APPENDIX B

WHITE CITY MULTI-USE RECREATION FACILITY
SCHEMATIC DESIGN REPORT

BUILDING SYSTEMS

White City

aodbt
architecture + interior design

B. Building Systems

The following sections outline the design intent and options that will be form the design of the White City Multi-Use Recreation Facility. Included in this section are design precis specific to Civil, Landscape, Architectural, Interiors, Structural, Mechanical, Electrical and Energy Modelling.

B.1 Civil

B.1.1 Water & Sewer Servicing

The initial phase of the MURF will be serviced by a 200 mm watermain (COORD W/ MECH) from the west side of the parcel. Approximately 600 m of water main would be across the site along the south side of the MURF. Future looping would be needed to provide system redundancy in the event of a water main break. Large facilities typically require at least two independent water services. There will be several onsite hydrants installed to provide adequate fire protection (in addition to building sprinklers), these hydrants will be located with 45m of the main entrances or Siamese connections to the sprinkler system(s). During the initial phase, periodic flushing of the line may be required in periods of low use to keep the water system chlorine residuals at their operating levels. The servicing reports from the developer recommend a fire flow of 190L/s for institutional sites. Figures 1 and 2 show the conceptual water servicing of the MURF.

The White City Multi-Use Recreation Facility (MURF) has a couple options available to sanitary sewer servicing. Option 1 is to bring a sanitary sewer main from the west side across the site to service the MURF. Option 2 is to install a temporary sewage pumping station on the east side, which pumps via a force main to the Betterridge Road trunk sewer. The estimated peak sewage flow from the MUFR is 9.3 L/s, using a peaking factor of 3.27 (COORD W/ MECH). Sewage flows are based on the Ontario Building Code (Section 8.2.1.3), which give water usage per person or seat in various facilities, such as pools, arenas, and schools. It should be noted that coordination with the Town of White City will be required when the aquatic center pool(s) is drained over several days.

Option 1

The sanitary sewer service would connect to a sewage pumping station (SPS) located in the southeast corner of the parcel. The MURF would be serviced by a sanitary sewer main along the south side of the building, approximately 120m long. An additional 135m would be needed to get to the north east rinks. The SPS would pump approximately 685m north to the Betterridge trunk sewer. Once a gravity sewer is installed to the east side of the site, the SPS could be decommissioned a bypassed and serviced via gravity sewer (assuming the sanitary sewer is deep enough). Figure 18 shows the site servicing for Option 1.

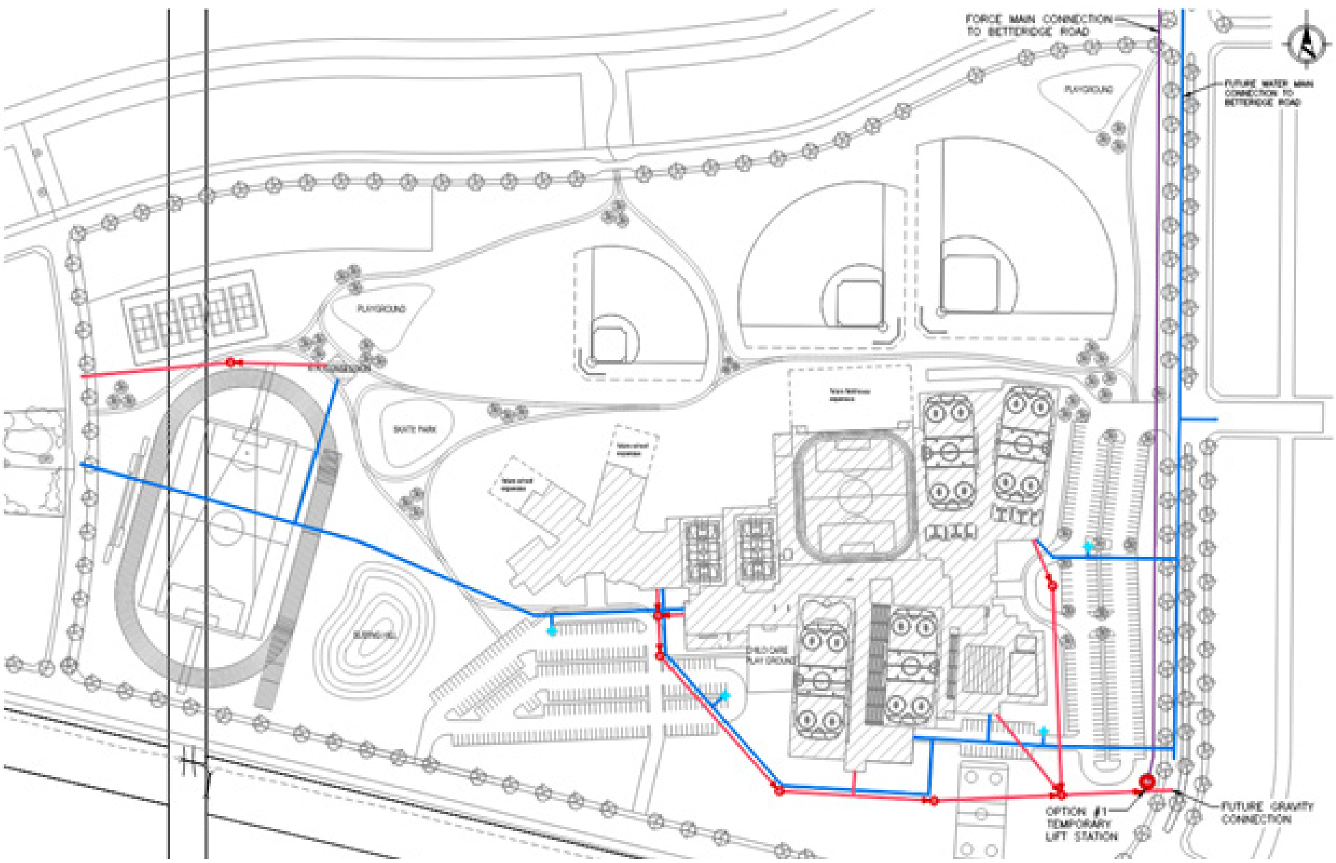


Figure 1: Option 1 Servicing

Option 2

The sanitary sewer service would connect to the developers sanitary main located in the roadway on the west side of the MURF parcel. A 200 mm sanitary main would be installed across the MURF parcel to the south side of the MURF. Manholes and service connections could be pre-stubbed to future building phases. This option would require approximately 575 m of sanitary sewer main to get to the Aquatic Centre. An additional 135 m would be needed to get to the north east rinks. Further information is required from the developer's engineer to determine if there is sufficient depth on the sanitary main on the west side of the parcel to reach the furthest service connection at the northeast rinks. Figure 19 shows the site servicing for Option 2.

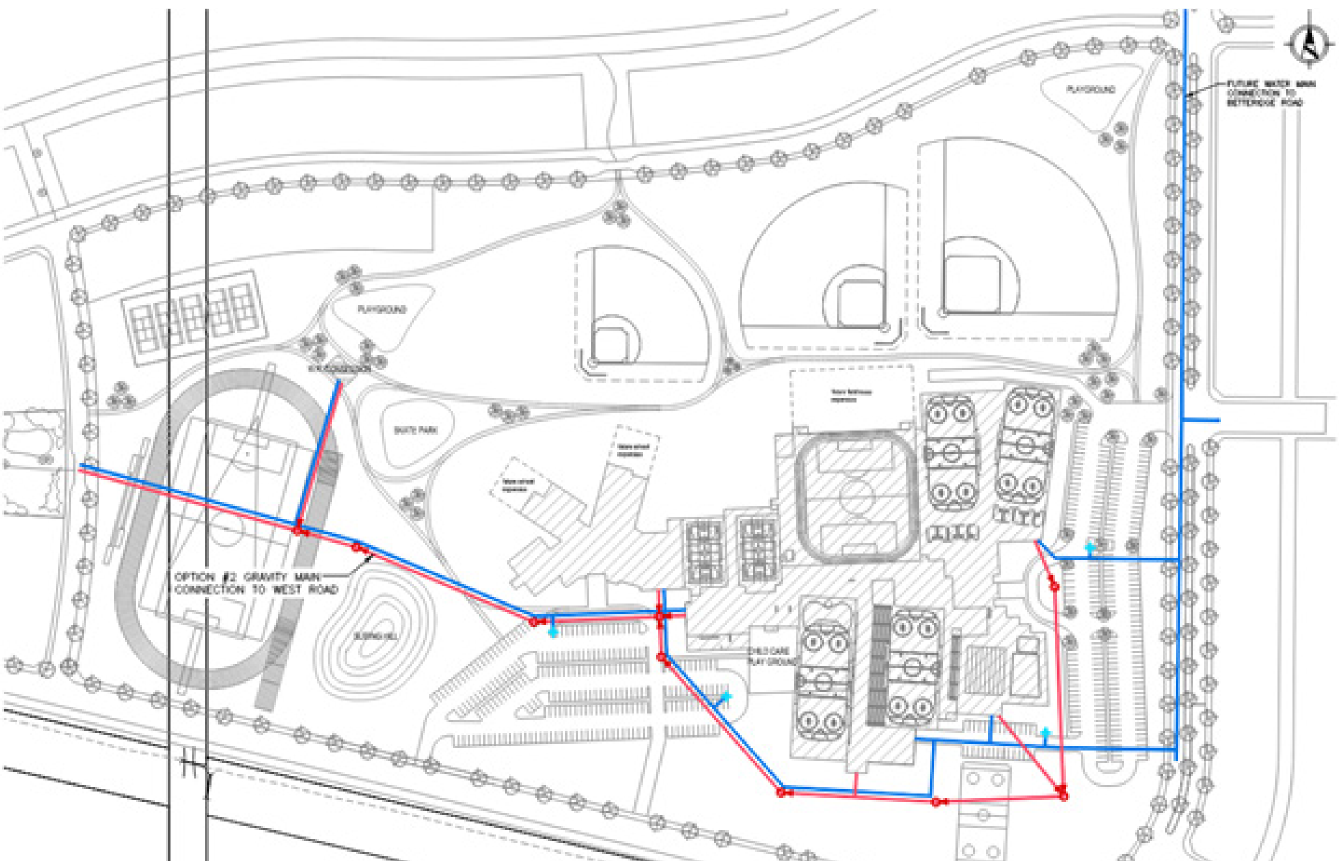


Figure 2: Option 2 Servicing

B.1.3 Storm Water Management

The Town of White City is largely surface drainage, with the larger development area being proposed as surface drainage. Topographic information on the parcel show that the ground generally slopes east to west. The conceptual design of the MURF parcel will be a combination of surface drainage and storm sewer. The storm sewer will drain to the proposed storm water pond directly north of the parcel. The pond is being incorporated into Chuka Creek. The use of storm sewer will provide more flexibility in grading the parcel and will provide better drainage and more ability to capture runoff and control its discharge. The short-term storage of runoff onsite will help mitigate peak storm water flows downstream. The storm water management will follow the City of Regina standards for onsite ponding requirements. The storm sewer would connect be brought to site about midway on the north property line and a local storm sewer network would be installed throughout the site. Portions of the perimeter of the parcel would surface drain into the roadside ditch. Areas with storm sewer would have a maximum ponding depth of 400 mm in the event of a large storm event. These areas would only surcharge temporarily and would drain down once the system has capacity. Generally, pavement and hard surface slopes would have a minimum of 1% of slope, major surface drainage channels would have a minimum of 0.5% and landscaped areas would have a minimum slope of 1% (COORD W/CHA). Figure 20 shows conceptual site drainage. Further information is required from the developer's engineer before more detailed grading information can be designed.

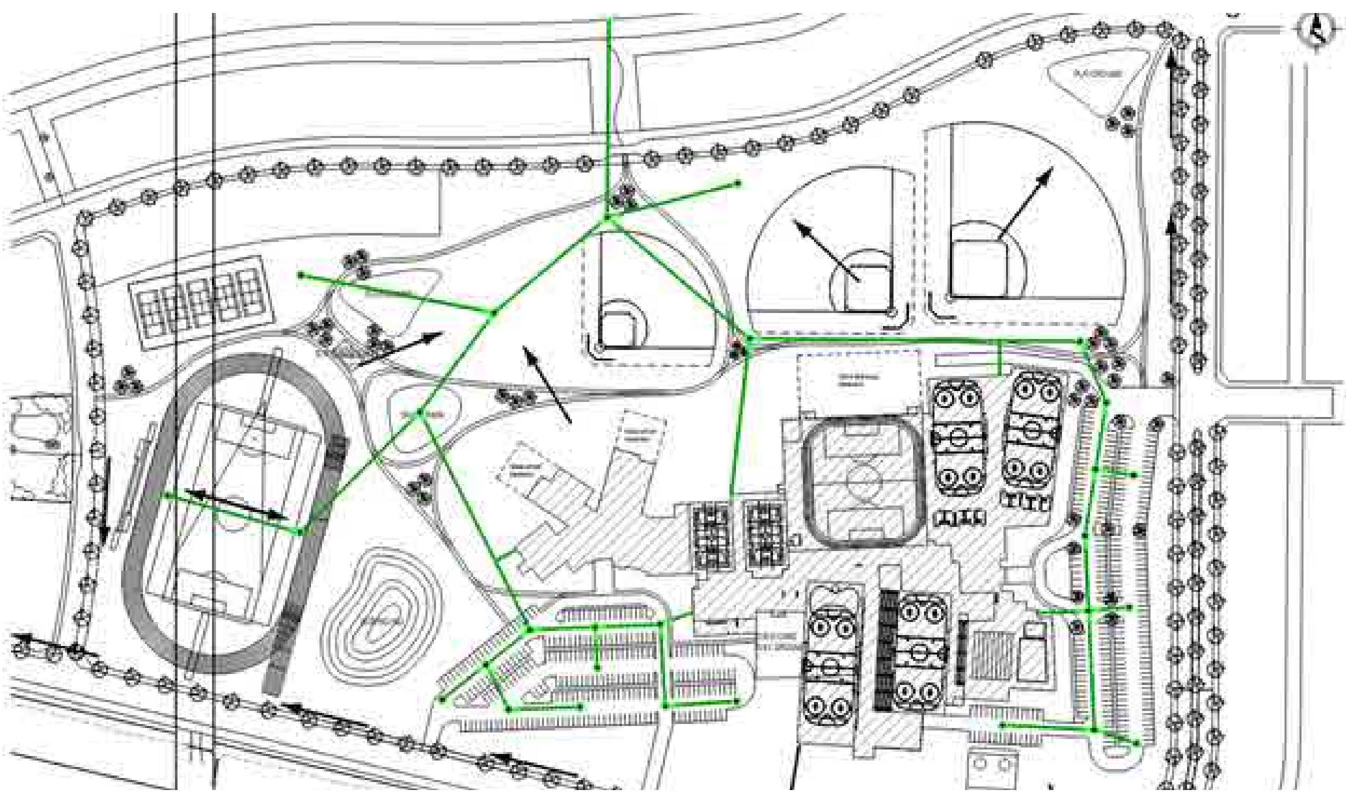


Figure 3: Drainage

B.2 Landscape

B.2.1 Existing Site

The proposed parcel is approximately 19.2 Hectares and is bounded on the north by Chuka Creek and a proposed subdivision roadway, on the south by a CN rail line, on the east and west by proposed subdivision roadways. The parcel is irregular in shape with a wider frontage to the east and a narrower west edge. The parcel is currently farmed and is relatively flat except for the northeast corner which has a two-meter grade change directing any rainwater that falls into the area into the creek on the north.

B.2.2 Subdivision Concept Plan

The parcel's irregular shape makes it slightly challenging to locate such a large facility. The specific location of the building on the site has not been finalized, as many factors are still being considered. The final location should take best advantage of views and access points and allow exterior recreational fields to be located nearer to the interior spaces with which they may connect. The parcel has a logical and appropriate connection to the main roadway that transects the neighbourhood to the east and which travels by the proposed elementary school.

Roadways on the east and south are proposed to be collector roads that are directly connected to other central areas of the larger subdivision. Vehicle connections to these larger roads would provide easier access for people coming to the facility from the wider community.

The rail line to the south poses some challenges and opportunities. One challenge is the safety or the perception of the safety of this adjacency. One would presume that, as this part of the community develops, fencing and/or berms would be installed to address this concern. The additional challenge is mitigating the effect that this adjacency may have on the feeling that this is the "back" of the facility. The facility is large and contains many uses, meaning that numerous entries will need to feel like a "important" entries. The landscape treatment, well placed vehicle entrance points, pedestrian accommodation and creating significant viewscapes will all help to enhance this. The opportunity that exists with the rail line adjacency relates to its permanence. Once the rail line roadway is built, it is not expected that this frontage will change. This will mean that the streetscape treatment can be crafted and delivered all in one phase, without change or alteration.

B.2.3 Site Development Elements

Approaches to Site

Three vehicle access points are currently proposed. These are located to provide the most logical access to the important entries – atrium, childcare, library and high school, outdoor rink and rink maintenance.

Pedestrian and bicycle access will be via the surrounding neighbourhood walks, as well as particular pathway connections that are being proposed by the subdivision developer. These latter pathways are part of and will connect to the wider pathway system that exists or is planned for the Town of White City. These pathway connections will be of particular importance to the goal of encouraging active transportation.

Parking Lots

Separated parking lots are proposed, rather than one large lot, in order that users have easy and close access to the specific part of the facility they wish to visit. This approach also minimizes the negative appearance that large, contiguous parking lots have.

Pedestrian routes through parking lots to main and important entries will be proposed. In this way pedestrian – vehicle conflicts will be reduced. Parking lots will be screened from the street and trees within and around the parking lots will be provide shade and reduce heat gain.

Maintaining good visual access at site entries, at vehicle intersections within parking lots and where vehicle and pedestrian routes cross will help ensure that these potential conflict points are visible.

Recreational Fields

Recreational fields and courts are proposed to be located, as much as possible, adjacent to a complementary interior use / user group so that interior activities / use can spill outdoors. Additionally, we would propose to locate fields and courts that may be used on a more casual basis by community near convenient access and parking.

As with all construction of recreational fields, there are a myriad ways to construct them that correspond to available budget, expected quality and level of play. The budget for each of the fields or courts assumes a good to high quality standard.

Baseball Diamond

Currently, the preferred baseball diamonds sizes are:

- 18U – Midget; 90 ft base distance; Lines – 320 ft; Centre – 400+ ft
- 15U – Bantam; 80 ft base distance; Lines – 270 ft; Centre – 300 ft
- 13U – Peewee; 70 ft base distance; Lines – 225 ft; Centre – 260 ft
- 11U – Mosquito; 60 ft base distance; Lines – 200 ft; Centre – 225 ft
- Softball (optional); softball could be played on a 11U diamond if there is a shale infield.

18U and 15U diamonds would require grassed infields and shale base runs and safety zones. For 13U, grassed infields would be preferred. Other diamonds would require shale infields. All diamonds should have a southwest orientation, have appropriate chain link fencing and backstops.

Support facilities for the diamonds would include a centrally located building(s) that would provide space for equipment storage, umpire change room and a community-run concession. Washrooms are also proposed. Vehicle access to the central area is preferred to facilitate delivery of equipment and supplies.

Dual batting / hitting cages are also required. Space behind and beside diamonds is allocated for spectator stands. Pathways to diamonds should make straightforward and logical connections from parking lots and wider community pathway system.

Alternate

- Artificial turf outfield for 13U or 11U.

Soccer Pitch / Football Field

Overlapping fields would be irrigated turf. Soccer field is proposed to be 65 m x 101 m; football field is 150 yd x 65 yd (137 m x 101 m) not including 20 yd (18 m) goal areas. This assumes that a shared football / soccer goal. We would expect that this soccer pitch would be used by high school students, as well as the wider soccer community. This combined field would also accommodate field lacrosse.

Alternate

- Artificial turf field.

Track

This assumes a 400-m, rubberized track with 100-m dash straight sprint and deceleration stretch. Though not shown, it is expected that other track and field facilities, such as long and triple jump would be installed near the track / soccer pitch area.

Alternate

- Rubberized track surface.

<u>Pickleball Courts / Tennis courts</u>

Four dedicated pickleball courts and two tennis courts are proposed within a single, fenced area. The tennis courts are expected to be used to increase total pickleball count to six, when required. The tennis courts are expected to be used on a casual basis, whereas pickleball's popularity is increasing rapidly and the use of these courts is expected to be programmed. Paving for the courts is asphalt, with a topping. Fencing is a chain link complete with wind screens. It is noted that existing fenced tennis courts double as a secure dog run in the winter months. The Town could decide whether to permit this type of use in the new courts.

Support for the court play would include: lighting, proximity to parking and room for tournament event set up (e.g. tents, tables and spectator viewing).

<u>Hockey rink</u>

An outdoor hockey rink is proposed adjacent to the interior rinks and parking. The rink is proposed to be boarded, have a concrete base and lighting. It is expected that users would use interior washrooms and change rooms; additionally, the Zamboni which is stored inside could be used to maintain this rink, if distances were minimal. A source of water is required in order to create and maintain the ice. The concrete base provides flexibility for use in non-winter months, as noted above with tennis courts.

<u>Irrigation</u>

A separate automated irrigation system is proposed for all diamonds and fields. Additional areas, such as entry plazas, may be irrigated depending budget and priorities. The expected field quality will be impacted by available volume of water and consideration for this infrastructure element should be undertaken in the initial stages so that capacities can be understood and accommodated.

Existing fields and diamonds in White City are irrigated with non-potable sources, however, it is not expected that these would be available at this parcel. As design investigations progress, the required capacity and available volumes will need to be understood. It is preferred to have a separate water source which may be combined with a proposed maintenance building.

<u>Maintenance Building</u>

The proposed site development will require storage of maintenance equipment on site; the Town prefers this to be a separate building. The building could be combined with irrigation pump and controls and would need a garage door for wheeled equipment.

Support Amenities

As the facility and its fields, courts and pathways develop, exterior support amenities will be an important addition to the facility's attraction for use by a wider range of visitors and for longer periods of time. Amenities, like a play structure and picnic areas, will allow families to spend time together at the facility, while one or two members are participating in programmed activities. A play structure would be located where there is easy access from one of the main entries. Picnic areas could be placed within easy access of concession or food retail functions within the building.

Key pieces of site furniture will be required to support interior and exterior function. We would expect that, at a minimum, these would include: bike racks, trash / recycle units, benches and picnic tables.

Childcare yard

The requirements for exterior spaces related to childcare centres are regulated by the Saskatchewan government's The Child Care Regulations, 2015. Requirements relate to amount of space per child as well as its location relative to the childcare centre. Consideration of the yard should include these requirements as well as educational and physical development objectives, safety, access for parents or guardians and long-term maintenance issues.

Childcare access is best planned so that short term parking is located immediately adjacent to the entry minimizing drop-off and pick-up time in morning and afternoon times. Looped vehicle routes allow for straightforward and clear paths of travel for both vehicles and pedestrians.

B.2.4 Accessibility

Site development would consider and accommodate users of many different physical abilities. Common reference standards for applicable to the exterior built environment include:

- CSA B651-18 Accessible design for the built environment
- Saskatchewan Accessibility Guidelines

Development of entry walks / plazas, parking lots, pathway connections to and through the site will be made accessible using low-sloped walks (<5% slope) and ramps (5-8% slope). Preliminary grades for the building phases and site elements should be developed early in order to ensure that accessibility can be achieved through walks, and ramps are minimized. The use of ramps, if necessary, should be understood early on in site plan development so that accommodation for the space that they require can be made.

B.2.5 Phasing

Understanding that the site development will be undertaken in phases, based on budget, priorities, and a confirmation of a high school, a strategy must be created to address the landscape treatment for the to-be-developed areas so their future development is not made more difficult or costly, while also allowing use of the space in an informal, unprogrammed manner. Control of weeds on unused areas will be key to ensuring that future development of landscapes can be done in a cost effective and efficient manner. The extent of constructed areas in each phase should be carefully delineated so that their edges can be either integrated into a previous phase or made neat and easy to maintain.

Phasing plans should also carefully consider underground servicing routes, in order that current phases do not make future site or building elements more costly or inefficient to install or service.

B.2.6 Technical Design Aspects

Sustainable Sites

One fundamental goal of sustainability as it relates to site development is to minimize disturbance or change to a site. During the construction process, responsible construction methodologies can be used to minimize impact on the site and reduce erosion and the movement of sediment and plant material waste off site.

Crime Prevention Through Environmental Design (CPTED)

As they progress, the site and building layouts should be reviewed against CPTED principles, to ensure that unsafe areas, or areas that could be perceived to be unsafe, are identified and addressed. Specific consideration of CPTED principles during the design development of each building phase should be reviewed against these principles, so that these "unsafe" areas aren't accidentally introduced with the subsequent phase.

Irrigation

The irrigation system would be a commercial-quality, automated system controlled from a central controller. The system would be designed such that irrigation times did not interfere with the programmed use of the diamonds and fields, which is expected to be high. The Town should consider use of a cistern and pump to ensure the required volume is available. Environmental inputs into controls should also be considered to ensure that precipitation rates are reflective of real-time environmental conditions.

Plant Material

Proposed plantings would be drought tolerant and selected for hardiness, suitability for the intended application, and site and soil conditions specific to White City. Planting would be used to provide shade, ameliorate climate, including wind abatement, highlight views to main entries, block views to unsightly conditions and integrate the site into the overall subdivision / community development.

Fencing

The careful location of fencing can be an effective tool to control pedestrian movement to and from the site and minimize the tendency of people to "scatter shot" across roadways or drive lanes. Some fencing, interior to the site, may be considered to separate uses and minimize accidental interference with programmed uses.

Lighting

Consideration of lighting within the site may include pathways, recreational fields, parking lots and entry plaza. Light levels and spray should not leave the site, so as to not affect nearby uses. Lighting should also consider the principles of CPTED as noted above.

B.3 Architectural

B.3.1 Building Envelope

Exterior walls are proposed to be a combination of assemblies which include pre-engineered and non-load bearing steel stud construction with the exterior finish being a combination of masonry and metal cladding products. The envelope will be designed to meet the NECB 2017 and can utilize the following options. Please refer to the energy modelling section of the report for further discussion and options related to the building envelope.

Construction described from the outside in for masonry faced walls (non-load bearing steel stud):

- Clay brick or concrete masonry veneer
- Air Space
- Semi-Rigid Insulation
- Air/Vapour Barrier
- Glass mat gypsum sheathing
- Steel Studs (152)
- Gypsum Board (or alternate interior finish)

Construction described from the outside in for metal clad walls (non-load bearing steel stud):

- Pre-finished metal cladding
- Metal Z-Girts with semi-rigid insulation
- Air/Vapour Barrier
- Glass mat gypsum sheathing
- Steel Studs (152)
- Gypsum Board (or alternate interior finish)

Construction described from the outside in for pre-engineered walls:

- Pre-finished vertical metal cladding c/w thermal clips to achieve NECB 2017 and/or Insulated Metal Panel
- Pre-engineered building wall system c/w batt insulation and vapour barrier
- Pre-engineered building steel frame

B.3.2 Roof

The option(s) available for the roof will be a low-slope (flat) roof over portions of the building and a pitched roof over the pre-engineered portions of the building. Flat roof areas will be internally drained while pitched roof areas will have water collected by a gutter system which will be drained to grade.

Construction of low sloped roof:

- SBS roof system
- Pre-sloped insulation (minimum 100mm at roof drains) 2% typical slope
- Vapour retarder
- Glass mat sheathing
- Metal deck
- Supporting structure

Construction of pre-engineered building:

- Pre-finished pre-engineered building metal roof system c/w thermal clips to achieve NECB2017
- Batt insulation
- Vapour retarder
- Pre-engineered building steel roof frame

B.3.3 Exterior Windows

It is proposed that all windows will be triple glazed sealed units set in thermally broken aluminum frames (curtain wall). Operable units will be located in all regularly occupied spaces such as offices. A slight tint may be used to control heat gain while maintaining proper colour perception. Low E will be used for long term cost savings. Sun shades may be employed to further reduce heat gain depending on the buildings final orientation. For a facility that is required to be non-combustible construction aluminum frames are the only viable option.

In lieu of a triple glazed system the project could pursue a double glazed system using aluminum storefront. Storefront glazing will restrict the size of openings which will require more openings to achieve the same amount of natural daylighting in the space.

B.3.4 Exterior Doors

Exterior doors at main entry points are recommended to be set in aluminum frames and to be sliding type with motion sensors to meet accessibility requirements. Other high traffic public entry points are to be aluminum swing doors in aluminum frames and are to be equipped with push button operators.

The exterior doors at all other locations are to be thermally broken steel doors in steel frames.

B.4 Interior Finishes

The interiors for the White City Multi-Use Recreation Facility will incorporate materials, finishes, colours and patterns that will provide an inviting and timeless design for end users to enjoy. We aim to create designated spaces that are clearly defined through the use of colour and material selections, while maintaining an overall cohesive aesthetic. Where possible, exterior glazing will be used to incorporate as much natural light into the interior spaces. Designing the overall interior to be open, attractive and community-driven will further attract residents of White City to the facility, while also allowing them to feel safe and proud of their thriving community.

The following description of interior finishes is recommended based on performance in previous projects, research completed based on current best practices and feedback received during the Pre-Design phase of the project. No specific product types or manufacturers have been noted at this time, and will be reviewed in further detail with the owners/end users during a future design phase of the project.

B.4.1 Floor Finishes

Floor finishes are anticipated to be of commercial grade quality, and will take long-term maintenance and warranty into consideration. Safety of end users is also ensured, and all product types identified will follow all governing codes and testing methods.

- Common Areas will be concrete with hardener and sealer and/or commercial grade sheet flooring and/or tile flooring.
- Food Vendors shall be specified as commercial grade safety sheet flooring and/or porcelain tile rated for food preparation.
- Multipurpose Rooms shall be commercial grade vinyl sheet flooring.
- Entry Vestibules shall be a continuation of the Common Areas finishes and/or commercial grade walk-off carpet tile system.
- Washrooms will be concrete with hardener and sealer.
- Exit stairs (contained within a vestibule) shall be rubber treads and tactile rubber tile at top, bottom and intermediate landings.

Aquatic Centre floor finishes are anticipated to meet all slip resistant ratings due to standing water and overall product selection will be completed in consultation with an Aquatics Consultant.

- Change Rooms will be pool grade slip resistant tile flooring.
- Pool deck will be pool grade slip resistant tile flooring.

Ice Arenas are anticipated to incorporate flooring that is easily maintained and tested to withstand sharp ice skates being worn by end users.

- Common Corridors will be commercial grade rubber skate flooring, tiled or sheet.
- Change Rooms (including washrooms) will be commercial grade rubber skate flooring, tiled or sheet.

- Shower Rooms will be poured epoxy flooring and/or slip resistant tile flooring.
- Maintenance areas will be concrete flooring.

Child Care floor finishes are anticipated to be selected in consultation with Child Care facility representatives, and will allow for easy maintenance and flooring that will allow for a softening feeling underfoot.

- Child Care Rooms will be commercial grade sheet flooring.
- Entry Vestibules will be commercial grade walk-off carpet tile system.
- Washrooms will be commercial grade sheet flooring.
- Child Care Administration will be commercial grade sheet flooring and/or carpet tile.
- Servery shall be specified as commercial grade safety sheet flooring, rated for food preparation.

Library floor finishes are anticipated to be selected in consultation with White City Public Library representatives, and will incorporate flooring to help with acoustics and long-term maintenance.

- Common areas will be commercial grade carpet tile.
- Washrooms will be commercial grade sheet flooring.
- Staff areas will be commercial grade carpet tile.
- Entry Vestibule will be commercial grade walk-off carpet tile system.

Gymnasium & Field House floor finishes are anticipated to be selected to meet the needs of the various end users and sports performed.

- Gymnasium floors will be hardwood sports flooring and/or pulastic poured flooring (for competitive play hardwood is recommended).
- Change Rooms will be concrete with hardener and sealer.
- Storage rooms will be concrete flooring.
- Running track will be a poured sports athletic flooring.

B.4.2 Wall Finishes and Protection

Wall finishes are anticipated to be cindercrete (concrete block) for all athletic and high traffic areas in the facility, with gypsum board and studs for all non-athletic areas.

- Wall base will be rubber cove, except where an integrated cove based is specified.
- Paint will be low VOC latex, in eggshell or semi-gloss finish, except in Shower/ Change Rooms where high build glazed coating will be used.
- Additional wall protection will be assessed in a later design phase in consultation with end users.

B.4.3 Millwork

The millwork design for the various areas within the facility will be further developed in consultation with the user groups.

- Millwork will be constructed of high-pressure laminate material or plywood veneer with melamine interiors.
- Countertops will be high pressure laminate with PVC edge banding and/or solid surfacing.
- Washroom vanities will be solid surfacing.
- Change Rooms benches will be high density polyethylene (HDPE), or commonly referred to as "puck board".

B.4.4 Ceilings

- The majority of facility ceilings will be acoustic tile or exposed structure with acoustic decking.
- Offices, Meeting Rooms and Multipurpose Rooms are recommended to be acoustic ceiling tile.
- Gypsum board bulkheads may be located at certain points of the facility to accentuate an area or to provide transition at ceiling height and/or type changes.
- Gypsum board ceilings to be used in Washrooms and wet areas (except for Pool Deck).
- Additional acoustic treatments will be used in key areas as required.

B.4.5 Interior Walls

- Interior walls are recommended to be concrete block in high traffic areas such as dressing rooms, washrooms and maintenance areas; steels studs with gypsum board to be utilized in common spaces and administration areas.
- Sound transmission between spaces to be reviewed on a case-by-case basis during design development to determine what is adequate; recommendation is to ensure concrete block walls are grout filled in sensitive areas and all steel studs walls are insulated (with sound bars as required).

B.4.6 Interior and Exterior Doors

- Interior doors in common spaces such as administration, main lobby spaces and lounge are recommended to be solid core wood doors (with glazing as required) set in steel frames. Field house dressing rooms, due to them being highly visible, are recommended to also be solid core wood in steel frames.
- Interior doors in sports areas such as dressing rooms in the arena and maintenance areas (mechanical and electrical rooms) are recommended to be hollow metal steel set in steel frames

B.5 Parking

Parking was determined based on bylaw requirements according to land use and building type. The total required parking for the White City Multi-Use Recreation Facility includes 701 parking stalls and 8 loading stalls.

B.5.1 Parking by Phase

Phase 1 Parking

Parking	Program Area	Bylaw Requirement		Parking Spots
	Spectator Arena	2 per sheet of ice plus 1 per 10 fixed seats	2 + 1260/10	128.0
	Community Arena	2 per sheet of ice plus 1 per 10 fixed seats	2 + 200/10	22.0
	Multipurpose Rooms	1 per 30 sq.m.	700/30	24.0
	Retail	1 per 40 sq.m.	575/40	15.0
	Lounge(s)	1 per 10 sq.m. of patron space	968/10	97.0
	Office	1 per 50 sq.m.	250/50	5.0
	Staff Parking	1 per 30 sq.m.		20.0
Total Parking				**311.0**

Phase 2 Parking

Parking	Program Area	Bylaw Requirement		Parking Spots
	Fieldhouse	2 per court plus 1 per 10 fixed seats	4 + 420/10	46.0
	Multipurpose Rooms	1 per 30 sq.m.	165/30	6.0
	Staff Parking	1 per 30 sq.m.		5.0
Total Parking				**57.0**

Phase 3 + 3b Parking

Phase 3				
Parking	Program Area	Bylaw Requirement		Parking Spots
	Gymnasiums	2 per court plus 1 per 10 fixed seats	4 + 240/10	28.0
	Multipurpose Rooms	1 per 30 sq.m.	680/30	23.0
	Library	1 per 30 sq.m.	466/30	16.0
	Childcare	1 per 30 sq.m.	330/30	11.0
	Staff Parking	1 per 30 sq.m.		60.0
Total Parking				**83.0**

Phase 3b				
Parking	Program Area	Bylaw Requirement		Parking Spots
	School	4 per classroom	20*4	80.0
	Staff Parking	1 per 30 sq.m.		60.0
Total Parking				**140.0**

Phase 4 Parking

Parking	Program Area	Bylaw Requirement		Parking Spots
	Pool	1 per 30 sq.m.	2015/30	67.0
	Staff Parking	1 per 30 sq.m.		10.0
Total Parking				**77.0**

Phase 5 Parking

Parking	Program Area	Bylaw Requirement		Parking Spots
	Future Arenas	2 per sheet of ice plus 1 per 10 fixed seats	4 + 240/10	28.0
	Staff Parking	1 per 30 sq.m.		5.0
Total Parking				**33.0**

B.6 Occupancy

B.6.1 Building Occupancy Load

Occupancy	Program Area	Building Code Requirement		Occupant Load
	Spectator Arena	1 per seat	1260	1260
	Spectator Arena	0.75 per sq.m. (Concert)	1920/0.75	2560
	Community Arena	1 per seat	200	200
	Commons Area	N/A (Crush space for people already in building)	0	0
	Fieldhouse	1 per seat	420	420
	Library	1.85 per sq.m.	62.0	252
	Childcare	4.60 per sq.m.	54.0	72
	Gymnasium 1	0.75 per sq.m.	24.0	1144
	Gymnasium 2	0.75 per sq.m.	17.0	1144
	Pool	9.30 per sq.m.	2015/9.3	217
	Multipurpose Rooms	1.85 per sq.m.	1545/1.85	835
	Arena 3	1 per seat	120	120
	Arena 4	1 per seat	120	120
	Retail	4.60 per sq.m.	575/4.6	125
	Running Track	N/A	6.0	0
	Lounge	1.20 per sq.m.	968/1.2	807
	Offices	9.30 per sq.m.	250/9.3	27
	Commercial Kitchen	9.30 per sq.m.	97/9.3	10
	Classrooms	N/A (Will be located in school)	270.0	0
Total Occupancy				**9313**

B.6.2 Washroom Occupancy Load

The washroom counts listed below include 58 public washrooms. An additional 73 change rooms will also be provided.

Washroom Count	Occupant Load (Code Required)	Fixture Count (Code Required)
Male – 7 plus 1 per 200 in excess of 400	4656	28
Female – 13 plus 1 per 100 in excess of 400	4656	50
Total Washroom Count		**78**

Washrooms by Phase	
Phase 1	58
Phase 2	12
Phase 3	33
Phase 3b (School)	0
Phase 4	16
Phase 5	12

B.7 Building Code Summary

All code references are to National Building Code of Canada 2015. Fire and Life Safety requirements for the building are contained in Part 3 of the Code. For Dangerous Goods refer to the National Fire Code.

B.7.1 Building Data

Building Area	First Floor	27,748 m²
	Second Floor	7,747 m²
	Third Floor	1,722 m²
Building Height	3 Storeys	
Fire Protection	Sprinklered	
Major Occupancies	GROUP A2 SCHOOL GROUP A3 ARENA	
Construction Requirements	SUBSECTION 3.2.2.23 GROUP A, DIVISION 2, Any Height, Any Area, Sprinklered SUBSECTION 3.2.2.29 GROUP A, DIVISION 3, Any Height, Any Area, Sprinklered	
Building Construction	Noncombustible	
Floor Assemblies	Fire Separation with 2 Hour Fire Resistance Rating	
Roof	Unrated	
Sprinklers	Required Conformance to NFPA-13	
Mezzanines	1 Hour Fire Resistance Rating	
Loadbearing	Fire Resistance Rating not less than that Required for the Supported Assembly	

B.7.2 Fire Separations

Janitor Room	3.3.1.21(3) NON-RATED
Mechanical Room	3.6.2.1(1) 1 HR
A2 to A3 Occupancy Separation	3.1.3.1. 1 HR
B3 Occupancy Separation	3.1.3.1. 2 HR
E Occupancy Separation	3.1.3.1. 2 HR
Exit Stairs	3.4.4.1.(1) 2 HR
Elevator	3.5.3.1.(1) 2 HR
Elevator Machine Room	3.5.3.3. 2 HR

Corridors 3.3.2.6.(3) N/A

Library Book Storage 3.3.2.13.(2) N/A

B.7.3 General

Interior Finish

3.1.13.2(1) Maximum permissible flame spread rating of Interior Wall and Ceiling Finishes shall not be more than 150, Exits shall not be more than 25.

Occupant Load

TABLE 3.1.17.1

B.7.4 Building Fire Safety

Fire Alarm

3.2.4.1(1) Fire Alarm is required.

Provisions for Firefighting

3.2.5.4(1) Access to front required for a building more than 600m^2.

3.2.5.5(1) Access route to be located 3-15m from a street.

3.2.5.5(2) Provide an unobstructed access route from the fire department connection to the fire hydrant, located not be more than 45m away as per 3.2.5.15(1).

Mezzanines

3.2.8.2(1)(c) A Mezzanine does not need to terminate at a vertical fire separation because it serves a Group E Major Occupancy, is less than 500 m^2 and conforms to

3.2.1.1(4) Where a Mezzanine is not considered at storey as the Mezzanine Area is less than 10% of the suite area.

B.7.5 Safety Within Floor Areas

Egress

3.3.1.5(1) Two Egress doors are required from rooms that have a travel distance more than 25m or are more than 200m^2.

3.3.1.6(1) If more than one Egress doorway is required from a room or suite referred to in ARTICLE 3.3.1.5., the travel distance within the room or suite to the nearest Egress doorway shall not exceed the maximum travel distance specified in 3.4.2.5.(1)(c).

3.3.1.7.1(a or b)	Areas of Refuge.
3.3.1.9(7)	Dead end corridors are located entirely within a suite and are therefore permitted to be more than 6m long.

B.7.6 Exits

Number of Exits

3.4.2.1(1) Two Exits are required from the floor area.

Location of Exits

3.4.2.5(1)(c) Maximum travel distance is 45m.

Exit Widths

Based on occupant load served

Doors	3.4.3.2.(1).(a)	6.1 mm per person
Stairs	3.4.3.2.(1).(b)	8.0 mm per person

B.7.7 Health Requirements

Plumbing Facilities

3.7.2.2(6)	Conform to TABLE 3.7.2.2.-A for Water Closets in an assembly occupancy.
3.7.2.3(1)	One Lavatory provided in every washroom.

4,656 Males require 28 Water Closets and Lavatories.
4,656 Females require 50 Water Closets and Lavatories.

B.7.8 Accessibility

Barrier Free Washrooms

3.8.2.3(1) Barrier Free Washrooms are required.

Doors and Doorways

3.8.3.3(10)	Door providing access must be provided with 300mm / 600mm latch side clear space.
3.8.3.6(6)	Power Door Operators shall be activated through controls that are located between 150mm ABD 300mm as well as between 900mm and 1100mm above.

B.8 Structural

B.8.1 General

The following report has been developed based on our present understanding of the building, project requirements and the information that has been provided to us at this time. As the design continues to develop and change, revisions or additions may be incorporated into the structural systems.

For all structures, the 2015 National Building Code of Canada (NBC) will be used for the basis of design. All structural members and systems will be designed to resist the loads and load combinations due to building self-weight, use, occupancy and environmental conditions as required by the code. For the purpose of calculating structural loads, the building will be designed with "High" importance factors which increases the environmental loads (15% snow, wind, 30% seismic) in order to produce a resilient structure capable of being utilized as a shelter following a natural disaster.

B.8.2 Loading

The following climatic data and loading tables meet the recommended structural approach in observance of the NBC. Load combinations for ultimate limit states will be completed as specified. The floor loading is separated between occupancy.

Climatic Information	
Specific Location	White City, SK
Importance Category	High
Snow Load	S_s = 1.4kPa
	S_r = 0.1kPa
Snow Importance Factor	I_s = 1.15
Wind Load	q 1/10 = 0.37kPa
	q 1/50 = 0.49kPa
Wind Importance Factor	I_w = 1.15
Seismic Data	S_a(0.2) = 0.101
	S_a(0.5) = 0.060
	S_a(1.0) = 0.030
	S_a(2.0) = 0.013
	PGA = 0.061
	PGV = 0.043
Seismic Importance Factor	I_E = 1.3
Seismic Site Class	Class C
Rain Load	24 hour 1/50 = 103mm

Main Floor – Gymnasium, Pool Deck, Fieldhouse, Daycare, Multipurpose, Retail, Change	
Live Load	4.8kPa
Dead Load	Self-weight of structural slab +
	1.0kPa Partition allowance [1] OR
	2.4kPa Partition allowance [2]

Main Floor – Library	
Live Load	7.2kPa (Permit books stacks anywhere on Main Floor)
Dead Load	Self-weight of structural slab +
	1.0kPa Partition allowance [1] OR
	2.4kPa Partition allowance [2]

Main Floor – Arena Ice Surface	
Live Load	4.8kPa
Dead Load	Self-weight of structural slab +
	3.6kPa 150mm Ice Slab +
	6.2kPa 300mm Sand/Heating Pipe/Insulation Allowance

Main Floor – Mechanical and Electrical Rooms	
Live Load	4.8kPa
Dead Load	Self-weight +
	2.4kPa Partition allowance [2]
Equipment Load	Self-weight of equipment

Upper Floors – Circulation, Multipurpose, Lounge, Flex Seating	
Live Load	4.8kPa
Dead Load	Self-weight +
	1.8kPa Concrete Topping on Precast
	1.0kPa Partition allowance [1] +
	0.30kPa Suspended mechanical and electrical [3]
Equipment Load	Self-weight of equipment

Upper Floors – Bleacher Seating	
Live Load	2.9kPa
Dead Load	Self-weight +
	0.30kPa Seating Furniture +
	0.30kPa Suspended mechanical and electrical [3]

Roof Loads	
Snow Load	Base Snow + Drift Load as per 2015 NBC
Dead Load	Self-weight +
	1.0kPa Superimposed [4]
Rain Load	Ponding Loads as per geometry and 2015 NBC

Notes:

1. The partition allowance of 1.0kPa is the anticipated weight of partitions placed in any probable position constructed of gypsum board and steel stud construction material or wood gym/access flooring.
2. The partition allowance of 2.4kPa is the anticipated weight of partitions constructed of concrete masonry unit partitions less than 5m in height or concrete housekeeping pads up to 100mm thick.
3. Suspended mechanical and electrical allowance of 0.30kPa is to support building mechanical and electrical services.
4. Superimposed dead load of 1.0kPa includes interior finishes, roofing materials and suspended equipment

B.8.3 Structural Performance

Structural floors and roofs will be designed to accommodate maximum serviceability deflections. Dynamic equipment and activities will be designed to limit effects of floor vibration and fatigue. Analysis and design will be in accordance with the 2015 NBC and Structural Commentaries entitled Deflection and Vibration Criteria for Serviceability and Fatigue Limit States.

Floor and roof systems supporting finishes will be designed for a maximum deflection of Span/360 under live loading criteria and supported finishes will need to accommodate this potential movement. Elements supporting masonry partitions will be designed for a maximum deflection of Span/720 due to the materials decreased tolerances for movement. Open roof systems not supporting finishes will be designed for a maximum deflection of Span/240 under snow and live loads. Total vertical drift of the structure is limited to Height/600 due to increased sensitivity of adjacent additions and phases.

As concrete dries and cures shrinkage cracks can occur due to volumetric changes in the material properties. While an attempt to limit and control cracking will be made through control of pour size, good rebar detailing and creating of saw-cuts and construction joints, some random shrinkage cracking will occur. Cracking on this nature is typically not a structural concern and can be repaired or left depending on the aesthetic concerns. As some of the facility may have exposed, sealed concrete slabs and thin flooring with the potential to telegraph cracks, it is important to understand the potential impact of the inherent nature of concrete.

While it is understood that the project will be built in phases, no additional loading is recommended to support horizontal or vertical additions. Each phase will be designed to be self-supporting as often future load capacity is not fully utilized due to changes in programming and layouts.

As the facility is significant in horizontal dimensions, several structural expansion joints will be required to ensure thermal expansion and contraction can occur without structural damage. The joint will run vertically from roof through to foundation across the building. Locations of the joints will be confirmed in design development based on phasing and building volumes.

B.8.4 Materials

Structural materials were selected based on their ability to form the required geometry and capacity to resist the applied loads. In addition, characteristics such as durability, constructability, fire resistance, schedule and cost were considered.

In addition to the National Building Code of Canada, materials are design in accordance to the following standards and requirements:

- Concrete
  - CSA A23.3 - Design of Concrete Structures
  - CSA A23.1 - Concrete Materials and Methods of Concrete Construction
- Structural Steel
  - CSA S16.1 - Limit States Design of Steel Structures
  - Wide Flange Shapes – GSA G40.21 350W
  - Hollow Structural Sections – CSA G40.20 Class C or ASTM A500
  - Channel, plates and angles – CSA G40.21 300W
- Engineered Masonry
  - CSA S304.1 - Design of Masonry Structures
- Engineered Timber
  - CSA 086-01 – Engineering Design in Wood

B.8.5 Foundation

Foundations will be designed in accordance to the recommendations of site specific geotechnical investigation by Thurber Engineering. This report, dated August 13, 2020 is based on four drilled test holes and three piezocone penetrations tests ranging between 15m and 18m in depth. It is understood that additional test holes will be drilled after finalizing the building footprint and layout on the site. In general, the site consists of the following subsurface conditions:

- Thin (125mm) topsoil layer
- 2-3m of highly plastic silty clay
- 9-10m of low plastic silt
- Firm/stiff glacial till clay was encountered 12.5-14m below grade
- Cobbles and boulders were encountered
- Groundwater seepage, sloughing and sand lenses within the silt layer
- Groundwater at time of drilling was 3.2m to 4.3m below the existing grade
- Near surface materials are moderate to highly frost susceptible.
- Deeper excavations for pool structures or basements will require flat side slopes (3H:1V) or use of shoring along with dewatering

The report provides parameters for pile designs as well as construction of the main floor system. Based on the soil logs, drilled concrete piles will need to be cased and dewatered or likely installed with continuous flight auger rigs. Alternatively, driven steel pipe or H-section piles will provide a suitable alternative piling system. Given the number of piles for the overall facility, pile load testing (static or dynamic) will likely be economical to optimize pile design and allow reduced load factors. This recommended to take place during detailed design of Phase 1.

Parameters for below slab drainage are provided and recommended at regular intervals around the perimeter of the building as well as under the main floor slab, ice slab and pool structures. In addition, a radon mitigation system should be considered including 150mm of granular material below the slab in combination with radon suction pits and a non-permeable air-vapour barrier.

Water soluble sulphates are present on the site and sub-surface concrete will be subjected to "Very Severe" exposure (Class S-1). This will dictate a concrete mix to achieve a minimum 56 day compressive strength of 35MPa and follow water/cement ratios and curing in accordance to CSA A23.1.

B.8.6 Structural Systems

Main Floor Construction

A grade supported concrete slab can be built on this site; however, highly plastic clay is susceptible to swelling and shrinking due to moisture fluctuation. As such, large volume removal and replacement of this material is required in order to construct a grade supported slab. Up to 2m of bulk fill below slab should consist of non-expansive low plastic clay or granular fill. Fill should not be frozen or contain detrimental materials. Base and Sub-base fill materials should consist of clean, well graded sand and gravel with which to construct floor structures. A grade support slab would utilize a single layer of steel reinforcing and be constructed on engineered granular base materials.

Even with the above noted construction, there could be up to 50mm of movement expected in the floor slab. If this magnitude of fluctuation in the floor slab is not tolerable and given the large volume of soil removal and replacement, there should be consideration to support the main floor slab on piles spaced on a 3.6m grid. As sport surfaces (gym, turf, and ice) and pools require level and stable floor structures, a structural slab is recommended throughout the facility. The structural slab will be cast on 150mm geo-void form with double layers of reinforcing to protect against soil shrinkage and volumetric expansion of the soil below.

The building perimeter and interior walls will be supported on cast concrete grade beams, the depth of which will be designed to suit site grading and locations of load bearing walls and columns. If a slab on grade is utilized in some locations, interior walls should be separated from the structure and constructed to allow for 50mm of movement. Perimeter insulation on the face of the grade beam and below the main floor slab will be based on requirements of the National Energy Code. All insulation utilized should be extruded polystyrene suited for below grade applications.

The ice slab will be independent of the adjacent building structure to allow for thermal contraction during operation. The ice slab will contain refrigerant piping and be cast on rigid insulation. A sand layer including heating piping below will allow for continuous operation without the risk of frost build up in the subgrade material. The entire assembly will be supported by a structural slab to avoid potential movement. The ice slab assembly from top to bottom is proposed as follows:

- 150mm Ice Slab with cast-in Refrigerant Piping
- 100mm Rigid Insulation (2 layers x 50mm staggered)
- 300mm Leveling Sand with Heating Piping
- 200mm Structural Slab
- 150mm geo-void Form

The pool structure is to be a pile supported slab with access adjacent and below the pool for piping galleries and pool systems, along with ensuring structural performance for water remaining elements.

Upper Floors

Several design items will have to be considered when designing upper floors including spans and occupancy, fire resistance rating, aesthetics, costs, sustainability, acoustics and vibration. Primarily floor constructions would be non-combustible and consist of steel beams, girders and joists supporting concrete floor slab. Concrete floor construction will vary by location and will include hollowcore pre-cast planks, precast bleacher units, concrete topping on composite metal floor deck and conventional cast-in-place construction. The upper floor assembly will in turn be supported by steel and concrete columns and masonry walls in combination.

Building Framing and Roof Construction

The primary building framing systems are proposed to be structural steel in combination with glue-laminated (glulam) wood structure in feature areas. Framing systems will be selected in conjunction with architectural wall and roof envelopes and lateral movement requirements. In all areas, the building structure will be constructed on the warm side of the envelope in an Insulated Structure Technique. This will assist in reducing the thermal bridging that result in condensation forming on the interior surfaces. Systems will consist of the following:

- Wide flange and Hollow Structural Section Columns
- Steel roof girders in combination with open web steel joist/truss girders acting as portal structures over open spans
- Steel braced frames within wall locations
- Open web steel joists supporting metal roof deck (acoustic profiles where required)
- Glulam beams/purlins with hybrid (glulam + steel) trusses in areas, pool and lobby areas supporting timber laminated decking

As a potential costs savings Pre-Engineered Rigid framed structures consisting of cold formed steel purlins/girts supported on tapered welded wide flange beams and columns can be considered during design development; however, they have a significant impact on structural performance, building envelope and aesthetics.

The structural Grid layout will be based on 6 – 8m increments with primary structure on-grid and secondary spanning between. This grid spacing is conducive to numerous systems and provides flexibility going forward.

B.8.7 Structural Innovation

Structural innovation will be provided through selection of materials based on structural capacity, durability, viability and aesthetics in exposed areas. It is understood that a glulam roof structure is being considered for the arena and adjacent common areas in order to enhance aesthetics. Modern glulam construction is increasing in popularity and is often utilized in recreation facilities with exposed structures. While often thought of as a "premium cost", if designed efficiently, paying attention of common sizes, manufacturing methods, shipping constraints and connection details, a feature roof structure for the arenas can be achieved with as little as a 2% increase in project cost. These costs can be absorbed and mitigated through design and selection of materials and systems in both the structural and remaining scopes of work. Based on the arena span (NHL standard 85' ice width), a queen post truss is proposed with glulam double top chords and single steel tension chord. The truss would be manufactured to a maximum length of 110' to meet the maximum economical shipping requirements from plants in Western Canada (standard steerable dolly) without splices. The truss would be support by perimeter columns and an interior steel frame making up the remaining clear span.

B.9 Mechanical

B.9.1 Arena Systems

General

AME provided a draft report which was shared with the Architect and the client to review and provide feedback. This final report covers all of the items raised.

AME has added tables to various categories to outline options for the arena and filtration systems. With the options we have included brief comparisons of each system. Where possible we also included order of magnitude comparison costs.

Design Conditions

- Ice temperature -3 Degrees C to -5 Degrees C.
- Ice thickness 20 – 25mm
- Concrete slab requirements +/- 3mm in any 1-m2 area and +/- 6mm overall
- De-ionized supply water for ice resurfacer
- Ambient Humidity 50 – 60% RH

Reference Standards

Conform to C.S.A. Standard B52 Mechanical Refrigeration Code 2013 Edition, CSA B51 Boiler, Pressure Vessel and Pressure Piping code 2014 Edition, and ASME B31.5 Refrigeration Piping Code 2013 Edition.

- CSA Standard 432.94 for Safeguarding Machinery
- ANSI/ASHRAE 15-1992 Safety Code for Mechanical Refrigeration
- CSA Standard 432.94 for Safeguarding Machinery.
- IIAR (International Institute of Ammonia Refrigeration) Regulations
- Ammonia piping shall conform to ASME Standard B31.5 and IIAR Standard 2.
- National Boiler and Pressure Vessel Act
- National Building Code
- Provincial Fire Marshall Regulations
- All local rules, codes, regulations and safety orders which also apply

Recommended Refrigerant

The use of ammonia R-717 refrigerant is highly recommended for all refrigeration systems serving ice rinks, for the following reasons:

- Most common refrigerant for Arena's in Saskatchewan thus operators will be more familiar with the product.
- More efficient than offer refrigerants.
- Costs much less than other refrigerants (most Halocarbon refrigerants are 5 to 10 times the cost of ammonia).

Refrigeration Requirements

The Ice Plant will be sized for two ice sheets. Any additional ice rinks will require a separate ice plant. We have summarized a few options to consider based on anticipated owner usage.

- Spectator Rink (seasonal) – 100 TR
- Spectator Rink (year round) – 140 TR
- Community Rink (seasonal) – 80 TR
- Community Rink (year around) – 100 TR

Refrigeration Plant Recommended Capacity

AME originally was told that the Community rink was year around usage while the spectator rink was seasonal. A meeting with Nustadia strongly suggested both rinks be sized for year around usage to provide the most flexibility for the operator and maximize revenues.

Based on that meeting AME recommends that the ice plant capacity should be approximately 240 Tons.

Equipment Suppliers

<u>Compressors:</u>

- Frick
- Mycom
- Vilter

<u>Chillers: (Plate & Frame)</u>

- Alfa Laval

<u>Evaporative Condensers:</u>

- CIMCO
- BAC (Baltimore Air Coil)
- Evapco

<u>Brine Pumps:</u>

- Armstrong
- Bell & Gossett
- Grundfos

Equipment Options

<u>Compressors Recommendation:</u>

Reciprocating Type – Direct drive with Variable speed drives.

- One of the most durable options.
- Less expensive and more efficient (3% for standard Mycom Compressors and 15% for Type "M" Mycom Compressors) than screw type compressors.

<u>Chillers – Condenser Recommendation:</u>

At this time we recommend either a Plate and frame or Plate and shell heat exchangers.

- Require considerably less footprint area compared to shell and tube chillers.
- More responsive to load requirements compared to shell and tube chillers.
- Excellent to use for low charge ammonia systems.
- Can come in a skid mounted arrangement.

<u>Heat Rejection Cooler Recommendation:</u>

AME recommends a draw through type fluid cooler which requires reduced pumping and chemical water treatment due to reduced quantities of water required in comparison to cooling towers and air cooled condensing systems.

- Can be designed for lower condensing temperatures, compared to air cooled condensers, resulting in lower compressor energy input.
- The unit will be sized to accommodate a "dry operation" mode. Fins are added to the bare pipe coil bundle to add surface area. This enables the condenser to operate dry below 32 F and outdoor temperatures when ice build-up can be troublesome. If the air is sufficiently cold, the evaporative condenser becomes a simple air cooled condenser.
- Very low construction cost based on the options.

Piping

<u>Ammonia Piping</u>

Ammonia refrigeration piping shall be black steel in accordance with current CSA mechanical Refrigeration Code B52 and B31.5 Refrigeration Piping Code. All piping 50 mm and larger shall be welded as per IIAR Standards.

Brine (Calcium Chloride) Piping

Brine piping located in the Refrigeration Equipment Room shall be schedule SDR-11 HDPE piping. Use of plastic piping is preferred due to the non-corrosive properties of the pipe.

Cooling and Heating Header Trenches

Return header trenches are not commonly utilized in current rink designs. Some Owner / Operators may request the use of supply header trenches. The current trend is not to use supply header trenches and to bury the cooling and heating headers below the rink slab. However, burying the headers and all the pipe connections should only be done if clamping is eliminated by the use of HDPE piping utilizing poly-fusion welding of joints.

Cooling and Heating Header Piping

Options for header piping, when placed in an accessible trench, include SDR-11 HDPE header piping and SDR-11 HDPE rink piping fusion welded to header piping (this is a preferred option as there are no mechanical joints which are subject to leakage).

The recommended location of header piping in header trenches, where nipples are used for rink piping connections to headers is to locate the cold headers in the trench closest to the rink and the heating headers in the trench back furthest from the rink. This staggered location of the cold and heating allows for access to all nipple connections should leaks occur. The cold and heating supply and return headers should also be staggered allowing access to all header nipple connections. This configuration will only work with a relatively wide trench. Where the trench is narrow then the configuration as shown below should be used.

Portion of the headers may be buried to avoid ice build up over the Ice Resurfacer trench.

Rink Cooling and Heating Piping

Options for cooling and heating rink piping include Linear Low Density (LLDP) Virgin CSA Polyethylene piping and SDR-11 HDPE piping.

- Polyethylene LLDP rink piping would normally be utilized with PVC or steel headers and SDR-11 HDPE rink piping with SDR-11 HDPE header piping.
- LLDP poly uses clamped joints; SDR-11 piping required poly-fusion welding.
- Spacing of cooling piping is normally 100 mm (4 inches) O.C. and heating piping 300 mm (12 inches) O.C. The 4 inch spacing is often reduced to 3 ½ inches in situations where there is a heavy load, such as an outdoor rink that is subjected to direct sun. 3 ½ inch spacing is typical of most rinks in the USA.
- We recommend the poly-fusion welding using HDPE piping. If HDPE is selected then a header trench is note required.

<u>Snow Melt Pit Piping</u>

The snow melt pit heating coils and piping drops in the snow melt pit shall be schedule 10 Stainless steel. The header and fins for the snow melting coil will be aluminum.

For a ice melt pit serving two ice rinks, the coil will have 450 sq. ft. of surface area.

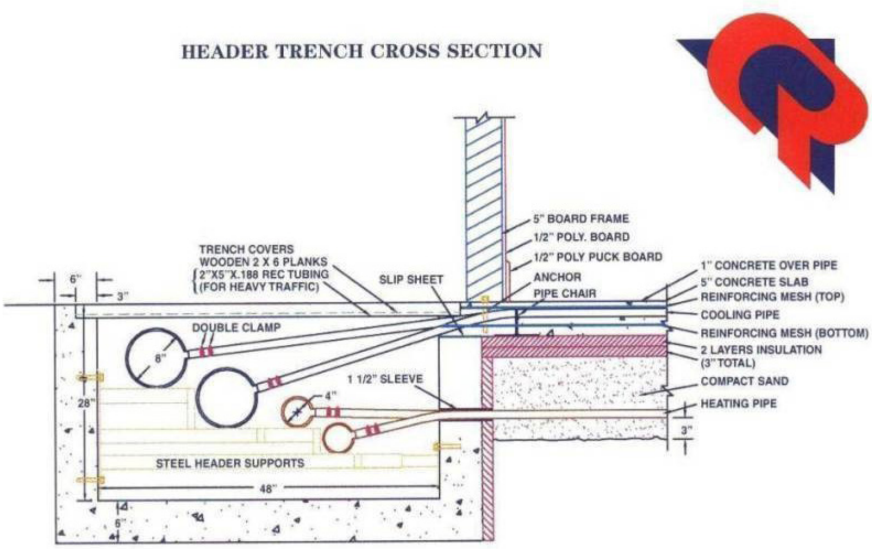


Figure 4: Typical Rink Floor Cross Section

Variable Frequency Drives

Variable frequency drives are normally provided for the evaporative condenser fans (highly recommended) to provide for a more efficient and accurate means of head pressure control.

The cold brine circulating pumps to reduce energy usage and to provide for better ice temperature control.

The Reciprocating Compressors to vary load output and reduce peak electrical demand charges.

All motors provided with variable frequency drives must be provided with ceramic bearings.

Flood Water Purification System

For arenas requiring high quality ice, it is recommended a reverse osmosis type flood water purification system be provided. A common purification system is provided by JET ICE.

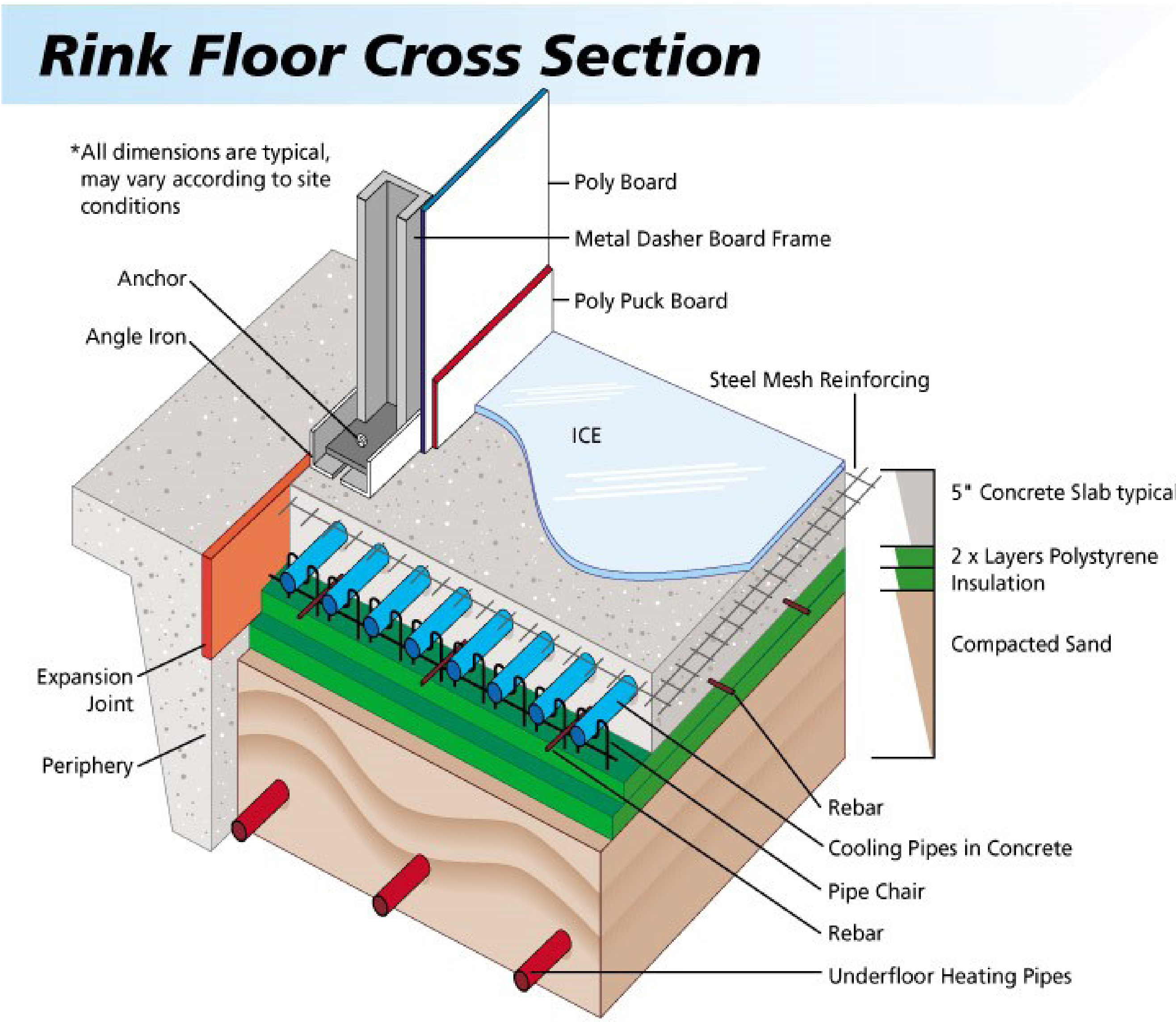


Figure 5: Typical Rink Floor Cross Section

Ice Temperature Sensors

Resistance Temperature Detectors (RTD)

Control of ice temperature and monitoring of below slab temperatures are normally done with RTD temperature sensors.

For control of ice temperature, sensors are located within the refrigerated slab and within the fill material, it recommended 2 to 4 locations be utilized. Each of the in slab and below slab sensing points shall be provided with two sensors, each wired back to the DDC control system. One sensor shall be active with the other being held in reserve if the connected sensor fails.

When an accessible header trench is used, a conduit feeding into the base sand and the cold concrete slab can also be used from the header trench. This enables changing of the TRD temperature sensor if necessary. In simple community rinks, only one RTD is used, which it is accessible from the header trench.

Equipment Room Special Requirements

Refer to the CSA Standard B52 Mechanical Refrigeration Code ("Class T" Mechanical Room) for details regarding special requirements for ammonia systems, including direct exterior access, vestibules connecting internal building access, gas masks, eye wash stations, space heating, space ventilation, etc.

Sub-Surface Drainage

It is recommended that a sub-surface weeping tile drainage system be provided for all ice rinks to minimize the possibility of water build up and possible freezing of the strata below the rink floor. Should the sub-surface heating system fail to function, water below the rink surface could possibly freeze and cause damage to the concrete floor. Recommendation in this regard should be made by a Geotechnical Consultant.

Typical Refrigeration System Control Sequence Specification

<u>Controls Sequences of Operation</u>

Cold Brine Pumps – When all compressors are not operating one brine pump shall operate with the pump VFD motor at minimum speed of 30% (operator adjustable by VFD and DDC control system.) In slab resistant temperature detectors (RDT's) shall send a signal to the DDC control system. The DDC system shall be capable of averaging any number of RDT's in an ice surface zone or sense an individual RTD in the zone. The DDC control system shall on a detection of slab temperature rise above the user defined and adjustable set point increase the speed of VFD pump motor as required satisfying set point temperature. When zone set point temperature is satisfied the DDC control system shall reduce the speed of the brine pump to minimum speed. DDC lead / lag sequencing shall be provided for the brine pumps.

Compressors – The first compressor shall start based on a detection of the slab temperature above the user defined and adjustable set point of the brine entering the chiller. Additional compressors shall be staged on based on maintaining the user defined and adjustable set point compressor suction pressure. The order of sequencing the operation of the compressors shall be totally user definable.

Evaporative Condenser – The evaporative condenser water pump motor and evaporative condenser fan motor shall be controlled by a pressure sensor located in the compressor discharge line. The order of sequencing the operation of the evaporative condenser components shall be totally user definable. On a change of compressor discharge line pressure, the following sequence of operation shall be provided:

- Evaporative condenser fan VFD motor on.
- Evaporative condenser fan VFD motor increase in speed to maintain set point pressure.
- Evaporative condenser fan VFD motor decrease in speed, condensing water pump motor on, evaporative condenser fan VFD motor increase in speed to maintain set point pressure.
- Evaporative condenser fan VFD motor decrease in speed, condensing water pump motor off.
- Evaporative condenser fan VFD motor off.

Warm Brine Pump – In slab resistant temperature detectors (RDT's) shall send a signal to the DDC control system. The DDC system shall be capable of averaging any number of RDT's in the below-slab zone or sense an individual RTD in the zone. The DDC control system shall on a detection of the below-slab temperature below the user defined and adjustable set point (usually at about 38 F.) start the warm pump motor as required to satisfying set point temperature. When zone set point temperature is satisfied the DDC control system shall stop the warm brine pump. The intent is to ensure there is no ice forming under the rink floor. A few degrees above the freeze point ensures that the underfloor temperature is not too warm and, therefore, not adding an unnecessary load on the refrigeration plant.

Snow Melt Pit Heating System – Temperature sensor located in the snow melt pit shall on a pit water temperature below set point, start the snow melt pit circulating pump. On an increase in snow melt pit water temperature above set point the snow melt pit circulation pump shall stop.

<u>Refrigeration Equipment Room Ventilation System</u>

- A two stage space cooling thermostat shall on a rise of space temperature above set point, shall open the air intake dampers and operate the exhaust fan EF-1 at low speed (50% capacity). A further increase in space temperature shall operate the exhaust fan at high speed (100%).
- A new ammonia detector located in the Refrigeration Equipment Room shall on a detection of ammonia gas vapour, automatically open the outside air intake dampers, run the exhaust fan at 100% capacity, and actuate an alarm.
- A new emergency control switch on a separate circuit located immediately outside of the Refrigeration Machinery Room shall open outdoor air dampers and run the exhaust fan EF-1 at 100% capacity. Complete installation shall be in accordance with the B52-2005 Mechanical Refrigeration Code.
- The ventilation system shall be interlocked with the compressor operation such that when any or all the compressor are operating the exhaust fan shall operate at 50% capacity and the intake air dampers shall open.
- A motion detector switch shall on detection of Refrigeration Equipment Room occupancy operate the exhaust fan at 50% capacity and open the intake air dampers.

Refrigeration Equipment Room Emergency Switches

- A emergency control switch located immediately outside of the Refrigeration Machinery Room shall shut down the entire refrigeration equipment in an emergency. A separate control switch on a separate circuit which is located immediately outside of the Refrigeration Machinery Room, shall open outdoor air dampers and run the supply and exhaust fans at 100% capacity. Complete installation shall be in accordance with the B52-2005 Mechanical Refrigeration Code.

Arena Bowl Dehumidification Recommendation

Each arena will have a dedicated gas fired desiccant dehumidifier to maintain relative humidity for proper ice conditions. The dehumidifying units will be mounted on the roof between the two arenas.

The intention at this time is to utilize electric powered ice re-surfacers. This will remove the requirement to have general exhaust and make-up air tied into a gas detection system. There will be a battery recharging station that will require a separate exhaust air component to limit the off-gassing of the batteries to below the lower explosion limits. It is likely this will be located in or near the ice re-surfacer storage garage.

The arenas will be provided with gas detection systems with audible and visual alarms even with the current intention to provide an extra safety precaution should a gas fired vehicle ever be driven on or near the ice.

B.9.2 Aquatic Centre

Pool Design Guidelines

Turnover Rates

A pool's turnover rate is defined as the time it takes for its full water volume to be passed through the filtration plant. It is expressed in hours or minutes, but can also be expressed as a volume flow rate when the pool's volume is taken into account. Lower turnover rates provide for better water quality, clarity, and a faster response to varying water chemistry.

Maximum pool turnover rates are determined by the Saskatchewan Guidelines for Pool Design. In AME's experience, however, turnover rates less than maximum values are recommended. Best practice turnover rates are determined by applying a recommended rate by depth approach for each pool type. Shallow pools, regardless of designation, tend to see concentrated bathers and less water volume per bather, requiring lower turnover than deeper pools.

Hot pools require the lowest turnover rates of all pools. This is due to their high temperature, which encourages biological growth; as well as their propensity for hi bather load.

The following table summarizes the minimum and recommended turnover rates for the facility described in this report.

Parameter	Code Minimum (h)	Recommended (h)
Lap Pool	**6**	**4 – 6**
0-600mm		n/a
600-1200mm		2
1200-1800mm		4
≥ 1800mm		6
Leisure Pool	**2**	**1 – 2**
0-600mm		0.5
600-1200mm		1
1200-1800mm		2
≥ 1800mm		3
Hot Pools	**0.5**	**0.15 – 0.25**

For this facility, the lap pool will be designed to approximately 4 hours, leisure 1.5 hours, and hot pools 0.15 hours

Pool Operating Temperatures and Heat-Up Times

AME recommends designing pool heating systems to generate pool temperatures in accordance the American Society of Heating Ventilation and Air Conditioning (A.S.H.R.A.E). The pool heating system will be designed to maintain those temperatures under normal operating conditions. Facility staff are free to operate their pools at lower rates than those allowed for, however, exceeding those temperatures are not recommended, nor will they likely be achievable.

The following table lists the recommended pool temperatures for this project. AME will design its heating plant such that it is capable of maintaining these temperatures with a pool hall air temperature of 27 °C. Should it be desired to operate at higher pool temperatures and/or lower air temperatures, this must be confirmed prior to the completion of design development.

Parameter	Recommended Operating Temperature (°C)	Design Heatup Time (h)
Lap Pool	29	72
Leisure Pool	32	48
Hot Pools	40	6

Pool Mechanical Systems

Pool mechanical systems consist of pool fittings, water features, piping, pumps, filters, chemical treatment, and controls. This section describes recommended mechanical systems and presents options for those subsystems whose selection will have an impact on pool operation and water quality.

Pool Tank and Fittings

The filtered and treated pool water will return back to the pool through floor inlet fittings. The inlet fittings will be spaced such that they achieve the required turnover rates, supply clean water to all areas of the pool and scour the pool bottom to promote suspended solids so they can be picked up from the main drain or gutter system. Inlets will be placed primarily on the pool floor to promote upward movement of suspended solids towards gutters.

The pool water is returned back to the filtration plant via main drains and either a gutter system. Main drains collect the water at the bottom of the pool and are sized for 100% of the filtration rate. The drain configuration and piping will be designed to ANSI / APSP-7: 2006 American National Standard for suction entrapment avoidance in swimming pools. And specified drains will be ANSI 16 certified to prevent entrapment and entanglement.

In the absence of a continuous gutter, skimmers will be installed around the pool. The skimmers will be designed to provide continuous skimming of the pool surface while the free board will handle instantaneous bather loads.

Pool Piping

Below-grade piping shall be concrete-encased Schedule 40 PVC, while above-grade piping shall be Schedule 80 PVC, with the following exceptions:

- Pool heat exchanger branch lines will be Schedule 80 CPVC.
- UV branch lines will be Schedule 80 CPVC or 316 Stainless Steel.
- Pool fill lines will be Schedule 80 PVC and feature water hammer arrestors.
- Air bubble piping from an air blower will be galvanized steel.
- Chemical feed piping will be high-density polypropylene (HDPP). Double-walled HDPP tanks with be used in all areas without structural containment.

Pool Pumps

Three-phase, base-mounted centrifugal pumps with epoxy coated wetted components will be used for the filter pumps and larger water feature pumps. Filter pumps will be sized to meet the minimum turnover rate when the pool filters are dirty. The pumps will be supplied with VFD's so that when filters are clean, the pumps will run at a lower speed to save energy. Parallel pumps each sized for 50% of the flow will provide redundancy for filtration system should one pump fail. With only one pump operating, the system will be able to achieve approximately 75% of design flow, which will meet minimum code turnover requirements. The result is that the pool can stay operational with one pump under service.

Smaller water feature pumps will be either stainless steel in-line circulators, or plastic end suction with integral strainer.

Chemical injection pumps will be plastic, fully modulating digital metering pumps. These will be capable of very precise variable dosing.

Electronic flow meters will be provided on all pool circulation systems and will work in concert with pump's variable frequency drives to provide the circulation flowrate required to provide the selected pool turnover rate. This ensures that the pumps are only using the minimum amount of energy required to meet the design flowrate, and will continuously adjust the pump speed as the filter loads.

As a safety feature, all secondary pumps will be provided with controls that will shut them down when circulation in a specific section of the pool piping stops, regardless of whether the main circulation pumps are running.

A 'strainer cleaning' pit will also be provided in the pump area to ease cleaning and limit the spread of debris generated by strainer cleaning.

Figure 6: Pool Pumps

Water Features

Each water feature will have a dedicated pump or pumps. Smaller volume pumps will be constructed of corrosion resistant, reinforced thermoplastic with an integral strainer. Larger pumps will be either base-mounted, end-suction type, similar to the filter pumps, or 316SS in line circulators.

A master control panel will be provided at the lifeguard station, allowing deck-level control of the water features by lifeguards. In addition, supplementary emergency stop buttons will be located strategically throughout the pool area to shut off all water features in case of a bather emergency, potential or real.

The lazy river pump will be provided with a variable speed drive that can be controlled and adjusted manually at the life guard station to allow staff to vary the speed of the river.

Pool Water Heating Systems

The pool heat will be provided by the central facility heating plant. It is currently expected that as part of the heating plant design, a portion of the heat provided to the pools will have been recovered from either the natatorium dehumidification process or the exhaust air stream.

Plate and frame type heat exchangers using 316L stainless steel plates will be provided for each individual pool. This material has proven to be an excellent balance between longevity/resistance to corrosion and first costs.

Each individual pool heat exchanger will be sized to meet the peak heating load, which is typically during the pool fill. By sizing the heat exchangers on peak load, they are guaranteed to be large enough to meet the remaining heating demands – make-up water for backwashes, spillover, carryout, and evaporation.

Pool heat will be controlled through the BMS. Return water temperature will be monitored by a digital temperature sensor located downstream of the filtration plant. Heating water flow into the pool heat exchanger will be modulated to maintain pool temperature setpoints. A secondary temperature sensor will be located at the heat exchanger discharge, to act as a hi limit. Should the heat exchanger temperature increase to an unsafe temperature, the heating system will be prevented from delivering more heat to the pool.

Swimming Pool Filtration

The filtration system is responsible for providing water clarity and assisting in the chemical balance in the pool tanks. The filtration system requires the most labour and attention of all the pool maintenance tasks; and is typically both the largest piece of mechanical equipment and the largest consumer of water in the facility.

The type of filtration plant selected for the facility will influence the overall design of the pool mechanical system, affect the mechanical space requirements, and affect the size and complexity of the wastewater system. In light of this, it is recommended that a decision be made on the filtration plant very early in the project design schedule. AME recommends regenerative filters or sometimes called Pressure DE Filters for this facility. They produce the best water quality, consume the least amount of water, and require the least amount of mechanical space, allowing more space for other program functions. They have the highest mechanical capital cost. However, it is believed that this will be offset by a reduction in building construction costs and water conservation.

Regenerative filters are similar to vacuum DE in that they incorporate Diatomaceous Earth media. However, instead of drawing pool water through the filter by generating a vacuum, pool water is pushed through the filter media. This filter provides great micron removal rating and rate of turbidity reduction for a commercially available filter. Regenerative filters make several substantial improvements over the traditional vacuum/open tank configuration.

The filter elements are contained in a pressurized tank, and water is not pulled through (vacuum) the media surface, but is pushed via pump pressure upward through the filter and back to the pool. Hence the filters are often referred to as 'pressure-D.E. filters.'

Filter element area is similar to that of vacuum D.E. filters and as a result, can be fit into a much smaller space than a conventional open tank vacuum D-E system. Rather than discs, long fabric-coated fingers or 'septa' provide filter surface area. This allows more filter area to fit into a smaller compartment. It also requires dramatically less space than an equivalent hi-rate sand filter system.
DE filters have a 'regenerative' function. Conventional D.E. filters require a constant feed of new filter media (and accompanying feed equipment) to replace media that is partly clogged with dirt that falls from the filter elements. However, the media still retains effective filter area as only a small part of its shape is contaminated. Regenerative filters take advantage of this retained useful area by shaking loose or –initiating a 'bump cycle' - and reorienting the media on the filter elements on a daily basis. This process takes 1 minute and is performed by the filter mechanism automatically, but can be manually initiated by the operator.

There is substantially less operator exposure to the filter media in comparison with vacuum-DE systems, and manual cleaning of the filter elements is not typically required. The re-introduction of media is also done via a dustless, tank-mounted system that minimizes operator involvement.

The 'regeneration' process involves a pre-coat cycle as is used in a vacuum-D.E. system, however it can be automated with a series of actuated valves to increase ease of operation. It also requires only two such valves per system, unlike a hi-rate sand system.

Backwashing of the filters is required very infrequently in comparison with hi-rate sand filters (1 to 2 month intervals), resulting in dramatic water savings. Media is drained from the bottom of the filter to the sanitary sewer. Operators are not required to manually clean the filter elements during backwashing.

The design options for these filters depend on the filtration rate selected (measured in # of USGPM/sq ft of filter area). The lower the USG/sq ft, the better the filtration performance.

The following are design flow rate options for DE filters:

- Industry Standard: The filtration rate will be 1.0-1.2 USGPM/sq.ft. This optimizes filter tank sizing, media 'bump' intervals and minimizes 'bridging' of the media. AME recommends this filtration rate.

Figure 7: Pool Filter

Chemical Disinfectant

Calcium Hypo-Chlorite Recommended

The calcium hypochlorite system operates on a briquette/tablet form and is clean, odour free, very reliable and safer to handle than either gas or liquid chlorine. The system is made entirely out of PVC therefore resistant to corrosion. The feed system utilizes the principles of erosion and requires minimal maintenance. The calcium hypochlorite system is pH neutral so there is no requirement for extra balancing of the pool water. The cost of chemicals is very expensive and the added chemicals in the briquettes are dissolved in the water which increases the TDS within the pool. For remote locations the chemical cost reduces as you can purchase sufficient amount of chemicals for 1-year thus you eliminate the trucking costs that is required for liquid chlorine due to its short shelf life.

Like liquid chlorine the tank needs to be stored in a separate room with a containment curb installed around the tank. Due to the high hardness and alkalinity within the city of Regina's source water a water softener will be required for the pool fill.

Figure 8: Proper Calcium Hypochlorite Storage

PH Control

Every form of chlorine also has a tendency to either raise (more basic) or lower (more acidic) the pH of pool water, such that continual chlorine use will eventually produce a high or low pH in the water. Yet chlorine, even if present in sufficient 'free' quantities, only forms an effective oxidizer at a pH range between 7.2 and 7.6 (how quickly this occurs is a function of the inherent pH of the source water used). Accordingly, a means of chemical pH adjustment is necessary for the pools.

Moreover, chemical controllers can only interpret chlorine levels accurately within this pH range, and typically will cease chlorine feed functions as a safety feature should this occur, risking low chlorine levels in the pools. To maintain consistent chemical control and thus consistent water quality, thus it is also important that the acid system be sized to react quickly enough to pH changes created by the addition of source water or large amounts of chlorine during high bather loads.

An acid feed (as opposed to a base feed) system is dictated by the use of a liquid chlorine system. Muriatic acid is Hydrochloric acid solution at 25% concentration. It can be fed by conventional pumps at a rate required to match chlorine- or source water-induced pH changes. Like the liquid chlorine system, it requires the installation of a tank, pump (controlled by an automatic chemical controller), and injector within a dedicated, exterior-facing room in a mechanical area. Operators should use protective eye and skin wear as well as an approved air purifier. The tank should be always sealed as it is a corrosive vapour.

Secondary Disinfectant – UV

Medium-pressure UV water treatment for each pool will provide chloramine control and secondary bacterial oxidation for the water. UV treatment has been used in drinking water, industrial, and effluent applications for many years. However, it is still relatively new for swimming pools in the North American market. The primary action of UV is to kill bacteria and viruses, reducing the risk of stomach, skin, and respiratory tract infection transmission to the pool users. UV has a secondary action that initiates photo-chemical and photo-oxidation reactions, which destroy chloramines.

UV treatment is not typically installed on outdoor facilities due to presence of, and exposure to, sunlight. Additionally, airborne chloramines dissipate from the pool area, eliminating the effect on air quality observed at indoor facilities.

Since this pool is outdoors the added benefit of chloramine reduction is not a concern compared to an indoor pool. As such, we will provide space for a future UV however will not include it within the base design.

Figure 9: UV Water Treatment

Supplementary Chemical Bulk Feed

In addition to chlorine and pH control, two other chemicals will be added in substantial quantities to the pools, depending on the source water and pool chemical balance requirements:

1. Calcium chloride, to increase water hardness; and
2. Sodium bicarbonate, to increase total alkalinity.

Experience has shown that the best means of adding large quantities of the chemical is to dilute it and add it manually to the pool. As such, a bulk feed supply system will be provided to allow facility staff to mix and supply chemicals in large quantities into the system. This system can also be used for superchlorination of the pool. AME recommends a chemical storage space adjacent to the deck for this purpose. A rolling tub can be provided to move the chemicals.

Chemical Controllers

Each pool will have its own standalone chemical controller that will signal the disinfectant and pH treatment systems. For chlorine control, there are two methods of measuring levels: ORP or ppm. An ORP-type controller is recommended for this facility. ORP Controllers measure the ability of chlorine to react in the water rather than the amount of chlorine within the water. In other words you could have a large percentage of chlorine within the water however it may not be available chlorine. An ORP controller will detect this and react accordingly.

The controller will also be provided with a ‘signal generator’ to allow precise recalibration of the chemical controller as required.

Figure 10: Chemical Controllers

The chemical controller will be provided with an interface to the Building Management System. This will allow the BMS to monitor and log pool chemical levels, chemical dose rates, and overall chemical usage over time. Trend logs can be reviewed for historical levels, should it be required.

Automatic System Control Strategy

The major pool mechanical systems will operate with a significant degree of automation under normal operation. This will be accomplished through the BMS or the equipment’s internal programming. However, there will still be the need for interaction and adjustments by facility operators. Typically, disabling and restarting of this equipment is done only through manual operator involvement.

The central lifeguard station will be provided with an emergency stop switch to shut off all filtration pumps. Everything would then have to be restarted manually.

The pool filtration system will have the following DDC interface:

There is a surge tank level sensor which will send a signal to the BMS based on the surge tank level. With this the BMS will either close the main drain control valve or open to assure continuous skimming is always occurring. Should the water drop below a set point then the BMS will send a signal to the pool fill solenoid valve to open thus adding water to the pool. Alarms are also added to the BMS for low or High level.

A digital flow meter will be connected to all filtration systems that are suppling water to the pool. The filtration pump flow meters (1/pool) will be interfaced with the BMS system to allow trend logging of the pool turnover rates.
Pump variable speed drives will be BacNet compatible to confirm the speed of the drive and send information to the BMS on any system failures.

A flow switch (1/ pool) downstream of the filters will send an alarm to the BMS on loss of flow. The BMS will close the pool heating valve, shut off the Ultra-Violet Filter (UV) if installed, and shut down any secondary pumps as well as lock out the chemical controllers.

Two temperature sensors will control the amount of heat is delivered to the pool. The upstream temperature sensor will control the two-way heating water control valve via BMS. The downstream temp. sensor will shut down the two-way control valve and send a high-level alarm on unsafe temp. conditions.

The filters will have a differential pressure switch or via pool flow meter to send a signal to the BMS and/or central lifeguard station control panel for a filter bump or backwash, depending the selected filter type. The process is also automatic thus opening and closing valves to allows filter media to be dumped to drain or recoated during the backwash cycle. The filter controller is a standalone control system interfaced to the BMS.

The UV filter, if added in the future, would be connected to the BMS to send an alarm on low intensity as well as shutting the system during the evening or low occupant usage. The UV could be controlled through the BMS to reduce output or shut off on low usages.

The Pool Chemical controllers are a stand-alone control system which controls the amount of Chlorine residual and pH that gets added to the pool to maintain pool chemistry. This system will also have a BacNet interface to allow operational staff to trend log the system as well as trouble shoot remotely.

A central lifeguard station control panel will be a standalone control located in the life guard control room. This system will be controlled through either the BMS or low voltage controls.

B.9.3 Sustainable Engineering Strategies

The following are a summarized list of recommended sustainable energy strategies that can be considered to assist in meeting any sustainability initiatives outlined in the RFP:

- 100% waste heat recovery off the ice plant for Building heat pump loop, snow melting pit, underslab heating and domestic hot water preheat.
- Variable speed pumping for the Ice plant Compressors, brine pumps and evaporative condenser.
- Variable speed pumping for pool system pumps.
- Modulating turn over rates between recommended design and code maximum based on free chlorine levels.
- High efficiency gas fired boilers to provide heat for the domestic hot water and building heat. This has the lowest energy cost and GHG emissions if you consider the energy source.
- Regenerative filters use approximately 75% less water than more traditional sand filters.
- Ammonia based refrigerant which has 0 global warming and Ozone depletion effect.

B.9.4 Facility Heating & Cooling Systems

Description

Radiant Floor Heating System

Building envelope heat losses will be offset using zoned, thermostatically temperature-controlled radiant floor heating. This will allow the heating system to be able to operate independently from the ventilation and cooling systems, allowing significant energy savings by having the ventilation systems shut off during unoccupied periods.

All areas of the facility will have PEX tubing embedded in the concrete floor slab and will be zoned by room or area for thermostatically controlled radiant heating. For areas cooled by heat pumps, the radiant floor system will provide the primary heat source and the heat pump units will provide the secondary heat source.

The radiant floor piping loop will be a closed loop system operating at temperatures ranging between 27°C and 52°C depending on the outside temperature. A heat exchanger integral to the Ice Plant will be the primary heat source for the radiant floor heating with the ability to inject heated glycol from the boiler plant when recovered Ice Plant heat is insufficient.

Radiant floor system active and standby variable-flow circulation pumps will be located in the south mechanical room. Space will be allocated within the mechanical room to accommodate additional circulation pumps as the future phases of the facility are constructed and the radiant floor system is extended.

High Temperature Glycol Heating System

The primary heat source for the facility will be a high efficiency hydronic boiler plant using multiple condensing modulating boilers. The system will be piped in a primary / secondary arrangement with the boilers and their circulation pumps forming the primary loop that adds head to the pumped variable flow secondary loop via a common pipe.

High temperature glycol, ranging from 55°C to 90°C depending on the outdoor ambient temperature will be injected into the radiant floor loop when required and will also be piped directly to entrance force-flow heaters, unit heaters and ventilation unit heating coils. Consideration will also be given to piping high temperature glycol to a secondary heating coil in the Arena snow-melt pit to supplement the coil supplied with rejected ice-plant heat.

The boilers, circulation pumps and ancillary equipment will be located in the south mechanical room.

Cooling System

A portion of the cooling for the facility will be provided by the ice plant depending on the time of year and the areas of the facility in use.

One or two air-cooled chillers will be provided outside at grade and will be the primary source of building cooling. Chilled glycol will be pumped from the chillers to glycol coils in the ventilation units and to unitary fan-coil units.

Active and standby chilled glycol pumps will be located in the Mechanical Room south of the Spectator Arena.

B.9.5 Spectator Arena & Ancillary Area Ventilation

Description

Two indoor air handling units AHU-1,2 will be provided to ventilate, cool and provide supplementary heating to the Spectator Arena playing surface and spectator seating areas. The units will be located in the 2nd floor Service Area south of the arena.

The units will include variable capacity supply & return fan arrays, outside air free-cooling economizer, pre & final filters and heated & chilled glycol coils. Outside air & Relief air openings will be ducted to exterior wall louvers or roof hoods.

Alternatively, AHU-1 & 2 could each be provided with DX cooling coils and matched with air-cooled condensers located on the roof of the mechanical room.

Supply air will be distributed from each AHU at high level within in the arena via concealed or exposed acoustically insulated & perforated sheet metal lined spiral ductwork complete with adjustable vane drum diffusers. Branch supply air ducts will be extended complete with diffusers to the main floor change room corridor in order to provide air-conditioning for the change rooms.

Return air will be drawn back to the AHU's through common return air louvers in the Arena space.

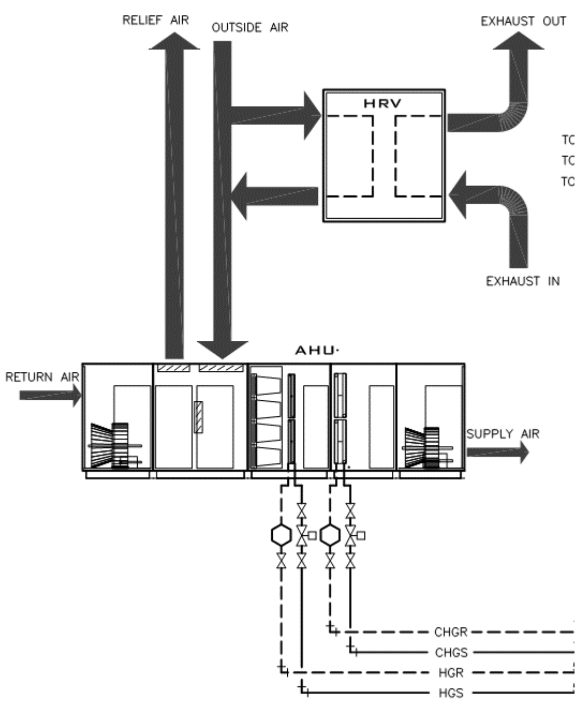


Figure 11: Typical Air Handling Unit

Two energy recovery units will also be located in the 2nd floor Service Area south of the arena. These units will draw exhaust air from the upper and lower level washrooms and lower level change-room shower areas. The air will be directed through the energy recovery core and exhausted outdoors. A matching volume of outside air will be drawn from the AHU-1,2 outside air ductwork, warmed by the energy recovery cores and supplied back to the AHU-1,2 outside air ductwork.

Make-up air to replace air exhausted from the change rooms and shower rooms will be transferred from the corridor through transfer ducts complete with thermostatically controlled heating coils.

B.9.6 Community Arena & Ancilliary Area Ventilation

Description

Two indoor air handling units AHU-3,4 will be provided to ventilate, cool and provide supplementary heating to the Spectator Arena playing surface and spectator seating areas. The units will be located in the 2nd floor Service Area south of the arena.

The units will include variable capacity supply & return fan arrays, outside air free-cooling economizer, pre & final filters and heated & chilled glycol coils. Outside air & Relief air openings will be ducted to exterior wall louvers or roof hoods. Alternatively, AHU-3 & 4 could each be provided with DX cooling coils and matched with air-cooled condensers located on the roof of the mechanical room.

Supply air will be distributed from each AHU at high level within in the arena via concealed or exposed acoustically insulated & perforated sheet metal lined spiral ductwork complete with adjustable vane drum diffusers. Branch supply air ducts will be extended complete with diffusers to the main floor change room corridor.

Return air will be drawn back to the AHU's through common return air louvers in the Arena space.

Two energy recovery units will also be located in the 2nd floor Service Area south of the arena. These units will draw exhaust air from the upper and lower level washrooms and lower level change-room shower areas. The air will be directed through the energy recovery core and exhausted outdoors. A matching volume of outside air will be drawn from the AHU-3,4 outside air ductwork, warmed by the energy recovery cores and supplied back to the AHU-3,4 outside air ductwork.

Make-up air to replace air exhausted from the change rooms and shower rooms will be transferred from the corridor through transfer ducts complete with thermostatically controlled heating coils.

B.9.7 Upper & Lower Lobby / Common Corridor / Multipurpose Room Ventilation

Description

Two variable capacity indoor air handling units AHU-5,6 will be provided to ventilate, cool and provide supplementary heating to the main and second level common lobby / corridor areas, Multi-Purpose rooms and Lounge. The units will be located in the 2nd floor Service Area east of the Community Arena.

The units will include variable capacity supply & return fan arrays, outside air free-cooling economizer, pre & final filters and heated & chilled glycol coils. Outside air &

Relief air openings will be ducted to exterior wall louvers or roof hoods. Alternatively, AHU-5 & 6 could each be provided with DX cooling coils and matched with air-cooled condensers located on the roof of the mechanical room.

Supply air will be distributed from each AHU at high level via concealed or exposed acoustically insulated & perforated sheet metal lined spiral or rectangular ductwork complete with ceiling diffusers. Branch supply air ducts will be extended to each Multipurpose room.

Return air will be drawn back to the AHU's through common return air louvers in the space or from return air grilles mounted in T-bar ceilings.
Two energy recovery units will also be located in the 2nd floor Service Area east of the Community Arena. These units will draw exhaust air from the upper and lower level washrooms. The air will be directed through the energy recovery core and exhausted outdoors. A matching volume of outside air will be drawn from the AHU-5,6 outside air ductwork, warmed by the energy recovery cores and supplied back to the AHU-5,6 outside air ductwork.

Each Multipurpose Room will be equipped with one or more horizontal ceiling-mounted 4-pipe fan-coil units. These fan-coils will provide room primary cooling and secondary heating. Branch ductwork off of AHU-5,6 will provide Multi-Purpose Room ventilation.

B.9.8 Fieldhouse, Track, Fitness, Warm-Up Area Ventilation

Description

Two outdoor air handling units AHU-7,8 will be provided to ventilate, cool and provide supplementary heating to the Field House. The units will be located on the roof above the adjacent 3rd level Fitness area.

The units will include variable capacity supply & return fans, outside air free-cooling economizers, pre & final filters and heated & chilled glycol coils. Alternatively, AHU-7 & 8 could each include integral DX cooling and air-cooled condensers or cooling could be deleted from these units.

Supply air will be distributed from each AHU at high level within the Fieldhouse via concealed or exposed acoustically insulated & perforated sheet metal lined spiral ductwork complete with adjustable vane drum diffusers. Branch supply air ducts will be extended complete with diffusers to the main floor change room corridor.

Return air will be drawn back to the AHU's through common return air louvers in the Fieldhouse space.

Two energy recovery units will also be located on the on the roof above the adjacent 3rd level Fitness area. These units will draw exhaust air from the change-room shower areas. The air will be directed through the energy recovery core and exhausted outdoors. A matching volume of outside air will be drawn from the AHU-7 & 8 outside air ductwork, warmed by the energy recovery cores and supplied back to the AHU-7 & 8 outside air ductwork.

B.9.9 Gymnasium Ventilation

Description

Two indoor or outdoor air handling units AHU-9,10 will be provided to ventilate, cool and provide supplementary heating to the two gymnasiums.

The units will include variable capacity supply & return fans, outside air free-cooling economizers, pre & final filters and heated & chilled glycol coils. Alternatively, AHU-9 & 10 could each include integral DX cooling and air-cooled condensers or cooling could be deleted from these units.

Supply air will be distributed from each AHU at high level within the gymnasiums via concealed or exposed acoustically insulated & perforated sheet metal lined spiral ductwork complete with adjustable vane drum diffusers. Branch supply air ducts will be extended complete with diffusers to the main floor change room corridor.

Return air will be drawn back to the AHU's through common return air louvers in each gymnasium space.

Two energy recovery units will also be provided. These units will draw exhaust air from the gymnasium change-room shower areas. The air will be directed through the energy recovery core and exhausted outdoors. A matching volume of outside air will be drawn from the AHU-9,10 outside air ductwork, warmed by the energy recovery cores and supplied back to the AHU-9 & 10 outside air ductwork.

B.9.10 Concession & Food Services Area Ventilation

Description

Concession areas will be provided with a centrifugal grease hood exhaust fans located on the roof. The fans and interconnecting grease exhaust ductwork from the kitchen hood will be constructed and installed in accordance with NFPA-96. The kitchen grease hoods & integral fire suppression system will be supplied and installed as part of the kitchen equipment package and will not be part of the mechanical scope.
Make-up air for the kitchen hoods will be drawn from the adjacent common areas. Alternatively, natural gas direct-fired make-up air units will be provided for each food services area.

B.9.11 Refrigeration Room Ventilation

Description

The Ice Plant Room will be ventilated and exhausted in accordance with the CSA B52 Refrigeration Code. This will generally be accomplished with exhaust fans suspended within the room exhausting through wall louvers and drawing from high and low level ductwork within the room. Motorized dampers & wall louvers will be provided for make-up of unconditioned outside air. The system will run at low speed when the ice plant is operating and will revert to high speed upon detection of high levels of ammonia.

B.9.12 Humidification System

Description

Humidification systems will not be provided.

B.9.13 Domestic Hot Water System

Description

Domestic hot water will be provided from the central boiler plant using a plate heat exchanger and will be supplemented with a heat recovery heat exchanger using heat rejected from the ice plant as the heat source.

Alternatively, Domestic hot water could be provided for the facility via multiple high efficiency stand-alone natural gas-fired water heaters.

Heating of domestic hot water will be supplemented with a heat recovery heat exchanger using heat rejected from the ice plant as the heat source.

Hot water will be constantly circulated through the mains to minimize the waiting time for hot water at the fixtures.

B.9.14 Plumbing Systems

Description

<u>Piping Materials</u>

A combination of cast, copper & PVC / PVC XFR sanitary, storm and vent piping will be utilized throughout the facility.

Domestic water piping will be copper with copper fittings. For piping 25mm and smaller, consideration will be given to using Uponor Aquapex piping with Propex plastic fittings.

Natural gas piping will be black iron pipe.

Water Treatment Systems

Water softening will be provided to suit the arena ice flooding water requirements. Other domestic water streams will not be softened.

Plumbing Fixtures & Trim

Water Closets will be elongated bowl, floor-mounted, low-flow, flush valve style with exposed or concealed hands-free trim.

Lavatories will be drop-in or under-mount stainless steel with low-flow hands-free trim and integral mixing valves.

Urinals will be vitreous china wall-hung, low flow flush valve style with exposed or concealed hands-free trim.

B.9.15 Fire Protection System

Description

A zoned wet pipe sprinkler system designed and installed to NFPA requirements will provide fire protection for all areas of the building. Dry pipe systems and/or dry heads will protect areas subject to freezing.

A standpipe system will be provided if required, based on the final overall area of the facility.

B.9.16 Energy Management & Control System

Description

A personal computer based direct digital (DDC) automatic controls system with full internet accessibility will be utilized to monitor and control the mechanical systems in this facility. The system will utilize a BACnet open protocol platform.

B.9.17 Mechanical Budget

Preliminary mechanical budget for all project phases

The preliminary mechanical systems budget for all phases of the project, assuming all phases were constructed together is $15,000,000 = 20% of the total construction budget.

This budget does not include site services outside of the building footprint.

B.9.18 Design Parameters

	INSIDE COOLING DESIGN TEMP.	INSIDE HEATING DESIGN TEMP.	INSIDE COOLING DESIGN RH.	INSIDE HEATING DESIGN RH.	DESIGN LIGHTING & EQUIPMENT HEAT GAIN	DESIGN OUTSIDE AIR VENTILATION RATE	DESIGN NOISE LEVEL (MECH SYS. GENERATED)
SOCCER FIELDS	26°C	18°C	55%	N/A	N/A	3 CFM / FT^2 variable	NC45
OFFICE AREAS	24°C	21°C	55%	N/A	16 w/m^2	10 l/s person min.	NC35
LOBBIES	24°C	21°C	50%	N/A	16	w/m^2	NC40
ARENA SPECTATOR AREAS	N/A	15°C	N/A	N/A	?	¾ CFM / FT^2 max	NC45
WASHROOMS & DRESSING ROOMS	24°C	21°C	N/A	N/A	N/A	10 AC/Hr	N/A
CORRIDORS	24°C	21°C	50%	N/A	10 w/m^2	N/A	NC45
ENTRANCE VESTIBULES	N/A	15°C	N/A	N/A	N/A	N/A	N/A
LOADING AREAS	N/A	15°C	N/A	N/A	N/A	N/A	N/A
MECHANICAL ROOMS	N/A	15°C	N/A	N/A	N/A	N/A	N/A
ELECTRICAL ROOMS	27°C	15°C	N/A	N/A	N/A	N/A	N/A

B.10 Electrical

B.10.1 General

Electrical systems for the White City Recreation Centre will be designed so as to contribute to its function as well as the safety and comfort of its occupants. The design will be based on the use of contemporary, but proven, systems that supply the occupants with a pleasing environment and meet the functional and aesthetic requirements of the project.

All Electrical systems are to meet the requirements of the latest editions of all applicable codes and include but are not necessarily limited to:

- National Building Code of Canada, 2015 edition.
- Canadian Electrical Code, 2018 edition.
- National Fire Code of Canada, 2015 Edition.
- National Energy Code of Canada, 2017 Edition
- CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
- CAN/ULC-S537, Standard for the Verification of the Fire Alarm Systems.
- TIA-568.0-D-15, Generic Telecommunications Cabling for Customer Premises.
- TIA-568.1-D-15: Commercial Building Telecommunications Infrastructure Standard
- TIA-568.3-D: Optical Fiber Cabling and Components Standard
- TIA-569-E-19: Telecommunications Pathways and Spaces
- TIA-606-C-17: Administration Standard for Telecommunications Infrastructure
- Special requirements of the national and local inspection authorities having jurisdiction.

B.10.2 Load Estimate

Based on the guidelines of The Canadian Electrical Code and the information available at this stage, the anticipated demand load for the building is estimated to be 1.05 MVA. It is proposed at this time to build for now and future capacity that the service type and size be 2000 Amp, 347/600 V, 3Ø, 4W. Current estimates from the utility suggest a customer cost of $80,000 before taxes for this service at the approved site.

The service size will be recalculated throughout the design as necessary, with a final estimate produced and implemented prior to completing construction documents. Careful consideration will need to be made to ensure future rinks can be accommodated. It is assumed at this time that the future school would be served via its own 120/208V service at a future date when the school is built.

B.10.3 Power Distribution

Services to the building will be routed underground from a utility pad mounted transformer to electrical room location. The location of the transformer will be coordinated with the landscape design and site works. The Main switchgear or will include a building main breaker and distribution breakers feeding sub distribution equipment in each facility portion. It is anticipated at this time that sub distributions would exist for the Field House, Aquatic Centre. For the future school, it is anticipated that the school will have its own independent incoming service as mentioned above. Other facility areas would be fed from the panelboards and distribution centres located nearby.

At this point of the design process it is assumed that most Mechanical loads would be supplied via a Motor Control Center(s) (MCC) in the mechanical, ice plant and fan rooms. At locations where motor concentration is not sufficient to warrant an MCC, discrete starters would be provided on an individual basis.

All distribution and branch circuit breakers will be automatic, molded-case type. Uniformity of manufacturer is to be maintained for all breaker panels and breakers.

Distribution panelboards will be located at areas of centralized distribution. All panelboards will be designed to retain a 25% spare capacity upon completion.

To address the issue of the effects of voltage transients on computer equipment, Transient Voltage Surge Suppressant (TVSS) Panels can be installed for providing branch circuit power to sensitive equipment. These panels act effectively to protect electronic-based systems from voltage transients that can be otherwise damaging to the sensitive equipment.

As part of the project a full coordination study will be produced to ensure overloads are properly coordinated thereby reducing unnecessary localized outages. An Arc Flash assessment shall be done to ensure safety of maintenance staff as per CSA Z462-18, Workplace Electrical Safety.

B.10.4 Emergency Power Distribution

It is desirous to use a portion of this facility as an Emergency Response Operations centre for the community. As such an Emergency Generator would be required provide emergency power during times of outages. Preliminary estimates put this generator at 200kW, however the size is dependent on the owner's desire as to how much of the facility should be operational.

It is anticipated that the generator will be designed to handle the minimum life safety, and some operational elements to keep an area within the building always operational. At the same time, the rest of the facility will have critical loads carried to ensure operation. The most logical area to be used as an area of refuge would be the indoor soccer pitch and support areas to it.

As an alternate, a much larger generator (~500kW) could be designed into the space that will allow some other areas of the facility remain operational in non-emergency times. This extra capacity would allow full facility operation in times of inconvenient power outages.

In any case, an emergency generator will be required to be in its own 2-hour fire rated room and have enough on-site storage capacity for a minimum of 4 hours of fuel. Unfortunately, because this is an emergency generator, the fuel source must be diesel fuel and natural gas cannot be utilized. This minimum requirement may want to be raised to 24 hours, depending on the availability of diesel fuel in the area.

Alternately to an interior unit, a packaged exterior generator unit could be utilized to provide emergency power but this comes with an additional expense and unheated repair in the winter months. On the other hand, it doesn’t use up area within the building footprint.

B.10.5 Power Factor Correction

A facility of this size represents a very large consumer of electrical power. To mitigate the demand charges that may occur with large mechanical loading, power factor correction capacitors can be added to some of the larger building loads. The cost of this power factor correction would have to be analyzed after a better understanding of the building loads is ascertained in the design process. The payback of this type of demand mitigation often times is in the 3-10 year range, depending on certain design factors.

B.10.6 Solar Power Generation

It is understood that the owner would like to investigate the possibility of the addition of renewable, on-site power generation such as a solar array (field). This will need to be investigated further as the design develops. Typically, large solar fields are ground mounted, however in this case the facility has a large uniform surface area over the indoor soccer pitch that may be some prime real estate for a solar array.

To give an idea of the costing for such a venture, we have received recent quotes for both a 50KW and 100KW solar field on another project that could apply here. For both options, the price includes the application to the utility for approval, mounting, system engineering, installation and commissioning:

1. 150kW, Ground mount solar array - $98,704.00
2. 100kW, Ground Mount solar array - $184, 535.70

B.10.7 Lighting

General

The lighting system will likely have more psychological and comforting impact on the building users than any other electrical system. Effective lighting must enhance an environment that is supportive of the operational tasks as well as ensuring comfort to the building occupants. Complementary to this is the utilization of the most energy efficient solutions to accomplish these tasks.

Lighting Design will be such as to meet the current IESNA (Illumination Engineering Society of North America) standards. (The IESNA has been in existence since 1906 and as an organization gathers and publishes the most widely accepted recommendations in the science of illumination. As related to building illumination, IESNA recommendations for practice have become a 'de facto' standard in the industry.)

The lighting design will also incorporate elements of the National Energy Code (NEC) and incorporate such elements as daylighting and occupancy sensing throughout all spaces where applicable and required. The NEC mandates items such as the maximum lighting power density, and control means and methods in spaces. The use of efficient LED sources will be utilized throughout all areas of the building. These light fixtures will be chosen with efficiency, comfort, and controllability in mind.

Exterior Lighting

To provide appropriate safety and security for the building, the design shall include enhanced lighting around the entire perimeter of the building and the parking lot. The exterior lighting will be designed so as to reflect the operation hours of the facility.

Enhancement of exterior building finishes and aesthetics shall also be considered in accordance with the National Energy Code and the desire of the owner to have an attractive and modern facility. All exterior fixtures will be chosen to discourage vandalism and be appropriate for Saskatchewan climates.

Arena Lighting (Ice Surface)

For the lighting of an Arena there are two approaches:

1. The arenas could be lit via LED high bays providing adequate and appropriate lighting throughout the ice area. This would be how many of the standard, higher end rinks are lit throughout Saskatchewan (not LED, but similar ideology).
2. The arena ice surface could be illuminated via LED, Stadium (NHL Arena) Style, c/w RGBAW (Red-Green-Blue-Amber-White) fixtures. NHL capabilities includes tunable white, adjustable beam spread, NHL preloads, colour control and full DMX control.

The latter of the two choices represents a higher cost but adds a tremendous amount of flexibility to the rink(s) areas.

Aquatics Centre Lighting

The aquatic area will be lit in accordance with IES lighting for pools and pool lanes, and will utilized LED high bays in locations that allow for serviceability without being over the water.

Lighting Control

Daylight and occupancy controls will be provided into every applicable space. Combined with dimmable fixtures these technologies work together to provide seamless lighting control to reduce energy use while maintaining comfort and productivity.

The National Energy Code strictly regulates lighting and lighting control and as such options have become more limited. Where once there was a good, better, best solutions, we are limited to better or best. In both cases the following examples would apply.

Circulation spaces would be designed to dim when no occupancy is detected, but brighten up when occupancy is detected in the space. This gradual and smooth transitioning allows further savings where traditional on and off would be more distracting to the occupants nearby.

Offices would be controlled via a combination of occupancy, manual and daylighting (if a window impacts the space).

Service areas will be controlled via occupancy sensing switches.

Other areas in accordance with the NEC including auto shut off in time of inactivity or after hours.

For the best option, there is a potential to upgrade this lighting control system to the best solution by incorporating a master control system for the facility. This programmable system will allow the end user to make changes to controls, light levels, etc, all via timeclock and calendar events if so desired. Every floor and area would be interconnected into one master control system that can be utilized for reporting, reprogramming, and trending space usage, etc. This includes energy logging and management as well as space usage analysis. The premium for such a system is approximately an $8000 adder to the base (better) scenario. The benefits to maintenance, and control however, are worth the cost over the length of a facility life.

B.10.8 Emergency & Exit Lighting

Emergency lighting will be accomplished utilizing stand-alone battery packs located in key areas to provide a 10 lux illumination along exit routes. In areas where it is possible to use the Emergency Generator for this lighting, it will be taken advantage of to reduce maintenance costs (batteries).

LED type exit lights, which conform to CAN/CSA-C860 and utilize the new, green running man pictogram, shall be used throughout the spaces as required by the National Building Code.

B.10.9 Fire Alarm System

A central, modular, microprocessor based, fully addressable, single-stage fire alarm system would be designed for this facility.

The fire alarm system will be designed to meet the requirements of the National Building Code for the occupancy type(s) and load as determined for the building by the Architect. This is to include the provision of pull stations, smoke detectors, heat detectors, duct detectors, audio/visual signal devices and zone isolation modules. Ancillary devices such as fan shutdown, security and alarm interlocks and auto-dialer/communicator activation shall be incorporated as required.

The system will include a main control panel with integral annunciator as well as remote annunciators at required fire-fighting entrances. Other desired locations for remote annunciators may develop further as the design progresses.

Smoke detectors would be of the dual chamber ionization type. Photoelectric types would not be utilized except possibly in air handling units as duct detectors if determined as beneficial. Heat detectors would be of both the fixed temperature and fixed temperature/rate-of-rise type as determined by the location. Heat detectors would only be provided where special detection is required as sprinkler heads can be used in lieu of heat detectors as allowed by the NBC.

B.10.10 Security Systems

A security system shall be designed for the facility. Emergency power and a self-contained battery backup will be provided for the security system. Passive infrared detectors will be used for intrusion detection and a keypad(s) shall be provided for arming and disarming the system. An internal clock may also be used for the arming of zones automatically at certain times of the day. The system will be zoned and partitioned off to allow for unique and separate use of the spaces as required.

Areas of protection will include all exterior doors, interior corridors, and other specific areas that may be identified by the client through the design process.

Security cameras will be installed to monitor the external doors and corridors within the facility. This design will be coordinated with the owner and/or owner's security provider.

A door access system shall also be designed for the facility. Installation including card access (fob), door contacts, request to exits, etc. for a fully monitored system. Areas of protection will be identified by the client throughout the design process.

It is anticipated that CCTV camera system will be required in the spaces, monitoring public corridors and areas.

B.10.11 Data & Communications Systems (Structured Wiring)

A full structured wiring system will be designed to support the voice and data communications within the building, where sizing, routing and ease of expansion shall be considered.

An infrastructure consisting of a communication rooms and raceways would be designed to meet the requirements of the Commercial Building cabling standards referenced above.

The structured wiring raceway system would consist of EMT zone conduit and cable tray systems. It is recommended for future proofing that the wiring system would be CAT 6A cabling and termination patch panels. While the CAT 6A system may not be utilized immediately, it is important to have the infrastructure in place even if the facility only plans on deploying a CAT 6 speeds and protocols at this time. The system would be designed to employ a star topology configuration to connect workstations, phones and devices to their localized network closet. Each network closet will be interconnected to the Main Server/Electrical Room via fibre optic cable.

The cable tray would be located in accessible ceiling spaces with conduit used to branch into particular spaces where data communication outlets are required. This type of system ultimately allows for relatively easy installation of new cables and alteration of the existing cable layouts.

The system would support each communication system requirements including voice and data. It would be designed to meet EIA/TIA standards with certification required by the component manufacturer.

All internal communications, regardless of speed, would have the same wiring and device standards unless a specific, incompatible requirement is identified.

The system will incorporate all required components to provide an operational system for connecting terminal equipment. Computers, hubs, routers, power supplies and other IT-related equipment will not be included as part of this system.

B.10.12 Audio/Visual & Integrated Telephone PA/Intercom Systems

General Telephone PA/Intercom System

The system as designed will be a complete zoned public address and VoIP telephone system, which would combine the functions of telephone, internal communications, and public address into what appears to the user to be a single system. Any handset throughout the building shall have the ability to access any of these functions (sometime with specific access codes). It shall be possible to make voice calls to outside telephone lines, to individual handsets within the building, to individual public address zones or to all zones from any handset location. The system shall be microprocessor-based and capable of offering many programmable features that allow the system to be customized to the needs of the users.

The switching and amplification equipment will be installed in the main electrical room on the Telephone backboard. From there it will be connected to the telecommunications network as described above. Individual speakers shall be used along the corridors and in other areas where the telephone sets may not be installed.

It will be the intent of the design that all the telephone handset wiring will fall under the structured cabling portion of the project.

Conduit for dedicated phone lines/fibre shall be provided for mechanical control panels, network servers and fax machines.

A telephone system will be selected and installed under this contract. Coordination will be done between the client group, the designers, and the system manufacturers to ensure a system is installed that meets both the present and possible future expectations of the users.

Localized Audio Systems

Independent PA/audio systems will be designed into spaces such as soccer field, gymnasiums, arenas, pool area, etc.

A typical system would consist of a grid of large format ceiling speakers. Equipment to drive the system would be located in a wall-mount rack in a sound closet or rack in an admin office. One set of input equipment (amp, Bluetooth receiver, wireless mic, etc) would permanently mount in the rack. Jacks at various locations would allow for simply plugging in sound equipment components. At the rack in the sound closet, a zone controller would allow independent source selection between the rack equipment or the mic jack.

A typical system would include:

- Mic jacks
- Wireless mic sets
- 24ch manual mixing console.
- Open architecture digital signal processor: the programmable unit that will take care of main system EQ, dynamics, crossovers, etc.
- Stereo pair of 2-way box speakers with matching subwoofers, etc.

The System will be designed and customized to each area as per the direction given by the owner group. Coordination will be required between wish lists, availability and costing with the end result being a fully functional, and appropriately modern solutions to the audio and visual requirements of these spaces.

B.11 Energy Modelling

B.11.1 Energy Objectives

NECB 2017

- The White City Multi-Use Recreation Facility will be subject to the 2017 National Energy Code of Canada for Buildings, which is the most advanced version of the NECB to date. Following an 'envelope-first' approach, NECB 2017 presents stringent R-value/U-value requirements as well as advanced calculation methods; thermal bridging effects of envelope transitions must be accounted for, in addition to repeating structural members.
- Energy efficiency credits will be captured from the proposed high efficiency space heating and energy recovery systems, which will in turn offset the challenging building envelope requirements.
- A minimum target of 10% energy savings over the NECB 2017 reference is recommended:
    a. This target is expected to be achievable with minimal or no impact on capital costs, compared to meeting the baseline requirements.
    b. It would allow a safety factor to account for potential changes during construction.
    c. It would provide a basis for future phases of the design, potentially under subsequent versions of the NECB.
    d. It pertains to prospective energy / sustainability objectives, e.g. as an alternative to LEED certification.
- A target of 25% energy savings over the NECB 2017 reference could be considered:
    a. This would place the project in the 95th percentile of new construction in Saskatchewan, based on Red Pelican's internal project database.

Additional Energy Objectives

The energy model serves as a sophisticated representation of the building's operation. As such, it can be used to evaluate design parameters and energy conservation measures over and above code requirements, examples of which include:

- Identification of energy conservation strategies based on building operation and system control strategies not covered in the NECB.
- Calculation of projected carbon intensity and energy-related costs based on utility rates (including peak demand charges / peak load shifting) and applicable carbon taxes.
    a. Strategies to optimize these costs during building operation.
- Identification of key energy end uses for design optimization.
- Using preliminary results, measurement of the building design against:
    a. Energy use intensity (EUI) benchmark values.
    b. Industry best practices.

- Interface with Life Cycle Cost analysis to provide input data.
- Analysis of energy-related environmental impacts of the design.
- Exploration of passive design strategies, such as:
  a. Daylight harvesting & radiance e.g. daylight penetration mapping
  b. Passive solar heating
  c. Passive shading devices, e.g. eave overhangs
  d. Deciduous tree placement for passive summer shading / glare control
  e. Thermal mass / load shedding
  f. Enhanced air barrier performance
  g. Natural ventilation and operable windows
  h. Passive cooling using summer nighttime air & concrete thermal mass
- Investigation of heating plant downsizing opportunities.
- Analysis of HVAC system options; demand control ventilation, displacement ventilation, occupancy control of mechanical equipment, chilled beam, etc.
- Evaluation of site energy options, e.g. solar photovoltaics, combined heat and power (cogen) and ground-source heat pump (geothermal).
- Investigation of the effect of lighting controls on cooling and heating loads (motion detectors, daylight harvesting, sensors etc.).

B.11.2 Building Envelope

2017 NECB Reference Effective Thermal Transmittance/Resistance Values – White City, SK · Climate Zone 7A

COMPONENT	METRIC		IMPERIAL	
Roof	U-0.138	W/(m²·K)	**R-41.1**	BTU/hr·ft²·°F
Above-Grade Walls	U-0.210	W/(m²·K)	**R-27.0**	BTU/hr·ft²·°F
Fenestration	U-1.900	W/(m²·K)	**R-3.00**	BTU/hr·ft²·°F
Ground-Contact Floors	U-0.162	W/(m²·K)	**R-35.1**	BTU/hr·ft²·°F
	+ Vertical Thermal Break, e.g. Ext. Grade Beam Insulation			

Above-Grade Walls

Fully Conditioned Spaces

Wall assemblies which achieve a minimum **R-20** ft²°F·h/BTU **clear field** thermal resistance are recommended. Assemblies meeting this value could include exterior-insulated, split-insulated, or wood frame infill walls, or a wall panel system.

Semi-Conditioned Spaces

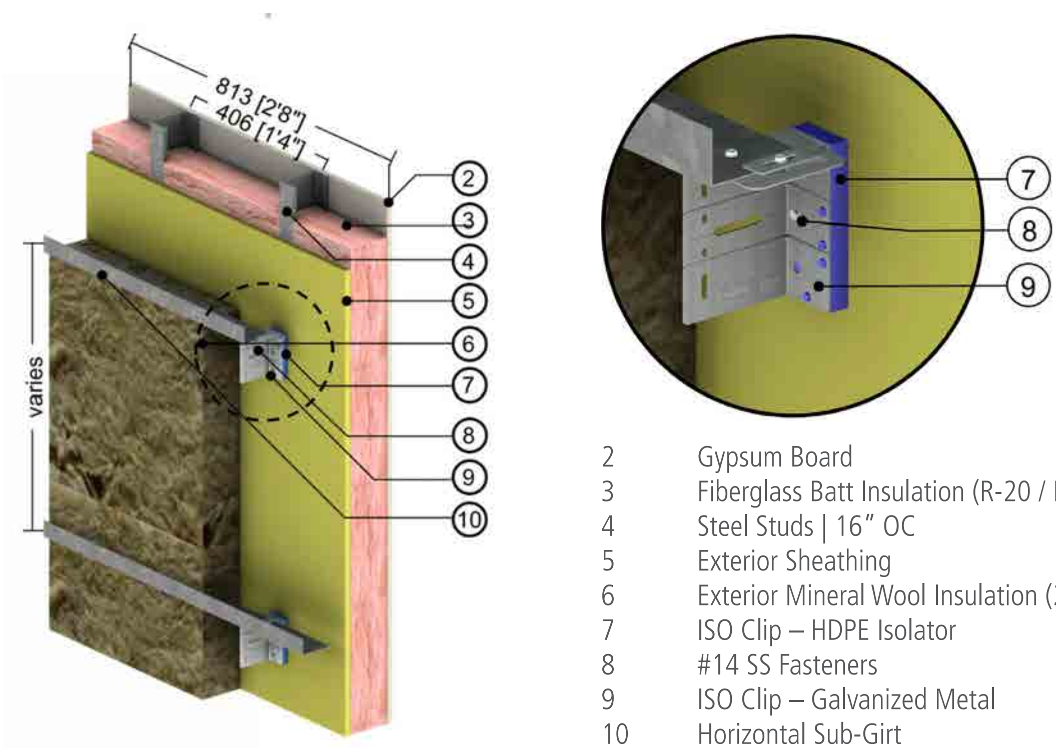
Air temperature in arenas typically ranges between 12°C (recreational facilities) and 15°C (professional facilities), with localized comfort heating provided to spectators through infrared tube heaters. This reduced space temperature means that the recommended thermal resistance values for envelope assemblies can be reduced.

Wall assemblies which have a minimum **R-14** ft2°F·h/BTU **clear field** thermal resistance are anticipated to be sufficient in semi-conditioned spaces. Assemblies meeting this value may include pre-engineered R-19 draped insulation with thermal blocks, insulated panels, or steel stud walls with exterior insulation. The location of the vapour barrier is an important consideration in these wall assemblies.

Thermal Bridging

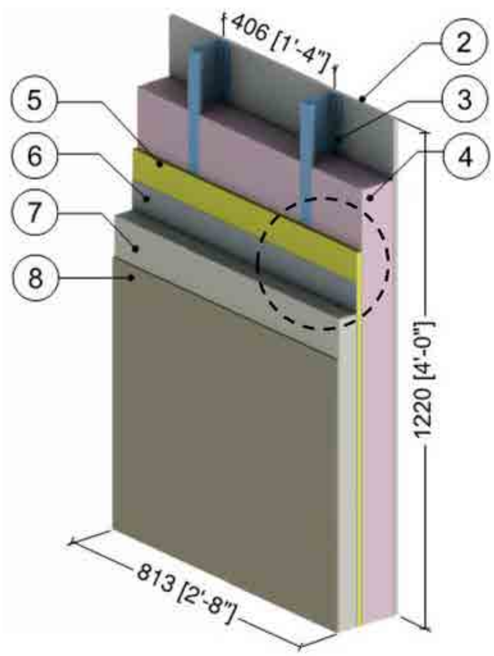
Determining the effects of thermal bridging at envelope transitions is a code requirement and can result in a substantial energy penalty on steel frame and pre-engineered metal buildings, which in turn requires additional compensation from the HVAC systems. Wall assemblies with exterior insulation, or a panel system would significantly reduce thermal bridging from structural components.
Red Pelican will undertake 2D & 3D thermal modeling (FEA) of transition details as required in order to offer feedback on mitigating thermal bridging in order to optimize wall assemblies.

SAMPLE WALL ASSEMBLIES FOR CONSIDERATION



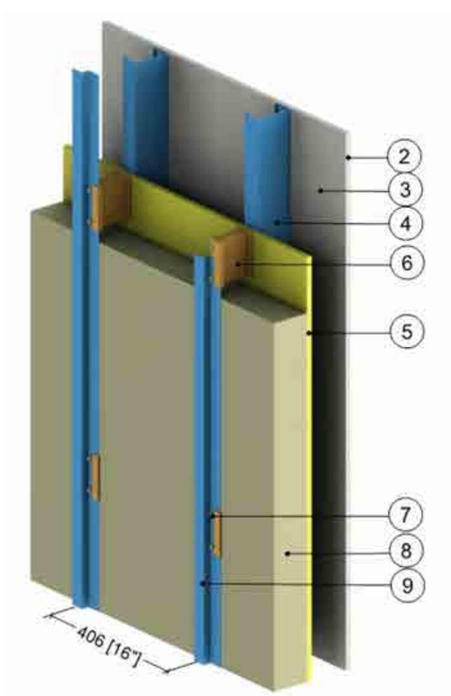
2	Gypsum Board
3	Fiberglass Batt Insulation (R-20 / R-24)
4	Steel Studs | 16" OC
5	Exterior Sheathing
6	Exterior Mineral Wool Insulation (2-4")
7	ISO Clip – HDPE Isolator
8	#14 SS Fasteners
9	ISO Clip – Galvanized Metal
10	Horizontal Sub-Girt

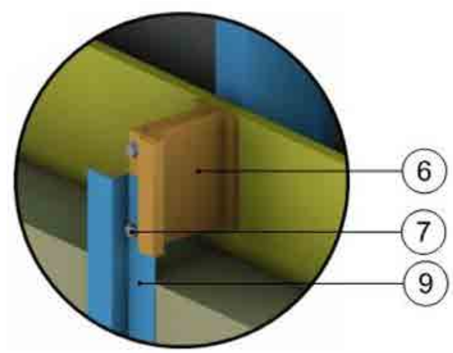
Figure 12: Split (Interior/Exterior) Insulated Thermally Isolated Clip Steel Stud Infill Wall Assembly [BETBG]



2 Gypsum Board
3 Steel Studs | 16" OC
4 Fiberglass Batt Insulation (R-20 / R-24)
5 Exterior Sheathing
6 Water-Resistive Barrier w/ Adhesive
7 Insulation Board
8 Lamina (Modified Cement w/ Woven Glass Fiber

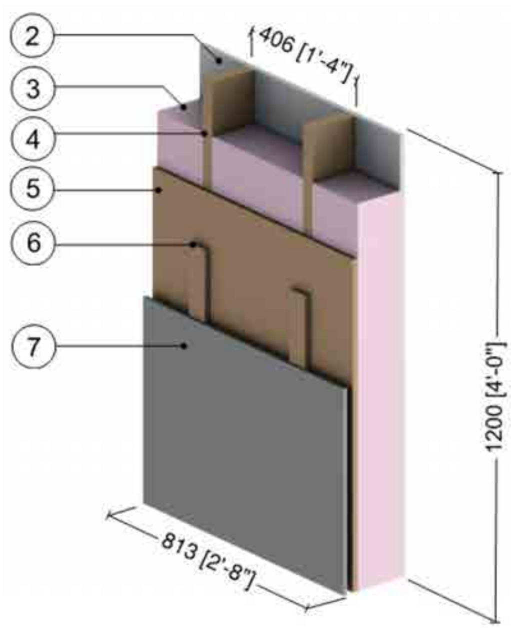
Figure 13: Split (Interior/Exterior) Insulated EIFS Steel Stud Infill Wall Assembly [BETBG]





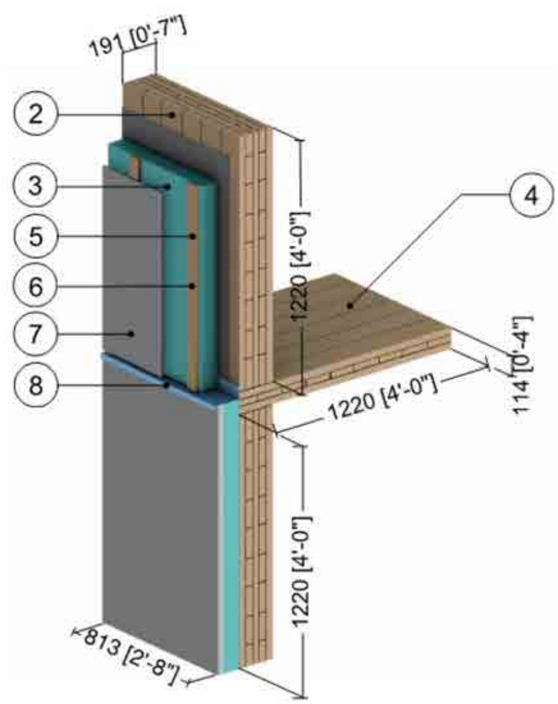
2 Gypsum Board
3 Air in Stud Cavity
4 Steel Studs | 16" OC
5 Exterior Sheathing
6 Cascadia Clip Thermal Spacer
7 #14 Stainless Steel Fasteners
8 Exterior Mineral Wool Insulation
9 Vertical Z-Girts
10 Cladding w/ Vented Air Space

Figure 14: Exterior Insulated Steel Stud Wall with Cascadia Clip [BETBG]



2 Gypsum Board
3 Fiberglass Batt Insulation (R-20 / R-24)
4 2x6 Wood Studs | 16” OC
5 Exterior Sheathing
6 Wood Strapping
7 Cladding

Figure 15: Interior (Cavity-Fill Batt) Insulated Wood Stud Infill Wall Assembly [BETBG]



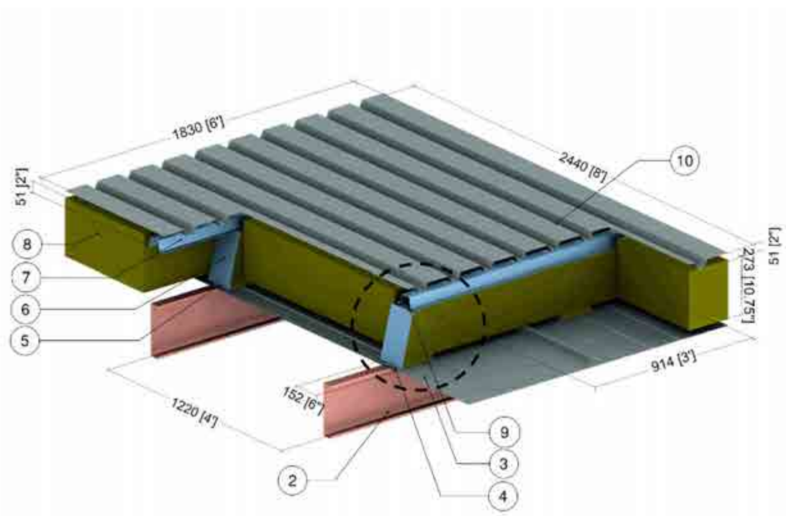
2 Cross-Laminated Timber Wall
3 Exterior Insulation
4 Cross-Laminated Timber Floor
5 1x3 Wood Strapping
6 #14 Steel Fasteners | 16” OC
7 Fibre Cement Board Cladding w/ Vented Airspace
8 Steel Flashing
9 Galvanized Steel L-Clips

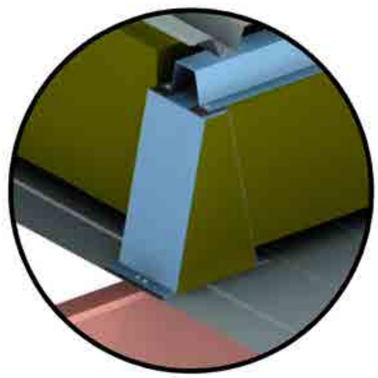
FIgure 16: Exterior Insulated Cross-Laminated Timber (CLT) [BETBG]

Roof

-
- Min. R-33 (U-0.172) effective recommended for fully conditioned spaces.
- Min. R-25 (U-0.227) effective recommended for semi-conditioned spaces.
- A built-up or single-ply roof would allow flexibility in increasing the roof R-value (e.g. to R-40) to facilitate offsetting wall insulation values.

SAMPLE ARENA ROOF ASSEMBLY FOR CONSIDERATION





2 Galvanized Steel Purlin @ 48" OC
3 Galvanized Steel Liner
4 Thermal Tape
5 #12 Steel Fasteners
6 10" Galvanized Steel Hat Section - Thermal Chair
7 2" Galvanized Steel Hat Section – Outer Rail
8 Mineral Wool Insulation
9 Air Gap
10 Galvanized Steel Cladding

Figure 17: Insulated Sheet Steel Roof Supported by Thermal Chairs [BETBG]

Glazing & Doors

Considering a moderate overall fenestration and door to wall ratio (FDWR), high performance glazing would contribute to a reduction in envelope heat loss, increase occupant comfort in areas with large glazing features, and also help to reduce the potential for surface condensation in areas of high humidity, such as the aquatic centre.

Initial Assumptions

- **Glazing · Standard Perform**
  - U-1.900 – U-2.100 W/m2·K
    - > Ideally equal to or lower than the reference U-value.
  - Framing: Aluminum, thermally broken
    - > Kawneer Trifab 451 UT or similar
- Glass: Double Pane
- **Glazing · Improved Performance:**
  - U-0.800 – U-1.400 W/m2·K
    - > Ideally equal to or lower than the reference U-value.
  - Framing: Fiberglass
    - > Cascadia Universal Series or similar
  - Glass: Triple Pane
- **Doors · Opaque Personnel:**
  - Foam-insulated steel slab, thermally broken steel frame
- **Doors · Sectional Overhead:**
  - 45mm Polyurethane, thermally broken
  - "R-16" Nominal (1D)

Note: Per the NECB, U-values indicate effective (e.g. NFRC 100) thermal transmittance of glazing assemblies including framing, as opposed to centre-of-glass (COG).

Below Grade Insulation

- Under unheated floors: recommended min. 2" rigid, 1.2m (4') under slab perimeter, or 2" rigid exterior grade beam.
- Under heated floors: recommended min. 1.5" Type II EPS continuous under slab insulation.
- Under ice surface: to be specified by others.

B.11.3 Mechanical

Space Heating

The proposed heating system will provide high efficiency space heating and increase occupant comfort. A large T value, ensuring low return water temperatures and boilers operating at condensing efficiencies ≥ 95% AFUE, will yield an appreciable energy credit in the energy model and reduce heating costs in operation.

Ventilation Heat Recovery

The proposed ventilation heat recovery on air handling units will help meet the energy goals with respect to the NECB, as the reference building will also have heat recovery on ventilation systems (based on projected ventilation rates).

Heat recovery ventilator units are recommended to meet or exceed a sensible recovery efficiency of 65% @ -25°C.

Ice Plant Heat Recovery

The proposed waste heat recovery strategy for the ice plant positions the project well to meet or exceed energy targets relative to the NECB, specifically addressing NECB 2017 5.2.10.3.(1).

Aquatic Centre Dehumidification Energy Recovery

Similar to the ice plant heat recovery system, the proposed energy recovery from the aquatic centre dehumidification system will facilitate meeting or exceeding energy targets, as it addresses NECB 5.2.10.2.(1).

Service Hot Water

Considering large service water heating loads (e.g. showers), it is recommended to implement high-efficiency hot water heating, capitalizing on heat recovery from other building systems where possible.

B.11.4 Lighting

General

Although lighting energy is expected to comprise a relatively small portion of the overall energy use of the building, savings in lighting energy will help to reduce operating costs, as well as the carbon footprint of the building due to the relatively high carbon intensity associated with grid electricity.

The NECB 2017 prescriptive lighting requirements constitute guidelines on lighting design; however they are not mandatory per the Performance Path. This approach allows a degree of flexibility in the design of lighting systems, to evaluate the potential benefits of particular components in given areas.

Lighting Power

LED lighting technology has dramatically lowered energy consumption from lighting and has become the industry standard.

Prescriptive lighting power density (LPD) values serve as appropriate guidelines, but can be exceeded in certain areas if required due to other considerations.

Daylight Harvesting & Occupancy Sensors

Similarly, the NECB prescriptive requirements serve as an appropriate basis for the implementation of lighting controls, however daylighting and occupancy sensors can be included or excluded from given spaces as desired. Daylight simulation tools can be employed in the energy model to assess the relative effectiveness of daylighting sensors in the relevant spaces within the building.

B.11.5 Site Energy Considerations

Ground-Source Heat Pump System

Considering substantial projected heating, cooling, and process loads, and extensive proposed heat recovery systems, further investigation would be required to assess the feasibility and cost benefits of a ground-source heat pump (geothermal) system.

Solar Photovoltaic Panels

Solar PV panels are recommended for consideration to offset site electricity loads, considering:

- The cost and carbon intensity of grid electricity.
- The Regina region has the highest solar energy generation potential of all major cities in Canada[1].

1. Canada Energy Regulator (formerly National Energy Board) Market Snapshot 2018-06-20.
Note: sun exposure is a function of climate factors, latitude, and elevation.

Combined Heat and Power Systems

While not in the scope of the NECB, combined heat and power (CHP), or cogeneration, has considerable potential to reduce both energy costs and the carbon footprint associated with the building's operation.

Saskatchewan Emissions Factors:

- Grid Electricity: 0.650 kgCO2/kWh (650 gCO2eq/kWh)[2]
- Natural Gas: 0.177 kgCO2/kWh (1829 g/m3)[3]

Based on the emissions factors noted above, offsetting grid electricity use by 1 kWh would be 3.67 times more effective in reducing the building's carbon footprint in comparison to 1 kWh of natural gas. Therefore, in terms of carbon reduction, sustainability strategies such as CHP and/or solar photovoltaics (offsetting grid electricity) can have a greater impact than additional insulation, for example (offsetting natural gas).

2. SaskPower 2015 Annual Report.
3. McCann TJ. 2000. Fossil Fuel and Derivative Factors: CO2 per Unit of Fuel, Heating Values.