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19 June 2023

Devils Lake Park District
Mr. Josh Janzen
Superintendent of Parks and Recreation
501 Firebird Lane NW
Devils Lake, ND 58301

Re: Bill Jerome Arena Structural Assessment Report
AE2S P15575-2023-001

Dear Mr. Janzen:

The undersigned staff of AE2S visited the Bill Jerome Arena in Roosevelt Park on 03 May 2023.

Digital photographs were taken and are summarized on the enclosed contact sheet. The are referenced by their photograph number throughout the report (e.g. P001).

The digital photos will be transmitted by separate correspondence.

The undersigned previously studied the arena approximately 12 years ago. The conclusions from the previous report are referenced within this report.

PURPOSE

The purpose of this study is to visually assess and report the qualitative condition of the structure. Design solutions for any recommended upgrades are not included in the scope of this report.

This study does not address any other feature, system, or functional purpose of the Bill Jerome.

BACKGROUND

The history of the Bill Jerome Arena is well known and will not be discussed in detail.

The pertinent comment regarding the main arena portion of the facility is unchanged from its initial construction.

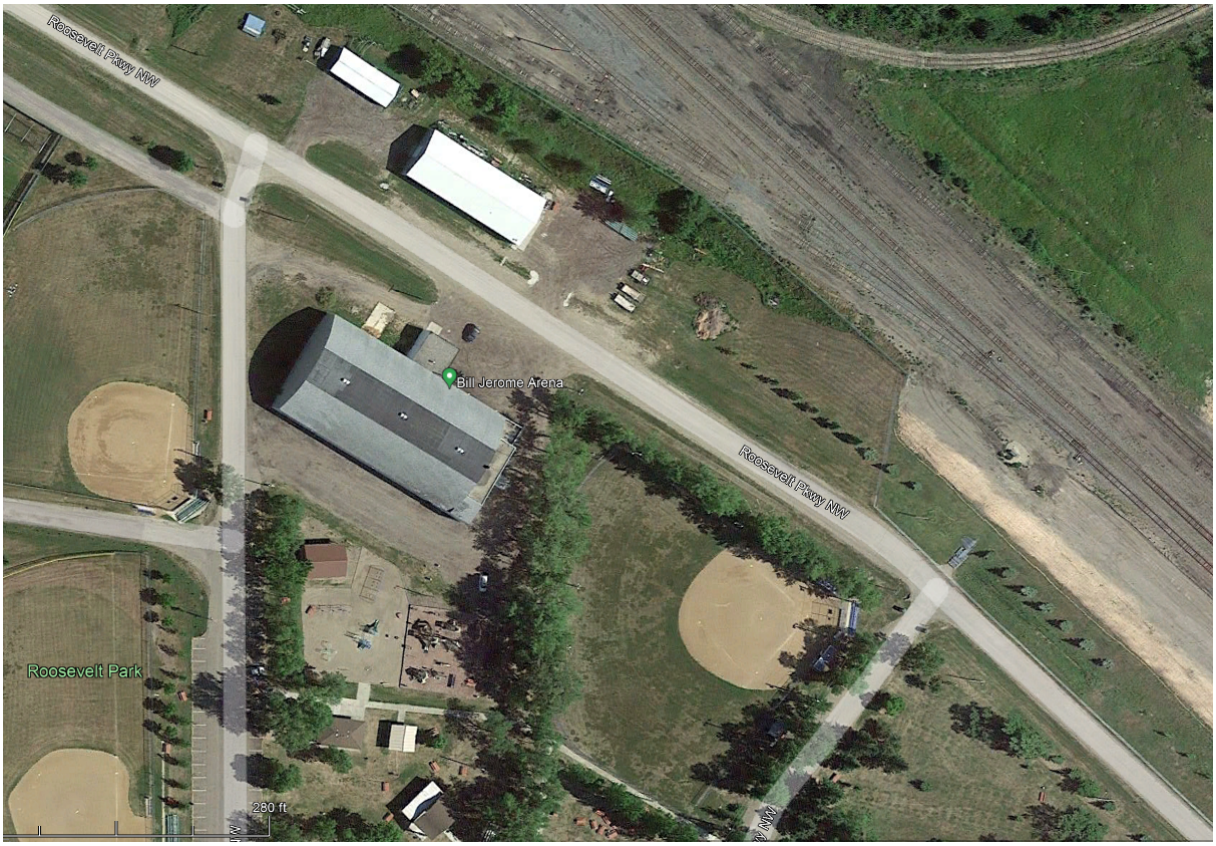
There have been two additions:

- East lobby.
- North ice resurfacer room.

The Bill Jerome is one of the last first-generation indoor rinks in the region still in operation and is a wonderful part of the history of hockey in our region.

EXISTING CONDITIONS

The axis of the facility runs NW/SE but for purposes of discussion the main lobby is the east end and the resurfacer room is on the north side.



The structure is highlighted by the circular arch roof system over the main arena portion:

- Wood chord arches spaced at 20′-0″ with steel rod vertical webs and wood compression webs (P001 - P009).
- Variable depth arches, approximately 6′-0″ deep at the crown and 5′-7″ deep at the base.
- The arches directly support solid sawn roof joists spaced approximately 24″ on-center, spanning east-west (P001, P008, P009).
- The roof deck is diagonally laid solid sawn wood board, supported by the roof joists (P019).
- The chords are multi-ply wood assemblies of variable thickness (P009, P021).
- The bases of all arches are supported by cast concrete piers (P021).

- The arches also provide wind force resistance for wind loads acting perpendicular to the east-west axis of the structure.

The north and south sections of the roof are framed to "lean on" the arches:

- 2x6 joists that span north-south and sloped at approximately a 9:12 slope (P016).
- Outside ends of the joists are supported by the exterior bearing wall (2x4 studs @ 24" oc) (P016)
- Inside ends are supported by a double 2x10 wood beam that spans between each primary truss (P019).
- The joists are toe-nailed and face nailed into their supports.
- The exterior bearing walls terminate at 15'-10" above the main floor level and are supported by a concrete foundation wall that extend to 24" above the floor level.
- The base of the studs are not in contact with the ground level.
- The top of the stud wall is terminate with a double 2x4 top plate that is essentially a horizontal beam that transfers loads to each roof arch (P012, P014).
- The wall boards are solid sawn wood sections laid diagonally (P013-P015).

The east lobby is framed separately from the main arena portion:

- Has a full basement housing a locker room, storage room, and the refrigeration system.
- Floor framing are wood joists at unknown spacing, supported by exterior foundation wall, interior wood beams and wood column grid, and a bearing wall at the west side that is common with the main arena end wall.
- Wood framed exterior walls and roof.
- Has a flat or nearly flat roof

A vehicle storage room is on the north side of the main arena area.

- Wood framed roof and walls.
- No basement.
- Also used to store vehicles and equipment.
- Has a flat or nearly flat roof.

There is seating on the south side of the ice rink playing surface and a small length on the north side located west of the scorekeepers and penalty boxes.

- Wood stringers, the upper end is supported by the exterior 2x4 stud wall and the lower end rests on the floor (P033-P035).
- Wood seating and footboards, attached to the stringers.
- Closed seating risers (P024-P031).
- Bare dirt floor under the seating areas (P033-P035).

The ice rink surface is a cast in place concrete floor (e.g. P001).

Cast in place concrete walkways surround the ice rink surface, but do not extend under the seating areas or around the west end boards (P017, P025).

The west end wall is framed with 2x studs spaced at 24" on-center. The tall wall is braced with wood diagonal braces that "kick" back tot eh arch structure (P018).

The exterior weather barrier is a shingle roof with steel siding over the original stucco wall finishes.

The foundations are constructed with cast in place concrete, and where visible are in acceptable condition.

A previous study was undertaken after a windstorm loss and identified wind damage to the wood ties that connect the top of the south wall to the arches. This damage was inelegantly but effectively repaired (P009-P012). The north wall was not damaged in the storm.

OBSERVATIONS

Previous study indicated the arches and their supporting concrete foundations have excellent capacity and are in very robust condition with no observed or reported concerns. Within the limits of our observation, the arches are in good condition with no visible rotting or other defects. These arches are the defining element of the Bill Jerome and are the most important structural component of the structure. Their robust condition provides fundamentally sound structure for the entire facility.

Previous study indicated that the calculated snow load capacity (20 psf) of the 2x6 roof joists on the north and south sides is insufficient to carry current building code snow load requirements (42 psf).

- However, there are no observed or reported instances where the calculated capacity has caused concern (cracking, sagging, etc.) likely due to the steep slope and exposed roof condition that allows snow to slide and blow off the roof.
- The previous study provided an upgrade option, but the intervening years and the continued successful performance record of the framing make the upgrade a recommended, non-essential improvement.
- Future building codes may further increase the required snow load requirements, which would not mandate the upgrade. However, it is observed that heavier snow loads than required by historical building codes and practices are more common.
- The upgrade is a long-term risk management project worth considering.

The north and south 2x4 stud bearing walls are no longer in their original position relative to the top seat of the seating structure.

- This is due to several conditions, mostly long-term outward thrust of the walls under sustained roof load.
- This condition need not be restored, but a more effective design to transfer the loads into the arches or into the seating structure is recommended.
- This condition is not an imminent safety risk.

The east lobby is intact, observed areas are in good condition, and shows no structural concern.

The vehicle storage room structure is intact, in good condition and shows no structural concern.

The wood framing for the seating has small, localized random areas of degraded footboards and seat boards that need repair.

- The underlying stringers are in good condition.
- Because the lower end sits at the floor level, periodic inspection to make sure that water damage does not start to occur is recommended.
- Even if the water damage begins, it will not create an imminent safety risk.

The ice surface concrete floor is in good condition. It is unlevel with low spots which may make ice maintenance difficult, but the slab is free of cracks or other such concerns that would lead to larger problems.

The concrete walk area is uneven and broken, especially near the SW exit door and along the aisle in front of the seating areas.

- Because these areas are part of the emergency exit paths, we recommend restoring these areas to an even, level condition.

The roof deck is in good condition, with no observed or suspected area of rotting.

- This indicates the roofing is in good condition and is still an effective water barrier.

The steel wall panel is intact and generally functioning well to prevent water entry.

- However, the base of the wall along the portion of wall west of the resurface door and wrapping around the north end of the west wall has significant rotting at the base of the wall and through other portions of the wall boards.
- This section of wall needs to be restored. Removal and replacement of the ties is the most feasible practical method.

The foundation walls, and by inference their below grade supporting footings, are in good condition.

- There are suggestions of frost heave and related soil movement, which has not caused a concern needing correction.
- The visible portions of the concrete foundations are in good condition with no cracks worthy of concern.
- The crack in the NW corner (P045-P047) should be sealed but is not itself a structural stability concern.

The top of wall wood ties connecting the bearing walls to each arch need to be upgraded.

- Removing the original ties (P016) and the previous repairs (P010-P012) and replacing them with a more appropriate detail is recommended.

REPAIR SUMMARY AND PRIORITY

While the structure has some areas that need repair (listed below in order of priority) its core elements are intact and in acceptable condition.

1. Repair the top of wall wood ties at each arch.
2. Repair the water damage at the north and west walls.
3. Improve the load transfer at the top of the bearing walls to the arches.
4. Correct the uneven walk surfaces in front of the seating aisle leading to the exit doors.
5. Upgrade the roof joist framing above the north and south seating areas.

The design and detailing of each repair is beyond the scope of this report.

The most critical long-term risk for any structure, especially a wood structure, is water damage. Continued diligence and maintenance of the exterior water proofing (roofing, siding, trim, gutters, etc.,) is the best long-term strategy to keep the Bill Jerome intact and safe and available for following generations of skaters.

Please contact the undersigned staff with any questions and follow-up tasks.

Sincerely,

JAY R. KLEVEN REGISTERED PROFESSIONAL PE 4685 ENGINEER NORTH DAKOTA

19 June 2023

AE2S
Jay Kleven, PE (ND PE-4685)

Encl/ Contact sheet