ 49	13 or 0 & 10ci[g]	4/6	13	0	0	0
3	~~0.32~~ .30	0.55	0.25	~~38~~ 49	20 or ~~13+5[h]~~ 13 & 5ci[h] or 0 & 15ci[g,h]	8/13	19	~~5/13[f]~~ 5ci or 13[f]	~~0~~10ci, 2 ft	~~5/13~~ 5ci or 13[f]
4 except Marine	~~0.32~~ .30	0.55	0.40	~~49~~ 60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	8/13	19	~~10 /13~~ 10ci or 13	10ci, ~~2~~ 4 ft	~~10/13~~ 10ci or 13
5 and Marine 4	0.30[i]	0.55	~~NR~~ 0.40	~~49~~ 60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	13/17	30[g]	~~15/19~~ 15ci or 19 or 13 & 5ci	10ci, ~~2~~ 4 ft	~~15/19~~ 15ci or 19 or 13 & 5ci
6	0.30[i]	0.55	NR	~~49~~ 60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	15/20	30[g]	~~15/19~~ 15ci or 19 or 13 & 5ci	10ci, 4 ft	~~15/19~~ 15ci or 19 or 13 & 5ci
7 and 8	0.30[i]	0.55	NR	~~49~~ 60	30 or 20 & 5ci[h] or 13 & 10ci[h] or 0 & 20ci[h]	19/21	38[g]	~~15/19~~ 15ci or 19 or 13 & 5ci	10ci, 4 ft	~~15/19~~ 15ci or 19 or 13 & 5ci

For SI: 1 foot = 304.8 mm.
NR = Not Required.
ci = continuous insulation.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall be not less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior of the wall.
"10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior of the wall.
"15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs, as indicated in the table. The slab-edge insulation for heated slabs shall not be required to extend below the slab.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in Warm Humid locations as defined by Figure R301.1 and Table R301.1.

~~g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an *R*-value of R-19.~~

g. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, "13 & 5" means R-13 cavity insulation plus R-5 continuous insulation.

h. Mass walls shall be in accordance with Section R402.2.5. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

i. A maximum *U*-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:
1. Above 4,000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the International Residential Code.

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Floor insulation footnote g in Climate Zones 4 through 8 improves the efficiency of dwellings in the coldest climate zones by removing an exception that allows weaker floor insulation *R*-values with no corresponding improvements elsewhere in the building.

Fenestration *U*-factors in Climate Zones 3 and 4 are similarly increased in efficiency, and SHGC has been introduced in Climate Zone 5 where it was previously not regulated.

Finally, Table R402.1.2 introduces a footnote that provides an exception to the prescriptive *U*-factors for fenestration installed at high altitudes (above 4,000 feet in elevation) and in regions that require fenestration to be resistant to windborne debris in Climate Zones Marine 4 and 5 through 8.

This table is applicable to the Prescriptive compliance path.

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R402.2.8

Basement Walls

CHANGE TYPE: Modification

CHANGE SUMMARY: Exceptions to the basement walls provision clearly define the characteristics of unconditioned basements.

2021 CODE: **R402.2.8 Basement walls.** Basement walls shall be insulated in accordance with Table R402.1.3.

Exception: Basement walls associated with unconditioned basements where all of the following requirements are met:

1. The floor overhead, including the underside stairway stringer leading to the basement, is insulated in accordance with Section R402.1.3 and applicable provisions of Sections R402.2 and R402.2.7.
2. There are no uninsulated duct, domestic hot water, or hydronic heating surfaces exposed to the basement.
3. There are no HVAC supply or return diffusers serving the basement.
4. The walls surrounding the stairway and adjacent to conditioned space are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2.
5. The door(s) leading to the basement from conditioned spaces are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2, and weatherstripped in accordance with Section R402.4.
6. The building thermal envelope separating the basement from adjacent conditioned spaces complies with Section R402.4.



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Unconditioned basements are exempt from basement wall provisions.

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R402.2.8.1 ~~R402.2.9~~ Basement wall insulation installation. ~~Walls associated with conditioned basements~~ Where basement walls are insulated, the insulation shall be ~~insulated~~ installed from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less.

CHANGE SIGNIFICANCE: Basement walls are required to comply with the provisions in Table R402.1.3 unless they meet each of the characteristics for unconditioned basements. Previous versions of the energy code did not consider the heat transfer through ducts, stairways, doors and other elements of the basement when defining an unconditioned basement. Changes to this section clearly outline the characteristics that must be present in an unconditioned basement to remove the basement from consideration as an extension of conditioned space.

These provisions are applicable to the Prescriptive compliance path.

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R402.4.1.2

Air Leakage Testing

CHANGE TYPE: Modification

CHANGE SUMMARY: The air leakage requirements are revised and a new definition for dwelling unit enclosure area is provided.

2021 CODE: **DWELLING UNIT ENCLOSURE AREA.** The sum of the area of ceiling, floors and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.

R402.4.1.2 Testing. The building or dwelling unit shall be tested ~~and verified as having an air leakage rate not exceeding five 5.0 air changes per hour in Climate Zones 1 and 2, and three 3.0 air changes per hour in Climate Zones 3 through 8.~~ for air leakage. The maximum air leakage rate for any building or dwelling unit under any compliance path shall not exceed 5.0 air changes per hour or 0.28 cubic feet per minute (CFM) per square foot [0.0079 $m^3/(s \times m^2)$] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where

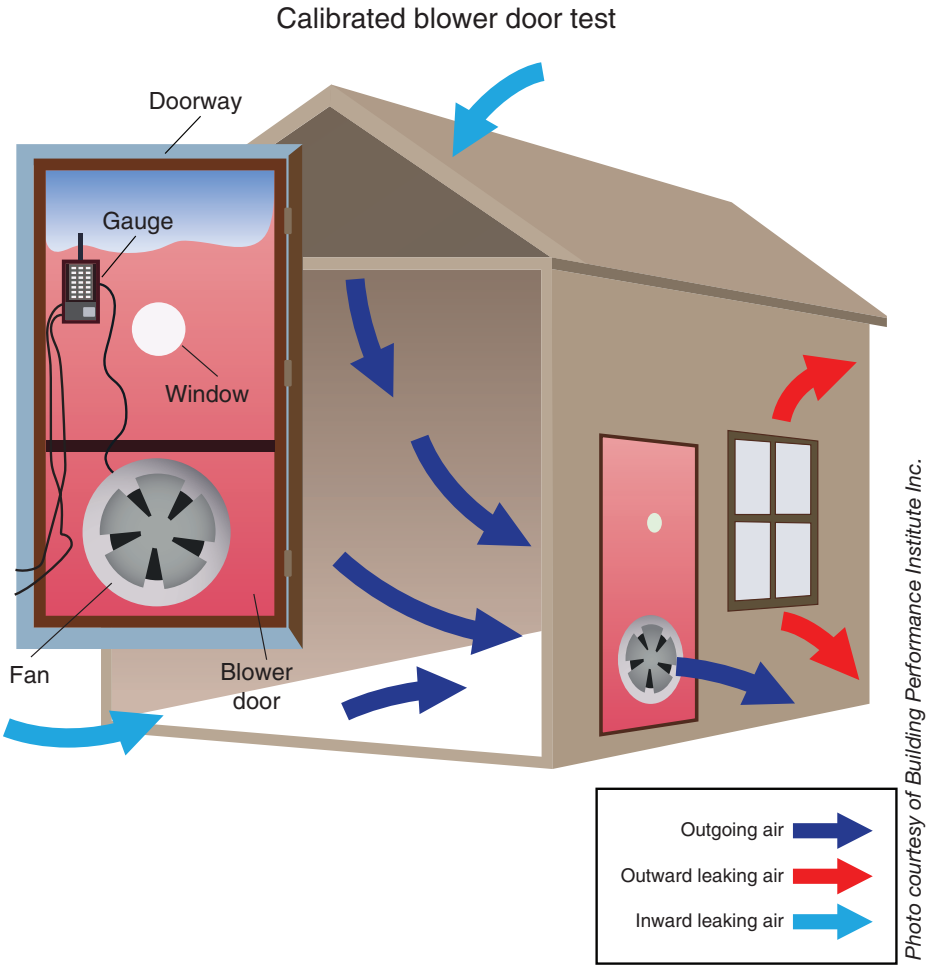


Photo courtesy of Building Performance Institute Inc.

Air leakage testing is required for residential projects.

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required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope have been sealed.

Exception: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.12 and R402.3.5, as applicable.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: When testing individual dwelling units, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 $m^3/(s \times m^2)$] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be permitted in all climate zones for:

1. Attached single and multiple-family building dwelling units.
2. Buildings or dwelling units that are 1,500 square feet (139.4 m^2) or smaller.

Mechanical ventilation shall be provided in accordance with Section M1505 of the International Residential Code or Section 403.3.2 of the International Mechanical Code, as applicable, or with other approved means of ventilation.

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R402.4.1.3 Leakage rate. When complying with Section R401.2.1, the building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 0, 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

CHANGE SIGNIFICANCE: Several significant changes have been made to the testing requirements for residential projects. The maximum air leakage rate is now 5 air changes per hour (ACH) for all compliance paths and 3 ACH for dwellings in Climate Zones 3 through 8 following the Prescriptive compliance path. The air leakage rate for buildings and dwelling units following the Prescriptive compliance path is detailed in the new Section R402.4.1.3. Heated attached and detached garages that are field verified for air barrier and insulation installation criteria in Table R402.4.1.1 are exempt from the testing requirements.

An alternative testing metric has been added to the 2021 IECC for attached single and multiple-family dwelling units and smaller homes. While median-sized single-family homes are typically able to achieve the air leakage rate required by the IECC, it can be more difficult for small volume or attached homes to comply. The alternative metric more accurately reflects leakage through the exterior enclosure area which ensures even small volume homes are able to comply with the required air leakage rates.

These provisions are applicable to all compliance paths except the Tropical Climate Region compliance option.

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R402.5

Maximum Fenestration *U*-Factor and SHGC

CHANGE TYPE: Modification

CHANGE SUMMARY: The maximum fenestration *U*-factors are reduced, and an exception is provided for storm shelters.

2021 CODE: R402.5 Maximum fenestration *U*-factor and SHGC (~~Mandatory~~). The area-weighted average maximum fenestration *U*-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones 0 through 3 shall be ~~0.50~~ 0.40.

> **Exception:** The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall not be required in storm shelters complying with ICC 500.

CHANGE SIGNIFICANCE: Maximum fenestration *U*-factors have been in the IECC since the 2006 version and serve as a backstop in the event of tradeoffs. Over four code update cycles, from the 2009 IECC through the 2018 IECC, prescriptive fenestration efficiencies increased, but the maximum *U*-factors and SHGCs used for tradeoffs were not updated. To remain consistent with improvements made to the prescriptive fenestration values, maximum fenestration *U*-factors and SHGCs permitting in the tradeoff compliance options are updated in the 2021 IECC.

This provision is applicable to the Prescriptive compliance option where tradeoffs are used and to the Total Building Performance compliance option.



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U-Factor and SHGC requirements indicate heat transmittance of fenestration.

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R403
Systems

Section R403 broadly addresses the efficiency, construction and operation of building mechanical systems that are not regulated by the U.S. Department of Energy. Federal regulation establishes energy efficiency standards for many consumer and commercial appliances under the Energy Policy and Conservation Act (EPCA). States are preempted from creating energy efficiency standards for appliances and equipment that are covered by federal law under EPCA 42 U.S.C. 6201, et seq.[1] Thus, the IECC efficiencies related to mechanical systems are achieved with insulated and sealed delivery systems and controls.

The 2021 IECC Section R403 is divided into 12 parts:

- Sections R403.1 and R403.2 address controls for residential systems, including thermostats and hot water boiler outdoor temperature
- Section R403.3 covers ducts and air handlers
- Section R403.4 addresses insulation for system piping
- Section R403.5 addresses service hot water systems
- Section R403.6 covers mechanical ventilation provisions, including whole house fan efficiencies and system testing
- Section R403.7 addresses equipment sizing and efficiency rating
- Section R403.8 provides requirements for systems serving multiple dwelling units
- Section R403.9 addresses snow melt and ice system controls
- Sections R403.10 through R403.12 address pool and spa energy consumption.

These are the significant changes to the building mechanical systems requirements in the 2021 IECC:

- Clarified insulation requirements for ducts located outside of conditioned space, in conditioned space and buried
- Expanded duct testing requirements
- New mechanical ventilation system testing requirements

1 For purposes of this document, "EPCA" refers the EPCA as amended and codified in 42 U.S.C. §§ 6201-6422. Since its enactment in 1975, EPCA has been amended by the National Energy Conservation Policy Act, Pub. L. No. 95-619, § 422, 92 Stat. 3206 (1978); the National Appliance Energy Conservation Act, Pub. L. No. 100-12, § 7, 101 Stat. 103 (1987); the Energy Policy Act of 1992, Pub. L. 102-486, §§ 121-28, 106 Stat. 2776 (1992); the Energy Policy Act of 2005, Pub. L. 109-58, §§ 135-36, 119 Stat. 594 (2005); Energy Independence and Security Act of 2007,Pub. L. 110-140, §§ 301-325, 121 Stat. 1492 (2007); and the American Energy Manufacturing Technical Corrections Act,Pub. L. 112-210, 126 Stat. 1514 (2012).

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R403.3.1-R403.3.3.1

Duct Location and Insulation

CHANGE TYPE: Modification

CHANGE SUMMARY: Ducts can be located in one of three locations: outside conditioned space, in conditioned space and buried. The 2021 IECC clarifies these locations and the insulation requirements for each.

2021 CODE: **R403.3.1 Ducts ~~Insulation~~ located outside conditioned space. (Prescriptive).** Supply and return ducts located outside conditioned space shall be insulated to an R-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Ducts buried beneath a building shall be insulated as required per this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the *R*-value equivalency.

R403.3.2 ~~R403.3.7~~ Ducts located in conditioned space. For duct~~s~~ work to be considered ~~as~~ inside a conditioned space, ~~such ducts~~ it shall comply with ~~either~~ one of the following:

1. The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.
2. ~~The ducts shall~~ Ductwork in ventilated attic spaces shall be buried within ceiling insulation in accordance with Section ~~R403.3.6~~ R403.3.3 and all of the following conditions shall exist:
   - **2.1.** The air handler is located completely within the continuous air barrier and within the building thermal envelope.
   - **2.2.** The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with



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Duct location determines insulation requirements.

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Section R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m^2) of conditioned floor area served by the duct system.

2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.

3. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:

3.1. A continuous air barrier installed between unconditioned space and the duct.

3.2. Insulation installed in accordance with Section R402.2.7.

3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.

4. Ductwork located within exterior walls of the building thermal envelope shall comply with the following:

4.1. A continuous air barrier installed between unconditioned space and the duct.

4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.

4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

R403.3.3 ~~R403.3.6~~ Ducts buried within ceiling insulation. Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation *R*-value not less than R-8.

2. At all points along each duct, the sum of the ceiling insulation *R*-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the *R*-value of the duct insulation.

3. In Climate Zones 0A, 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an R-value of not less than R-13 and in compliance with the vapor retarder requirements of Section 604.11 of the International Mechanical Code or Section M1601.4.6 of the International Residential Code, as applicable.

Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

R403.3.3.1 ~~R403.3.6.1~~ Effective *R*-value of deeply buried ducts. Where using the Total Building Performance Compliance Option in accordance with Section R401.2.2 ~~simulated energy performance analysis~~, sections of ducts that are installed in accordance with Section R403.3.3, ~~R403.3.6~~ located directly on, or within 5.5 inches (140 mm) of the ceiling, surrounded with blown-in attic insulation having an *R*-value of R-30 or

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greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

CHANGE SIGNIFICANCE: Section R403.3 includes both structural and technical changes. First, Section R403.3 is reorganized for clarity and application, making it more understandable and usable for field practitioners. From that reorganization, three distinct locations where ductwork can be installed—outside conditioned space, inside conditioned space and buried—are outlined along with the insulation requirements for each.

The 2018 IECC fully addressed buried duct provisions and updates to the 2021 IECC offer similar changes for ducts located within the continuous air barrier and building thermal envelope. Section R403.3.2 now lists conditions that must be met for ducts to be considered inside a conditioned space. Changes made to this section are intended to increase the energy performance of ductwork within homes.

Section R403.3.1 is applicable to all compliance paths except the Tropical Climate Region compliance option. Sections R403.3.2 and R403.3.3 are only applicable to the Prescriptive compliance option.

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R403.3.5

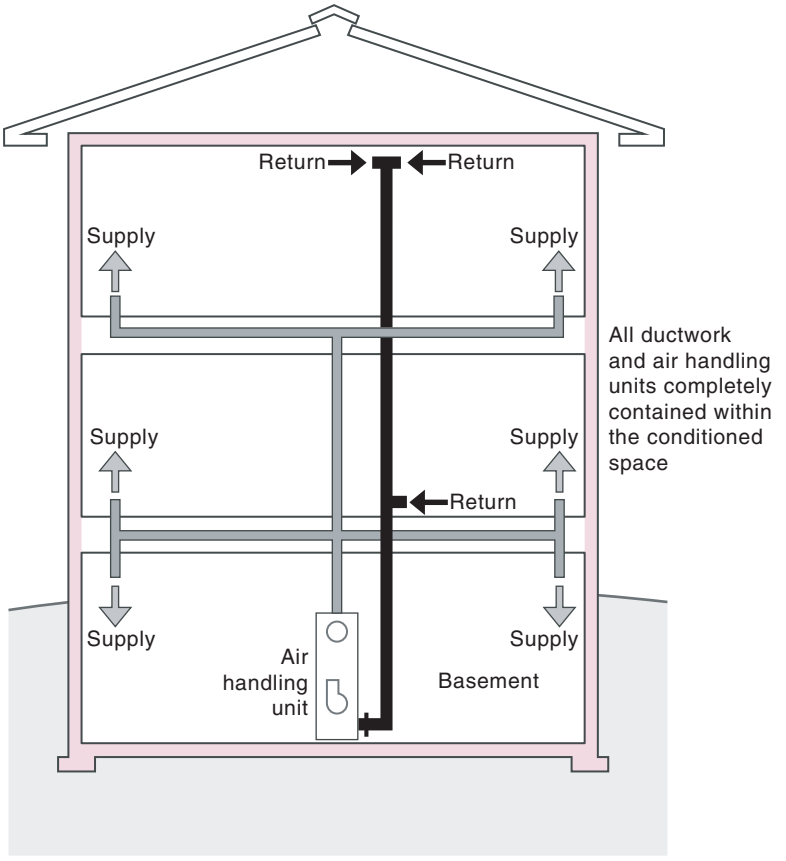
Duct Testing

CHANGE TYPE: Modification

CHANGE SUMMARY: Ducts in conditioned spaces are no longer exempt from duct testing requirements and a duct testing standard is specified.

2021 CODE: **R403.3.5 ~~R403.3.3~~ Duct testing (~~Mandatory~~).** Ducts shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.



Graphic courtesy of Building America

Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.

Ducts inside conditioned space must now be tested.

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Exception:

1. ~~A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.~~
2. A duct air-leakage test shall not be required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

CHANGE SIGNIFICANCE: Previously, the IECC exempted homes from duct testing requirements where the air handler and all ducts were located inside a conditioned space. Although moving all ducts inside a conditioned space may have a positive impact on energy efficiency overall, this practice alone cannot guarantee that the ducts will be tight enough to deliver conditioned air to all occupied areas of the home. Uncomfortable occupants commonly adjust thermostat settings to counteract the effect of poor delivery of conditioned air, leading to losses in energy efficiency. Additionally, homes with leaky ducts and poor air delivery are at far greater risk for builder callback. The 2021 IECC requires a duct leakage test for all new homes, including homes with all ducts inside conditioned space, mitigating the risk for such callbacks and ensuring ducts are functioning appropriately.

Duct leakage rates can be extremely high when ducts are not tested. Without an objective test as a means of quality assurance, even careful builders may not be aware of missed connections or poor sealing. In a recent DOE field study of residential homes in Kentucky, homes received duct leakage tests even where all supply and return ducts were located inside conditioned space.[2] Of the 24 homes tested with ducts inside conditioned spaces, the leakage rate averaged 18.5 cfm/ft^2, with individual homes ranging from 6.26 cfm/ft^2 to as high as 40.36 cfm/ft^2, higher leakage rates than the 2018 IECC requirement. Forty other homes in the same study with at least some ducts located outside the conditioned space achieved leakage rates of 9.7 cfm/ft^2, on average—roughly half the leakage rate of homes that qualified for the exemption. The field studies found similar results in Pennsylvania, where exempt homes (those with all ducts inside conditioned space) averaged almost 31 cfm/ft^2 leakage, while homes that were required to be tested averaged almost 18 cfm/ft^2 leakage.

The concept of requiring a test for all new homes is not new. DOE's Building America Program recommends that "[e]ven in conditioned space, ducts should be insulated to reduce the risk of condensation and mold. They should be tightly sealed and tested for leakage."[3]

This provision is applicable to all compliance paths except the Tropical Climate Region compliance option.

2 "Energy Efficiency Field Studies." *Building Energy Codes Program*, US Department of Energy. https://www.energycodes.gov/energy-efficiency-field-studies.

3 DOE Building Technologies Program. (January 2013). Ducts in Conditioned Space. US Department of Energy [PDF].

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R403.6.3

Mechanical Ventilation System Testing

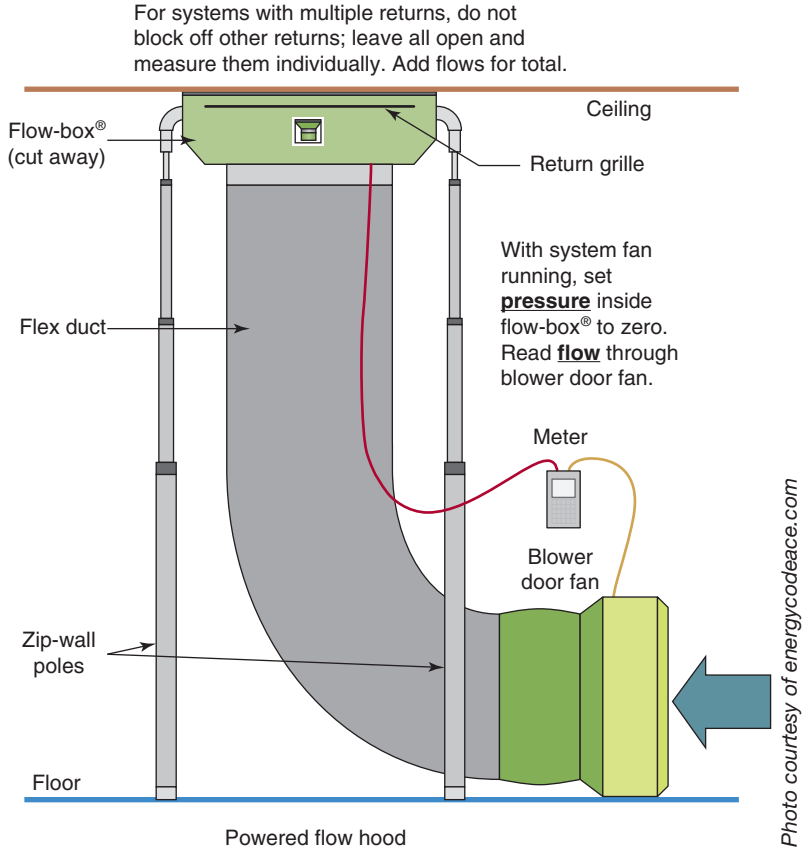
CHANGE TYPE: Addition

CHANGE SUMMARY: Mechanical ventilation systems must be tested to ensure they are installed and operating as intended.

2021 CODE: **R403.6.3 Testing.** Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6. Testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood or box, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals or grilles, outlet terminals or grilles, or in the connected ventilation ducts. Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

> **Exception:** Kitchen range hoods that are ducted to the outside with 6-inch (152 mm) or larger duct and not more than one 90-degree (1.57 rad) elbow or equivalent in the duct run.

CHANGE SIGNIFICANCE: Minimum ventilation rates are indicated in R403.6. The testing experience gained through the verification of the ENERGY STAR program demonstrated that ventilation fans are installed but not performing as required by the code. Fan-rated flow does not equate



Mechanical ventilation system testing is required.

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to the flow that is actually produced once a fan has been installed. The quality of the installation of the duct—from the fan, to the termination of the duct, to the outside—as well as the quality of the termination device ultimately governs the amount of air that any fan can push.

This new provision requires testing to ensure that the systems are installed in such a way that they work as intended by the code.

This provision is applicable to all compliance paths except the Tropical Climate Region compliance option.

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R404

Electrical Power and Lighting Systems

Section R404 broadly addresses residential electrical power and lighting systems. Lighting uses about 10 percent of residential electrical power. Significant changes to the 2021 IECC electrical power and lighting requirements include both the introduction of exterior lighting requirements for some residential occupancies and controls into the residential provisions.



Photo courtesy of karamysh/iStock/Getty Images Plus

The 2021 IECC now regulates both interior and exterior lighting.

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R404.1.1
Exterior Lighting

CHANGE TYPE: Addition

CHANGE SUMMARY: An exterior lighting requirement to comply with Section C405.5 is introduced for select residential buildings.

2021 CODE: **R404.1.1 Exterior lighting.** Connected exterior lighting for residential buildings shall comply with Section C405.5.

Exceptions:

1. Detached one- and two-family dwellings.
2. Townhouses.
3. Solar-powered lamps not connected to any electrical service.
4. Luminaires controlled by a motion sensor.
5. Lamps and luminaires that comply with Section R404.1.

CHANGE SIGNIFICANCE: Historically, the IECC has not included specific requirements for exterior lighting for residential buildings. The exterior lighting load may not be a significant issue for single-family homes, duplexes or townhomes, but it can be significant for Type-R occupancies because the load includes multiple-family parking lots and other exterior lighting applications.

The new Section R404.1.1 directs select residential occupancies to the commercial code and its lighting power density requirements. The section exempts detached one- and two-family residences, solar-powered lighting and any lighting controlled by a motion sensor.

When applied to the low-rise multiple-family prototype building developed by Pacific Northwest National Laboratory for the code determination studies, this requirement saved up to 0.5 percent (based on climate zone) of the whole building energy over the 2015 IECC. Since both the 2018 and 2015 IECC do not include exterior lighting requirements, this is a reasonable approximation of savings over the 2018 IECC as well.

This provision is applicable to all compliance paths.



Photo courtesy of rgaydos/E+/Getty Images

Exterior residential lighting must meet commercial requirements where applicable.

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R404.2

Interior Lighting Controls

CHANGE TYPE: Addition

CHANGE SUMMARY: Permanently installed lighting fixtures are required to have either a dimmer, occupant sensor or other control unless exempt.

2021 CODE: **R404.2 Interior lighting controls.** Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.

Exception: Lighting controls shall not be required for the following:

1. Bathrooms.
2. Hallways.
3. Exterior lighting fixtures.
4. Lighting designed for safety or security.

CHANGE SIGNIFICANCE: Previous versions of the IECC have not included specific requirements for residential lighting controls. However, as has been proven with the commercial market, controls applied to efficient equipment and lighting can further efficiencies.

Section R404.2 requires interior lighting controls in the form of either a dimmer, occupancy control, switch or similar control, such as an automatic daylight sensor. Dimmers can reduce energy use by about 20 percent, while occupancy sensors reduce wasted energy by around 30 percent. These controls are essentially permanent due to their long lifetimes.

This provision is applicable to all compliance paths.



Photo courtesy of SDI Productions/E+/Getty Images

Interior lighting is controlled.

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R404.3

Exterior Lighting Controls

CHANGE TYPE: Addition

CHANGE SUMMARY: Exterior lighting is required to have a manual on/off switch that permits automatic shutoff.

2021 CODE: **R404.3 Exterior lighting controls.** Where the total permanently installed exterior lighting power is greater than 30 watts, the permanently installed exterior lighting shall comply with the following:

1. Lighting shall be controlled by a manual on and off switch which permits automatic shut off actions.

Exception: Lighting serving multiple dwelling units.

2. Lighting shall be automatically shut off when daylight is present and satisfies the lighting needs.
3. Controls that override automatic shut off actions shall not be allowed unless the override automatically returns automatic control to its normal operation within 24 hours.

CHANGE SIGNIFICANCE: Similar to interior controls, Section R404.3 introduces residential exterior lighting provisions to the IECC. The new section requires controls for systems with greater than 30 watts; these controls must have manual switches that allow automatic shutoff and lighting must automatically shutoff based on daylight. The provisions also outline the limits to the override functions of the controls. The type of control is not specified, only what it must accomplish. The 2014 Consortium for Energy Efficiency report titled, "Residential Lighting Controls Market Characterization"[4] identifies that the use of a photosensor or timer can save, on average, 15 to 60KWh per year, based on the efficacy of the light source that is controlled.

This provision is applicable to the Prescriptive and Tropical Climate Region compliance options.



Photo courtesy of ShutterWorx/E+/Getty

Exterior lighting controls are required.

4 Consortium for Energy Efficiency. (January 9, 2014). Residential Lighting Controls Market Characterization [PDF]. https://library.cee1.org/system/files/library/11458/CEE_LightingMarketCharacterization.pdf.

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R405

Total Building Performance

Section R405 contains the provisions for the Total Building Performance compliance option. This performance-based option offers flexibility in determining the most cost-effective methods to design a code-compliant structure. Total Building Performance uses software to predict the annual energy use of the proposed design compared to that of the standard design of building components listed in Table R405.4.2(1). If the proposed building's annual energy use is less than or equal to that of the standard design, the building complies with the code's goal of effective energy use. This method is useful to consider for any building designs that incorporate shading strategies to minimize air-conditioning loads in the summer and maximize heat gain in the winter.

The 2021 IECC includes a restructuring of the section to clarify required provisions (formerly referred to as mandatory) and updates to the standard reference design.

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R405.2

Performance-Based Compliance

CHANGE TYPE: Addition

CHANGE SUMMARY: Table R405.2 lists required provisions for performance-based compliance.

2021 CODE: **R405.2 ~~Mandatory requirements~~ Performance-based compliance.** Compliance ~~with this section~~ based on total building performance requires that ~~the mandatory provisions identified in Section R401.2 be met. Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.~~ a proposed design meets all of the following:

1. The requirements of the sections indicated within Table R405.2.
2. The building thermal envelope shall be greater than or equal to levels of efficiency and solar heat gain coefficients in Table R402.1.1 or R402.1.3 of the 2009 International Energy Conservation Code.
3. An annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

~~**R405.3 Performance-based compliance.** Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.~~

~~**Exception:** The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.~~

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TABLE R405.2 Requirements for Total Building Performance

Section[a]	Title
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration *U*-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

[a] Reference to a code section includes all the relative subsections except as indicated in the table.

CHANGE SIGNIFICANCE: The labels *prescriptive* and *mandatory* were introduced in the 2009 IECC. Although the terms were applied to various section and subsection titles throughout previous versions of the IECC, the terms were never defined and were sometimes used inconsistently.

Long-time code users generally understood that *mandatory* was intended to mean "non-tradeable" when using performance compliance options. That is, where the procedures or systems described within the section are included as part of the design, the requirements of that section must be met and cannot be traded off. *Prescriptive*, on the other hand, was intended to mean *mandatory* when using the prescriptive path but "tradeable"

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when using the performance path. However, this understanding is not explicitly based on code language, leading to confusion about the use of the terms.

The 2021 IECC eliminates the terms mandatory and prescriptive, and instead, all the requirements applicable to the R405 Total Building Performance are located within Section R405. Table R405.2 includes all the required provisions for this compliance path. Code users should also note the provision for additional energy efficiency included in section R401.2.5 requires projects complying with the Total Building Performance option to either include one item from Section R408 that is not included in the proposed design, or demonstrate the proposed design annual energy cost is less than or equal to 95 percent of the annual energy cost of the standard reference design.

This provision is only applicable to the Total Building Performance compliance option.

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R405.3.2

Compliance Report

CHANGE TYPE: Modification

CHANGE SUMMARY: The performance path compliance report is simplified for greater usability and easier enforcement.

2021 CODE: **R405.3.2 ~~R405. 4.2~~ Compliance report.** Compliance software tools shall generate a report that documents that the proposed design complies with Section R405.3. A compliance report on the proposed design shall be submitted with the application for the building permit. Upon completion of the building, a confirmed compliance report based on the ~~as-built~~ confirmed condition of the building shall be submitted to the code official before a certificate of occupancy is issued. ~~Batch sampling of buildings to determine energy code compliance shall only be allowed for stacked multiple-family units.~~ Compliance reports shall include information in accordance with Sections R405.3.2.1 and R405.3.2.2. ~~Where the proposed design of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the proposed design for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case building air leakage and worst- case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.~~



Performance path certificate requirements are expanded.

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R405.3.2.1 ~~R405.4.2.1~~ Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other building site identification.
2. ~~A statement indicating that the proposed design complies with Section R405.3.~~ The name of the individual performing the analysis and generating the compliance report.
3. ~~An inspection checklist documenting the building component characteristics of the proposed design as indicated in Table R405.5.2(1). The inspection checklist shall show results for both the standard reference design and the proposed design with user inputs to the compliance software to generate the results.~~ The name and version of the compliance software tool.
4. ~~A site-specific energy analysis report that is in compliance with Section R405.3.~~ Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. ~~The name of the individual performing the analysis and generating the report.~~ A certificate indicating that the proposed design complies with Section R405.3. The certificate shall document the building components' energy specifications that are included in the calculation including: component-level insulation *R*-values or *U*-factors; duct system and building envelope air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
6. ~~The name and version of the compliance software tool.~~ Where a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

R405.3.2.2 ~~R405. 4.2.2~~ Compliance report for certificate of occupancy. A compliance report submitted for obtaining the certificate of occupancy shall include the following:

1. Building street address, or other building site identification.
2. Declaration of the total building ~~simulated~~ performance path on the title page of the energy report and the title page of the building plans.
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.3.
3. ~~A certificate indicating that the building passes the performance matrix for code compliance and indicating the energy saving features of the buildings.~~ The name and version of the compliance software tool.
4. A site-specific energy analysis report that is in compliance with Section R405.3.

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5. ~~The name of the individual performing the analysis and generating the report.~~ A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home, including component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.
6. ~~The name and version of the compliance software tool.~~ When onsite renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

~~R405.4.3 Additional documentation.~~ ~~The code official shall be permitted to require the following documents:~~

1. ~~Documentation of the building component characteristics of the standard reference design.~~
2. ~~A certification signed by the builder providing the building component characteristics of the proposed design as given in Table R405.5.2(1).~~
3. ~~Documentation of the actual values used in the software calculations for the proposed design.~~

CHANGE SIGNIFICANCE: The Total Building Performance compliance option has seen extensive use in Colorado, Florida and other parts of the country since the 2009 IECC, and these experiences continue to inform the language of the IECC. In the 2015 IECC, the process by which the Total Building Performance path was successfully implemented in Colorado was included in the code to help jurisdictions and builders better understand both how to implement the pathway to gain the flexibility of choice and tradeoff as well as how to verify compliance.

In the 2021 IECC, the Colorado experience further informs the code by simplifying the compliance report and clarifying documentation requirements. For example, the use of the terms *proposed* and *confirmed* to refer to documentation needed to obtain the building permit and certificate of occupancy is more clearly laid out. In addition, Sections R405.3.2.1 and R405.4.2.2 have been consolidated and reordered to more clearly identify for the jurisdiction having authority what documentation needs to be reviewed to demonstrate compliance.

These provisions are only applicable to the Total Building Performance compliance option.

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R406

Energy Rating Index Compliance Alternative

Section R406 of the IECC contains the provisions for the Energy Rating Index (ERI) compliance option. Introduced in the 2015 IECC, the ERI is another path that can be used to demonstrate compliance with the energy code. The ERI is an index scoring system with a scale that ranges from 0 to 100. A net zero home or residential building will achieve an index value of 0; a home built to minimum requirements of the 2006 IECC is considered the reference design and has an index score of 100. Each point on the scale represents a 1-percent change in the total energy use of the rated design relative to the total energy use of the ERI reference design. The ERI score considers all energy used in the residential building.

Significant changes to the 2021 IECC include a restructuring of the section to clarify required provisions (formerly referred to as mandatory), updates to the target ERI scores and the introduction of provisions for renewable energy certificate documentation.

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R406.2

ERI Compliance

CHANGE TYPE: Modification

CHANGE SUMMARY: Table R406.2 lists required provisions for the Energy Rating Index compliance option.

2021 CODE: **R406.2 ERI compliance.** Compliance based on the ERI requires that the rated design meets all of the following:

1. The requirements of the sections indicated within Table R406.2.
2. Maximum ERI of Table R406.5.

TABLE R406.2 Requirements for Energy Rating Index

Section[a]	Title
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3, except sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope

[a]Reference to a code section includes all of the relative subsections except as indicated in the table.

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CHANGE SIGNIFICANCE: As discussed throughout this book, the 2021 IECC eliminates the terms mandatory and prescriptive, and instead, all the requirements applicable to the R406 Energy Rating Index are located within Section R406. Table R406.2 outlines the required provisions for this compliance path.

Code users should also note the provision for additional energy efficiency included in section R401.2.5 requires projects complying with the ERI to demonstrate the ERI value is at least 5 percent less than the ERI target specified in Table R406.5.

This provision is only applicable to the Energy Rating Index compliance option.

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R406.3

Building Thermal Envelope

CHANGE TYPE: Modification

CHANGE SUMMARY: Target ERI scores are lowered and the role of on-site renewables is clarified.

2021 CODE: **R406.3 Building thermal envelope.** Building and portions thereof shall comply with Section R406.3.1 or R406.3.2.

R406.3.1 On-site renewables are not included. Where on-site renewable energy is not included for compliance using the ERI analysis of Section R406.4, the proposed total building thermal envelope UA, which is sum of *U*-factor times assembly area, shall be less than or equal to the building thermal envelope UA using the prescriptive *U*-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1. The area-weighted maximum fenestration SHGC permitted in Climate Zones 0 through 3 shall be 0.30.~~levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.1 or 402.1.3 of the 2009 International Energy Conservation Code.~~

$$UA_{\text{Proposed design}} = 1.15 \times UA_{\text{Prescriptive reference design}} \quad \textbf{(Equation 4-1)}$$

R406.3.2 On-site renewables are included. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2018 International Energy Conservation Code.

TABLE R406.5 Maximum Energy Rating Index

CLIMATE ZONE	ENERGY RATING INDEX
0-1	~~57~~ 52
2	~~57~~ 52
3	~~57~~ 51
4	~~62~~ 54
5	~~61~~ 55
6	~~61~~ 54
7	~~58~~ 53
8	~~58~~ 53

~~a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 *International Energy Conservation Code*.~~

CHANGE SIGNIFICANCE: Table R406.5 restores the lower ERI target scores from the 2015 IECC. Coupled with the requirements for additional energy efficiency in R401.2.5, which specify projects must reduce the ERI target by at least 5 percent, the 2021 ERI compliance option results in a significantly more efficient building than the 2018 IECC.

These provisions are only applicable to the Energy Rating Index compliance option.

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R406.7.3

Renewable Energy Certificate Documentation

CHANGE TYPE: Addition

CHANGE SUMMARY: Renewable energy certificate (REC) documentation is introduced to ensure homeowners are able to legally document ownership of the RECs associated with their homes.

2021 CODE: **R406.7.3 Renewable energy certificate (REC) documentation.** Where on-site renewable energy is included in the calculation of an ERI, one of the following forms of documentation shall be provided to the code official:

1. Substantiation that the RECs associated with the on-site renewable energy are owned by, or retired on behalf of, the homeowner.
2. A contract that conveys to the homeowner the RECs associated with the on-site renewable energy, or conveys to the homeowner an equivalent quantity of RECs associated with other renewable energy.

CHANGE SIGNIFICANCE: Renewable energy has been an aspect of the IECC since its inception in 1998. However, as the industry has evolved in complexity, so have the issues of documentation and attribution.

The new section R406.7.3 addresses ownership of the environmental attributes of an on-site renewable energy system. The environmental attributes of solar power and other renewable energy systems have a market value that is reflected and transacted in RECs. This provision ensures the attributes are not double-counted by other entities by requiring legal documentation of ownership.

This section is supported by a new definition of renewable energy certificate that provides clarification on what the renewable energy certificate represents.

This provision is only applicable to the Energy Rating Index compliance option.



RECs represent the environmental attributes of renewable energy systems.

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R407

Tropical Climate Region

CHANGE TYPE: Modification

CHANGE SUMMARY: The Tropical Region Compliance option is now located in Section R407.

2021 CODE:

SECTION R407
TROPICAL CLIMATE REGION COMPLIANCE PATH

R407.1 Scope. This section establishes alternative criteria for residential buildings in the tropical region at elevations less than 2,400 feet (731.5 m) above sea level.

R407.2 Tropical climate region. ~~R401.2.1 Tropical zone.~~ ~~Residential buildings in the tropical zone at elevations less than 2,400 feet (731.5 m) above sea level shall be deemed to be in compliance with this chapter provided that the following conditions are met~~ Compliance with this sections requires the following:

1. Not more than one-half of the occupied space is air conditioned.
2. The occupied space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.
4. Glazing in conditioned spaces has a solar heat gain coefficient (SHGC) of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The exterior roof surface complies with one of the options in Table C402.3 of the International Energy Conservation Code–Commercial Provisions or the roof or ceiling has insulation with



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Dwellings in the tropical zone may comply with the Tropical Climate Region option.

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an *R*-value of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.

7. Roof surfaces have a slope of not less than 1/4 unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

CHANGE SIGNIFICANCE: The provisions for compliance via the alternative Tropical Climate Region Compliance path were originally located in Section R401.2.1, and there was some confusion as to the application of the compliance path. The creation of Section R407 aligns with the modifications to Section R401.2, clearly and consistently identifying each compliance path and providing each compliance path its own section. No technical changes have been made.

These provisions are only applicable to the Tropical Climate Region compliance option.

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R408

Additional Efficiency Package Options

CHANGE TYPE: Addition

CHANGE SUMMARY: Residential projects are required to include additional energy efficiency measures as specified by the compliance path option selected. Section R408 outlines the additional energy efficiency package options for the Prescriptive and Total Building Performance paths.

2021 CODE:

SECTION R408
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

R408.1 Scope. This section establishes additional efficiency package options to achieve additional energy efficiency in accordance with Section R401.2.5.



More efficient HVAC equipment is one additional efficiency package option.

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R408.2 Additional efficiency package options. Additional efficiency package options for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.

R408.2.1 Enhanced envelope performance option. The total building thermal envelope UA, the sum of *U*-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the *U*-factors in Table R402.1.2 by the same assembly area as in the proposed building. The UA calculation shall be performed in accordance with Section R402.1.5. The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration SHGC in Table R402.1.2.

R408.2.2 More efficient HVAC equipment performance option. Heating and cooling equipment shall meet or exceed one of the following efficiencies:

1. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner.
2. Greater than or equal to 10 HSPF/16 SEER air source heat pump.
3. Greater than or equal to 3.5 COP ground source heat pump.
4. For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the heating design load.

R408.2.3 Reduced energy use in service water-heating option. The hot water system shall meet or exceed one of the following efficiencies:

1. Greater than or equal to 82 EF fossil fuel service water-heating system.
2. Greater than or equal to 2.0 EF electric service water-heating system.
3. Greater than or equal to 0.4 Solar Fraction solar water-heating system.

R408.2.4 More efficient duct thermal distribution system option. The thermal distribution system shall meet or exceed one of the following efficiencies:

1. 100 percent of ducts and air handlers located entirely within the building thermal envelope.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the building thermal envelope.
3. 100 percent of duct thermal distribution system located in conditioned space as defined by R403.3.2.

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R408.2.5 Improved air sealing and efficient ventilation system option. The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 cubic feet per minute per wall (0.03m^3/min/watt) and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/Moisture Transfer (LRMT).

CHANGE SIGNIFICANCE: Arguably the most significant change to the residential provisions of the 2021 IECC, Section R408 provides five options from which residential projects can choose to demonstrate additional energy efficiency. These improvements increase energy savings and reduce costs to the homeowner over the useful life of the building. Section R408 largely mirrors the format of the additional efficiency package options of the commercial provisions (Section C406) as included in the 2012 through the 2018 IECC, and is modeled after code language adopted in states like Oregon and Washington that have successfully created a list of options available to builders to meet the residential code improvements. This approach is intended to increase flexibility for code users while advancing the code's efficiency baseline.

Projects complying with the residential energy code prescriptively must include one of these packages from R408: enhanced envelope performance, more efficient HVAC equipment, reduced energy use in service water-heating, more efficient duct thermal distribution system or improved air sealing and efficiency ventilation system.

Projects using the Total Building Performance compliance option must either incorporate one package into the project without including it in the proposed design, or the proposed design must have an annual energy cost less than or equal to 95 percent of the standard reference design. These package options do not apply to the Energy Rating Index or Tropical Climate Region compliance options.

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PART 8

Residential Energy Provisions: Residential Appendices



- **Appendix RA** Board of Appeals – Residential
- **Appendix RB** Solar-Ready Provisions – Detached One- and Two-Family Dwellings and Townhouses
- **Appendix RC** Zero Energy Residential Building Provisions

Appendices to the *International Energy Conservation Code* (IECC) provide options for jurisdictions to expand the requirements of the IECC. These options are not mandatory unless specifically referenced in the adopting ordinances. The 2021 IECC introduces two new residential appendices – Appendix RA provides guidance for establishing a board of appeals and Appendix RC outlines provisions for zero energy residential buildings. The existing solar-ready appendix is also modified. ■

Appendix RA

Board of Appeals – Residential

RB 103.5

Shading

Appendix RC

Zero Energy Residential Building Provisions

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Appendix RA

Board of Appeals–Residential

CHANGE TYPE: Addition

CHANGE SUMMARY: A new Appendix RA provides guidance for establishing a board of appeals, including criteria for membership and instruction for developing rules and procedures.

2021 CODE:

APPENDIX RA
BOARD OF APPEALS—RESIDENTIAL

SECTION RA101
GENERAL

RA101.1 Scope. A board of appeals shall be established within the jurisdiction for the purpose of hearing applications for modification of the requirements of this code pursuant to the provisions of Section R110. The board shall be established and operated in accordance with this section, and shall be authorized to hear evidence from appellants and the code official pertaining to the application and intent of this code for the purpose of issuing orders pursuant to these provisions.

RA101.2 Application for appeal. Any person shall have the right to appeal a decision of the code official to the board. An application for appeal shall be based on a claim that the intent of this code or the rules legally adopted hereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The application shall be filed on a form obtained from the code official within 20 days after the notice was served.



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Any person may appeal a decision of the code official.

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RA101.2.1 Limitation of authority. The board shall not have authority to waive requirements of this code or interpret the administration of this code.

RA101.2.2 Stays of enforcement. Appeals of notice and orders, other than Imminent Danger notices, shall stay the enforcement of the notice and order until the appeal is heard by the board.

RA101.3 Membership of board. The board shall consist of five voting members appointed by the chief appointing authority of the jurisdiction. Each member shall serve for [INSERT NUMBER OF YEARS] years or until a successor has been appointed. The board members' terms shall be staggered at intervals, so as to provide continuity. The code official shall be an ex officio member of said board but shall not vote on any matter before the board.

RA101.3.1 Qualifications. The board shall consist of five individuals, who are qualified by experience and training to pass on matters pertaining to building construction and are not employees of the jurisdiction.

RA101.3.2 Alternate members. The chief appointing authority is authorized to appoint two alternate members who shall be called by the board chairperson to hear appeals during the absence or disqualification of a member. Alternate members shall possess the qualifications required for board membership, and shall be appointed for the same term or until a successor has been appointed.

RA101.3.3 Vacancies. Vacancies shall be filled for an unexpired term in the same manner in which original appointments are required to be made.

RA101.3.4 Chairperson. The board shall annually select one of its members to serve as chairperson.

RA101.3.5 Secretary. The chief appointing authority shall designate a qualified clerk to serve as secretary to the board. The secretary shall file a detailed record of all proceedings which shall set forth the reasons for the board's decision, the vote of each member, the absence of a member and any failure of a member to vote.

RA101.3.6 Conflict of interest. A member with any personal, professional or financial interest in a matter before the board shall declare such interest and refrain from participating in discussions, deliberations and voting on such matters.

RA101.3.7 Compensation of members. Compensation of members shall be determined by law.

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RA101.3.8 Removal from the board. A member shall be removed from the board prior to the end of their terms only for cause. Any member with continued absence from regular meeting of the board may be removed at the discretion of the chief appointing authority.

RA101.4 Rules and procedures. The board shall establish policies and procedures necessary to carry out its duties consistent with the provisions of this code and applicable state law. The procedures shall not require compliance with strict rules of evidence, but shall mandate that only relevant information be presented.

RA101.5 Notice of meeting. The board shall meet upon notice from the chairperson, within 10 days of the filing of an appeal or at stated periodic intervals.

RA101.5.1 Open hearing. All hearings before the board shall be open to the public. The appellant, the appellant's representative, the code official and any person whose interests are affected shall be given an opportunity to be heard.

RA101.5.2 Quorum. Three members of the board shall constitute a quorum.

RA101.5.3 Postponed hearing. When five members are not present to hear an appeal, either the appellant or the appellant's representative shall have the right to request a postponement of the hearing.

RA101.6 Legal counsel. The jurisdiction shall furnish legal counsel to the board to provide members with general legal advice concerning matters before them for consideration. Members shall be represented by legal counsel at the jurisdiction's expense in all matters arising from service within the scope of their duties.

RA101.7 Board decision. The board shall only modify or reverse the decision of the code official by a concurring vote of three or more members.

RA101.7.1 Resolution. The decision of the board shall be by resolution. Every decision shall be promptly filed in writing in the office of the code official within three days and shall be open to the public for inspection. A certified copy shall be furnished to the appellant or the appellant's representative and to the code official.

RA101.7.2 Administration. The code official shall take immediate action in accordance with the decision of the board.

RA101.8 Court review. Any person, whether or not a previous party of the appeal, shall have the right to apply to the appropriate court for a writ of certiorari to correct errors of law. Application for review shall be made in the manner and time required by law following the filing of the decision in the office of the chief administrative officer.

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CHANGE SIGNIFICANCE: Appendix RA mirrors the requirements of the 2018 *International Building Code* (IBC), 2018 *International Fire Code* (IFC) and 2021 *International Residential Code* (IRC), providing a consistent set of requirements for a board of appeals across the family of I-Codes. This appendix offers a framework for jurisdictions to establish a functional board of appeals, outlining the rights and responsibilities of the appellant, code official and board members. The provisions contained in this appendix are not mandatory unless specified as such in the jurisdiction's adopting ordinance.

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RB103.5

Shading

CHANGE TYPE: Addition

CHANGE SUMMARY: To maximize solar technology effectiveness, Appendix RB defines a minimum setback for the designated solar-ready zone from permanently affixed objects and focuses on roof slopes facing sunward with sufficient slope to maximize energy collection.

2021 CODE: **RB103.5 Shading.** The solar-ready zone shall be set back from any existing or new permanently affixed object on the building or site that is located south, east or west of the solar zone a distance not less than two times the object's height above the nearest point on the roof surface. Such objects include, but are not limited to, taller portions of the building itself, parapets, chimneys, antennas, signage, rooftop equipment, trees and roof plantings.

RB103.6 Capped roof penetration sleeve. A capped roof penetration sleeve shall be provided adjacent to a solar-ready zone located on a roof slope of not greater than 1 unit vertical in 12 units horizontal (8-percent slope). The capped roof penetration sleeve shall be sized to accommodate the future photovoltaic system conduit but shall have an inside diameter of not less than 1 1/4 inches (32 mm).

CHANGE SIGNIFICANCE: The Solar-Ready Zone appendix (Appendix T) to the 2018 *International Residential Code* (IRC) was updated to include shading and capped roof penetration sleeve requirements; however, these updates were not incorporated into the Solar-Ready Provisions appendix to the 2018 IECC. These new code provisions not only better align the appendices of the 2021 IRC and 2021 IECC, but also provide clarification for and strengthen the existing Solar-Ready Provisions appendix. Section RB103.5 clarifies the concept of "shading" by defining the setback for the



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Roof with installed solar panels meeting the new shading requirements.

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designated solar-ready zone from permanently affixed objects. Section RB103.6 requires a sleeve to provide a path for future wiring from the solar panel to the meter at the time of new construction; as such, roofs with a slope of 1:12 or less must be provided with a pipe sleeve penetration. For roofs with slopes greater than 1:12, other design options are available and a penetration is not necessary.

The Solar-Ready Provisions appendix of the IECC was also renumbered from Appendix RA to Appendix RB. The provisions contained in this appendix are not mandatory unless specified as such in the jurisdiction's adopting ordinance.

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Appendix RC

Zero Energy Residential Building Provisions

CHANGE TYPE: Addition

CHANGE SUMMARY: Appendix RC provides a model for residential construction to achieve net zero energy consumption through the use of renewable energy systems.

2021 CODE:

APPENDIX RC
ZERO ENERGY RESIDENTIAL BUILDING PROVISIONS

SECTION RC101
COMPLIANCE

RC101.1 Compliance. Existing residential buildings shall comply with Chapter 5. New residential buildings shall comply with Section RC102.

SECTION RC102
ZERO ENERGY RESIDENTIAL BUILDINGS

RC102.1 General. New residential buildings shall comply with Section RC102.2.

RC102.2 Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.



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On-site solar for net zero energy consumption.

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2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

   Adjusted OPP = OPP + CREF + REPC (Equation RC-1)

   where:

   CREF = Community Renewable Energy Facility power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.

   REPC = Renewable Energy Purchase Contract power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.

TABLE RC102.2 Maximum Energy Rating Index[a]

CLIMATE ZONE	ENERGY RATING INDEX not including OPP	ENERGY RATING INDEX including Adjusted OPP (as proposed)
1	43	0
2	45	0
3	47	0
4	47	0
5	47	0
6	46	0
7	46	0
8	46	0

a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table RR402.1.3 of the 2015 International Energy Conservation Code.

CHANGE SIGNIFICANCE: Appendix RC provides adoptable language that is easily incorporated into the 2021 IECC and results in residential buildings that have zero energy consumption over the course of a year. The appendix builds on the familiar Energy Rating Index compliance option of the IECC (Section R406) by requiring the use of RESNET/ICC 301. This standard compares the energy performance of a home to a reference home of the same geometry modeled to the 2006 IECC; where the home requires no net purchased energy, the ERI is 0 and the home is considered to have net zero energy consumption.

Appendix RC requires projects to meet or exceed two separate ERI targets. First, projects must achieve a target ERI of 43 to 47, depending on climate zone, without considering on-site power production. The project must then account for renewable energy and achieve an ERI of 0.

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Renewable energy may be a combination of on-site power production, energy generated through community renewable energy facilities and renewable energy purchase contracts or leases.

Jurisdictions may choose to adopt this appendix in support of policy goals related to energy efficiency and renewable energy. The provisions contained in this appendix are not mandatory unless specified as such in the jurisdiction's adopting ordinance.

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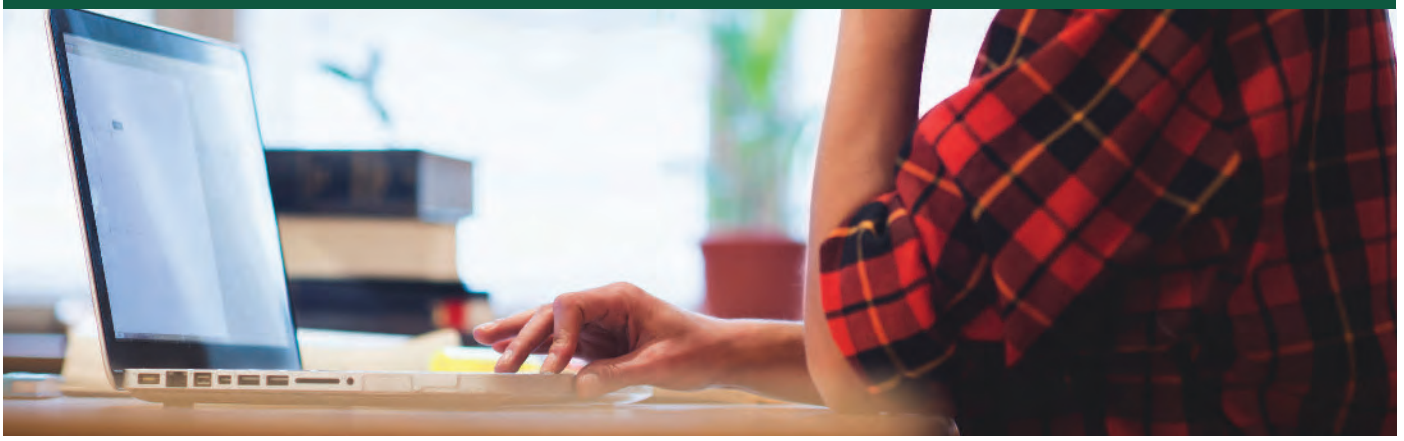
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