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Acoustics Report: IRA Civic Center

1. Acoustical testing and observations

We visited IRA Civic Center in Grand Rapids, MN on 12/12/2023 to study the existing conditions and perform acoustical testing in the Ice Arena and Lobby.

Currently neither space has acoustical ceiling or wall treatment, and excess room reverberation is an issue, particularly in the Ice Arena where it affects speech intelligibility during events and hockey practice, and makes communication difficult during practice.

Reverberation Time testing was performed in the Ice Arena and Lobby using balloons as impulsive noise sources and Larson Davis Model 824 Type 1 sound level meter for measurements. The tested Reverberation Times are shown in Table 1 below:

Table 1: Ice Arena and Lobby RT's

	125	250	500	1k	2k	4k Hz
Ice Arena	8.6	7.4	8.1	7.3	5.0	3.1 sec
Lobby	1.75	1.7	2.4	2.6	2.0	1.3 sec

The tested Reverberation Times are very high in both spaces. The recommended maximum mid-frequency RT for large sport facilities with sound amplification is 2 seconds. There are no industry guidelines for lobby spaces, but the RTs are high for this size space.

In addition to testing we subjectively evaluated the quality of amplified speech in the Ice Arena. Based on observation excess reverberation is the primary cause for poor speech intelligibility. There seemed to be some sound reflected back from the opposite surfaces and seating to the risers where we were observing, but when the space is occupied this is likely reduced.

2. Analysis and recommendations

2.1 Ice Arena

When the Ice Arena is occupied the audience will provide a significant amount of sound absorption. To determine what the Reverberation Times are during an event we calculated the RTs with 100% and 50% occupancy. The occupied RTs are shown in Table 1 below.

Table 1: Ice Arena RT's with 100% and 50% occupancy

Occupancy	125	250	500	1k	2k	4k Hz
100% (2,400)	5.0	4.5	4.4	3.1	2.6	2.0 sec
50% (1,200)	6.4	5.6	5.7	4.4	3.4	2.4 sec

When the space is occupied the RTs are significantly lower than when it is unoccupied, but still in 4.4-5.7 second range.

The Ice Arena has a curved wood deck. Acoustically the ideal solution would be to treat a significant area of the wood deck with sound absorptive material, but for aesthetic reasons this is undesirable. For that reason we have evaluated an option for wall treatment only.

Wall surfaces that would be available for acoustical treatment include the upper surfaces on the north and south wall, and potentially a 4' high band of vertical surface on the north, east and west wall that currently has metal advertisement plaques.

Assuming a 10' high band of NRC 1.0 rated acoustical panels on the north wall and an 8' high band on the south wall (see the Materials Appendix, Panel 1) a total of 1,592 square feet of acoustical panels would be placed on the upper wall surfaces. See Figures 1 and 2 below. (This is schematic. The panels would need to be coordinated with beams, ducts etc.)

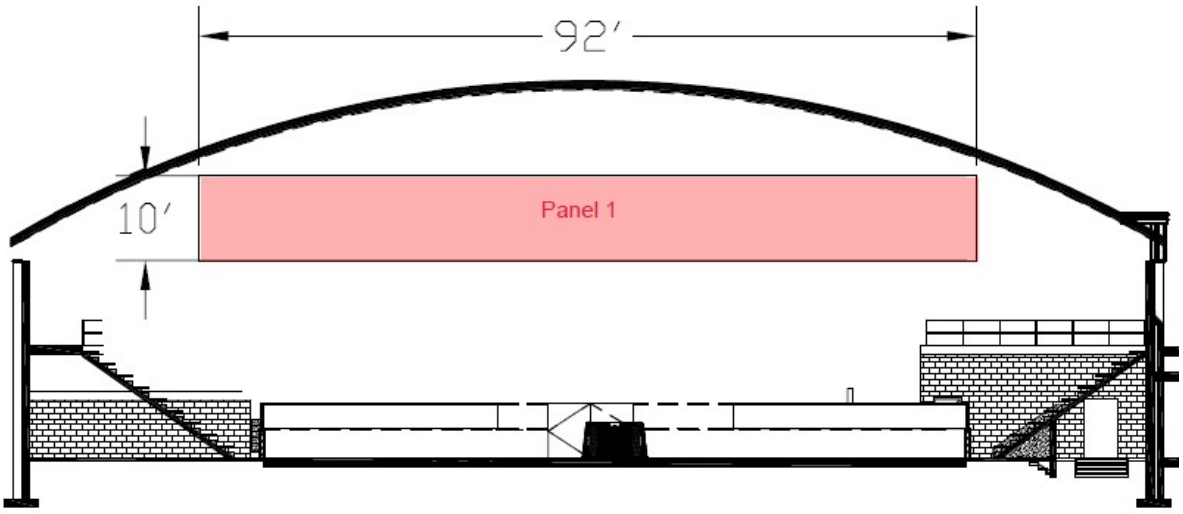


Figure 1: Ice Arena north wall acoustical treatment

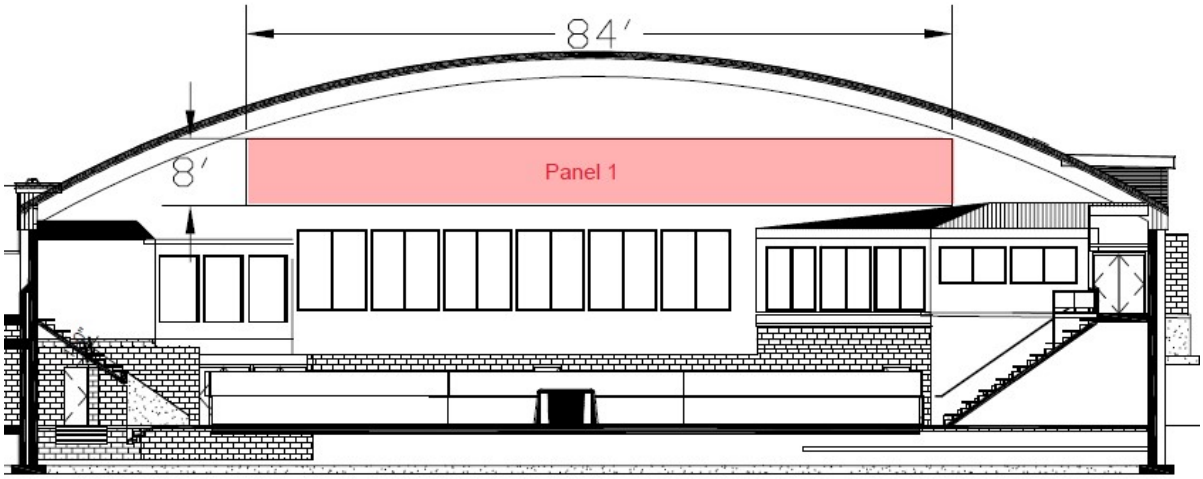


Figure 2: Ice Arena south wall acoustical treatment

With the above treatment the projected RTs with different occupancies would be as follows:

Table 2: Ice Arena RT's with 1,592 sf of Panel 1

Occupancy	125	250	500	1k	2k	4k Hz
Unoccupied	8.1	6.4	6.5	6.0	4.3	2.8 sec
100 %	4.8	4.1	3.9	2.8	2.4	1.9 sec
50%	6.1	5.0	4.9	3.9	3.1	2.2 sec

Adding the panels on the upper wall surfaces of the north and south wall would reduce mid-frequency RTs by 0.5-1.6 seconds. It would have greater effect on unoccupied than occupied RTs. For hockey practice this treatment would be expected to provide very limited benefit because it is so far removed from where the players and coaches are on the ice, and because the RTs would still be very high.

Considering the small reduction particularly for occupied RTs with the above treatment we calculated RTs if the 4' high vertical surface with the advertisement plaques were sound absorptive as well. (NRC 1.0) Treating that surface would add approximately 1,760 sf of sound absorptive material for a total of 3,352 sf. This is assuming that the advertisement plaques could be sound absorptive, either acoustical panels with advertisement printed on the fabric finish (most manufacturers provide this option), or possibly microperforated with sound absorptive panels placed behind.

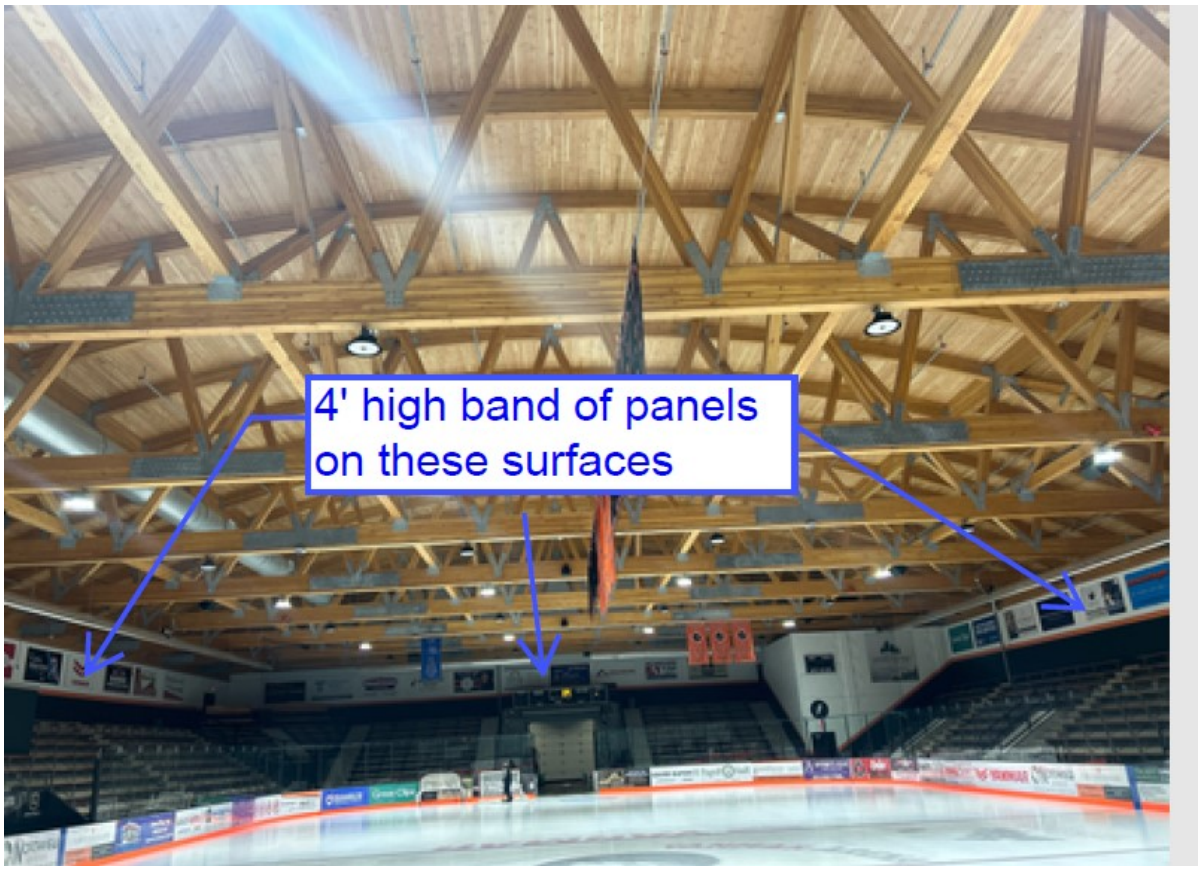


Figure 3: Treatment location on vertical surfaces

With 3,352 sf of NRC 1.0 rated acoustical wall treatment the projected RTs are as follows:

Table 3: Ice Arena RT's with 3,352 sf of NRC 1.0 rated panels (Panel 1 or equal)

Occupancy	125	250	500	1k	2k	4k Hz
Unoccupied	7.5	5.5	5.3	5.0	3.8	2.6 sec
100 %	4.6	3.7	3.4	2.6	2.2	1.8 sec
50%	5.8	4.4	4.2	3.4	2.8	2.1 sec

Unoccupied RTs would be reduced by 2.8 seconds, and occupied RTs by 1.0-1.5 seconds.

This would make a more noticeable difference, and when the space is fully occupied the environment would likely be acceptable. However, with lower occupancies and for practice the space would still be quite live.

If ceiling treatment is not acceptable, we would recommended placing treatment both on the upper wall surfaces of the north and south wall, as well as on the 4' high vertical band.

As an alternative option we evaluated placing acoustical treatment in the ceiling.
The advantage of this would be that more of the treatment would be located closer to where sound is produced, and a greater area of treatment could be provided without modifications to the advertisement plaques.

Acoustically vertical acoustical baffles or lapendary panels hung from the deck would be the most effective treatment. Baffles provide a greater amount of sound absorption than direct attached panels because they absorb sound from both sides. However, visually direct attached panels would be less noticeable, particularly if the fabric were to match the wood color of the deck, and the panels were located above the seating areas. See Figure 4 below.

We calculated the acoustical effect of providing a 12’ wide band of NRC 1.0 rated acoustical panels direct attached to deck above the east and west seating. The total amount of absorption would be approximately 4,000 sf. See Figure 4 below.

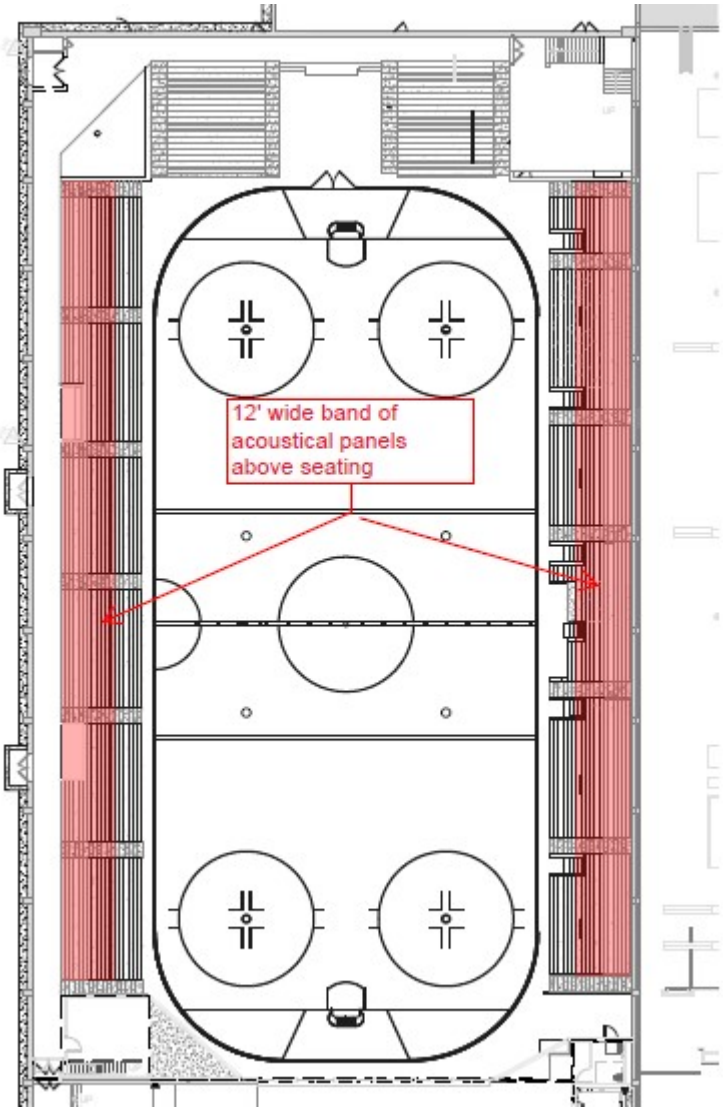


Figure 4: Acoustical ceiling treatment option

With 4,000 sf of NRC 1.0 rated acoustical ceiling treatment the projected RTs are s follows:

Table 4: Ice Arena RT's with 4,000 sf of NRC 1.0 rated ceiling treatment

Occupancy	125	250	500	1k	2k	4k Hz
Unoccupied	7.4	5.3	5.0	4.7	3.6	2.5 sec
100 %	4.6	3.6	3.3	2.5	2.2	1.7 sec
50%	5.7	4.3	4.0	3.3	2.7	2.0 sec

The RTs would still not be at the recommended 2-second mid-frequency range for large sport facilities with sound amplification, but still noticeably improved.

2.2 Lobby

Room reverberation amplifies conversational noise in the Lobby. Ideally this space also would have sound absorptive ceiling treatment, but for aesthetic reasons it is desirable to keep the wood deck exposed.
We recommend placing acoustical panels on the upper wall surface of the south wall as shown in Figure 5 below.

With the above treatment the room reverberation times in the Lobby are expected to be reduced by approximately 1 second. For the projected RTs see Table 5 below.

Table 5: Lobby RTs

	125	250	500	1k	2k	4k Hz
current	1.75	1.7	2.4	2.6	2.0	1.3 sec
new	1.5	1.3	1.5	1.6	1.3	1.0 sec

When the space is filled with people we would expect mid-frequency RTs to be in 1 second range, which would be a reasonable RT for this size lobby.

2.3 Meeting rooms

The meeting room have exposed metal deck at approximately 12-6" and no acoustical treatment. With the ductwork. Lights, etc. in place surface attached acoustical treatment would be the most feasible option. We recommend 2" thick black acoustical panels direct attached to the deck. These panels would need to be coordinated with the roof structure, ductwork, and lights, but we estimated that it would be possible to cover approximately 50% of the deck area with panels. A schematic lay-out would be 4' wide bands of panel 8' o.c. The following products would be acoustically effective and would be easy to field cut, if necessary:

2" acoustical foam panels https://www.pinta-acoustic.com/en/support/ceiling-and-wall-systems/willtec.html

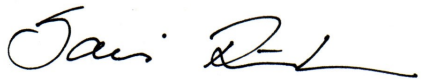
2" thick black fiberglass board: https://www.owenscorning.com/en-us/insulation/products/selectsound-black-acoustic-board

Assuming 50% coverage the projected RTs for the meeting rooms are as follows:

Table 5: Meeting room RTs

125	250	500	1k	2k	4k Hz
1.1	1.1	1.0	1.0	0.9	0.8 sec

These RTs would be in appropriate range for the size and use of the spaces.



Sari Rönnholm

MATERIALS APPENDIX

Panel 1	Fabric-wrapped, glass fiber panels, 2" thickness, 6-7 lb. density and NRC of 0.90 to 1.0.
Sound Concepts	http://www.soundconceptscan.com/
Conwed	Respond A https://www.conwed.com/products/walls/
Kinetics	HardSide https://kineticsnoise.com/interiors/hardsidepanel.html

2" acoustical foam panels https://www.pinta-acoustic.com/en/support/ceiling-and-wall-systems/willtec.html
(click on "Product information" on the left, and color chart)

2" thick black fiberglass board ("theater board"): https://www.owenscorning.com/en-us/insulation/products/selectsound-black-acoustic-board