March 25, 2024 | **Project No.: 24VR-600400**

City of Salmon Arm
500 2 Avenue Northeast
Salmon Arm, BC
V1E 1J5

Phone: 250.803.4088
Email: dgerow@salmonarm.ca

Attn: Darin Gerow
Re: Structural Assessment & Life Cycle Assessment of the Memorial Arena – Interim Report
100 - 30th Street SE, Salmon Arm, BC

BAR Engineering Co. Ltd. is pleased to submit this interim report of the detailed structural assessment of the Memorial Arena to the City of Salmon Arm.

This report describes our findings, analysis, and conclusions concerning the state of the building's structural integrity and building envelope, as well as recommendations for repair and associated costs.

Should you have any questions regarding the contents of this report, please do not hesitate to contact the undersigned at (250) 541-9590 or via e-mail at joey.funk@bareng.ca.

Respectfully Submitted,
BAR Engineering Co. Ltd.

Per:

Joey Funk, P. Eng.
Senior Structural Engineer

Structural Assessment and Lifecycle Analysis of the Memorial Arena

Interim Report

Engineering services for

City of Salmon Arm

March 25, 2024

Project No. 24VR-600400
City of Salmon Arm | 500 2 Avenue N.E., Salmon Arm, BC V1E 1J5
Attn: Darin Gerow –Manger of Roads & Parks, City of Slamon Arm

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1.0 Introduction

1.1 Purpose

BAR Engineering Co. Ltd. (BAR) has prepared this interim report of the Memorial Arena located at 351 – 3 Street SW in Salmon Arm, BC, for the city of Salmon Arm. The purpose of this Interim Report is to report on the existing conditions of the building envelope and structural systems and provide recommendations for repair and associated costs to maximize facility usage while ensuring user safety. More specifically, the following items will be addressed.

- Provide an opinion on the structural condition of the deteriorated wood column, as identified in the Preliminary Structural Assessment prepared by R&A Engineering, and suitability of the current foundation at the northeast corner of the arena and provide recommendations for repair.
- Provide recommendations for repair of truss web members showing signs of distress and cracking at bolted connections, as identified in the Preliminary Structural Assessment prepared by R&A Engineering.
- Undertake a detailed structural assessment of the existing structure to verify the feasibility of repairing or replacing the existing main roof structure, and a review of the lateral load resisting system.
- Undertake a detailed building envelope and roof drainage assessment and provide recommendations for repair.
- Examine the condition of the arena truss connection bolts, by temporary removal, at random locations and assess the extent of corrosion.

In summary, the recommendations shall include the minimum repairs and associated costs to permit partial occupancy until a full structural rehabilitation can be completed. Furthermore, provide repair recommendations and associated costs to permit full occupancy year-round.

The building envelope and structural assessments were executed by Joey Funk, P. Eng., and Chris Thornton, E.I.T., between February 20, 2024, to March 4, 2024. This interim report has been prepared by Joey Funk, P. Eng., and Chris Thronton, E.I.T. Whit Saretsky, P. Eng. aided with structural analysis and peer reviews.

1.2 Report Organization

This report has been organized as follows:

- Methodology: A summary of the process used by BAR to complete a comprehensive condition assessment of the building envelope and structure.
- Building Information: A summary of the building envelope and structural components.
- Building Envelope Condition Assessment: A summary of the site observations related to the building envelope.
- Structural Condition Assessment: A summary of the site observations related to the building structure.
- Structural Evaluation: Summary of design analysis and results.
- Discussion: Detailed discussion regarding the building envelope and structural condition assessments and the structural evaluation.
- Recommendations: Outline of recommendations to achieve partial and full occupancy.
- Class D Construction Cost Estimate.
- Conclusion.

1.3 Building Background

The Memorial Arena is located at 351-3 Street SW in Salmon Arm, BC. The Arena has a footprint of approximately 26,500 square feet. The arena was built in 1957 with additions added to the East and West of the building in 1961 and 1966 respectively. A mezzanine supporting an additional office and additional storage was construction around 1975. Significant fire and life safety upgrades were conducted in 1991 including the removal of fixed spectator stands, installation of emergency exits, and installation of a fire alarm system.

The original building, the Arena, includes the artificial turf playing field and has an approximate footprint of 18,000 ft^2. The East Addition is approximately 3,350 ft^2 and includes a kitchen, reception area, washrooms, and offices. The West Addition is approximately 3,000 ft^2 and includes storage rooms, a workshop, a truck bay, two washrooms, and offices. The mezzanine, constructed in 1975, is approximately 1,250 ft^2 and includes additional office space and storage.

The ice plant was decommissioned in 1999 and the ice sheet converted to an artificial turf playing field. The ice equipment room was converted into office space and the change rooms were converted into a woodshop and additional storage.

For the purpose of this report, the Arena refers to the original building, and the east and west additions are referred to as the East Addition and West Addition, respectively. A site plan and floor plan illustrating the general layout of the facility has been included in Appendix A.

1.3.1 General Construction

The general construction of the Arena, East Addition, and West Addition is as follows.

1.3.1.1 Arena

Roof Construction: The Arena has an arched roof with two flat roof sections at the east and west ends. The roof construction is 1”x8” diagonal planking over 2”x12” Douglas Fir (D. Fir) rafters spaced at 16” on centre spanning between timber bowstring trusses spaced at 20’ on centre. The east and west ends of the arena have flat roofs. The truss top chords are 5”x14$^{5/8”}$ 9-ply D. Fir glulam members spanning 104’. The angle of curvature at the eaves is approximately 30 degrees. The bottom chords are flat and consist of 5”x9$^{¾”}$ 6-ply D. Fir glulam members. The truss webs consist of vertical and diagonal 2”x6” and 2”x8” D. Fir rough timber. The web to chord connections consist of single 4” diameter split rings. A roof framing plan of the arena has been included in Appendix A.

The gable trusses 20’ from each end of the arena are of similar construction with the exception of vertical steel tension rods spaced evenly along the length of the truss providing additional support of the bottom truss chord. The rafters of the east and west flat roofs are supported by the bottom chord of the gable trusses and timber beam and columns along each end wall.

The roofing includes torch-on SBS roll roofing.

The gable truss ends are clad with horizontal cedar lap siding over 2x4 studwall framing.

Wall Construction: The trusses are supported on 21’ tall 10”x16” D. Fir rough timber posts. The infill framing between the columns consists of 6”x10” D. Fir horizontal struts at the top and bottom of the walls, and two additional struts at approximately 8’ and 16’ above floor level; 4”x6” D. Fir rough timber diagonal bracing between the struts; and 2”x4” D. Fir studs spaced at 16” on centre.

The walls are clad with horizontal cedar lap siding.

Foundation: The side wall columns are supported on 18”x20”x36” concrete pilasters supported on 56”x56”x15” concrete spread pad footings. The end wall columns are supported on 18”x18”x36” pilasters over 24”x24”x12” concrete spread pad footings. The original arena foundation plan is included in Appendix B.

1.3.1.2 East Addition

Roof Construction: The east addition consists of an extension of the original flat roof of the arena and a lower flat roof. The lower roof is constructed of tongue and groove 3”x4” rough timber D. Fir planking. The planking is supported on 10”x14” D. Fir rough timber beams and 10”x10” D. Fir rough timber posts.

The roofing includes torch-on SBS roll roofing.

Walls Construction: The exterior walls of the East Addition are combination of the arena wall construction type and conventional studwall framing with exterior sheathing.

The exterior wall finish is painted stucco.

Foundation: The foundation consists of concrete frost walls over strip footings and spread pad footings below interior columns. The floor is a concrete slab on grade, contrary to the East Addition record drawings included in Appendix B.

1.3.1.3 West Addition

Roof Construction: The roof construction consists of wood rafters and TJI Joists. The size and spacing cold not be confirmed due to ceiling finishes. The roof framing is supported on concrete masonry unit (CMU) walls.

The roofing includes torch-on SBS roll roofing.

Wall Construction: The interior walls consist of CMU walls and conventional wood studwalls. The exterior walls are CMU.

The exterior wall finish is painted CMU.

Foundation: The foundation consists of frost walls on strip footings. The floor is a slab on grade.

2.0 Methodology

The building envelope and structural condition assessments were completed using the following processes:

- Background Investigation
- Site Assessment
- Structural Evaluation

2.1 Background Investigation

The following documents were provided by the City of Salmon Arm and were reviewed in detail. The documents are listed in approximate chronological order. Copies of the following documents are provided in Appendix B and C.

- Original Construction Drawings, Partial
- 1984 Arena Inspection Report
- 1994 Arena Review Report

- 1996 Proposed Building Geotechnical Review Report
- 1999 Arena Architectural Assessment
- 2000 Arena Fire Safety Recommendations Report
- 2016 Asbestos Materials Management Survey Report
- 2016 Lead Paint Bulk Sampling Results Letter
- 2016 Asbestos Clearence letter
- 2023 Preliminary Structural Condition Assessment

No construction records of the west addition were available.

The following is a brief summary of the documents reviewed.

2.1.1 Original Construction Drawings, Partial

Drawings include the following:

- Arena Foundation Plan and Details
- Arena Bracing Details
- Arena Wall Framing and Details
- Arena Truss section, specifications, and connection detailing.
- East Addition Floor Framing Plan, Foundation Plan, Exterior Elevations, and Sections
- East Addition Framing and Foundation Details

2.1.2 1984 Arena Inspection Report

The 1984 arena inspection report by Lowell A. Paul P.Eng. noted the trusses were in good condition however were under designed for the snow load of the time (49psf). The assessment recommended contacting the original truss designers for guidance on potential upgrades to the trusses. In the meantime, the report recommended the clearing of snow on both the arched and flat roofs to prevent exceeding the design snow load. The report noted decay at the base of the arena columns and along the exterior wall siding. The report recommended further investigation into the severity of the decay observed in the wood columns.

2.1.3 1994 Arena Review Report

The 1994 arena review report by Gordon Isaac noted the completion of major repairs to the roof columns and wood framing. Additionally, the report noted frost heave damage and decay on interior columns. The report recommends a structural engineer examine all exterior columns for decay and provide an estimated lifespan for the columns. Isaac noted decay particularly in areas in contact with or near to the ice surface. The report notes the exterior walls were installed without building paper which allowed extensive wetting of structural framing members. Discussion regarding life safety considerations, energy efficiency, accessibility requirements, and parking were also included.

2.1.4 1996 Proposed Building Geotechnical Review Report

A geotechnical report was prepared for the property south of the Memorial Arena and north of 5th Ave SW. The report notes the soil is composed of loose silt, soft to very soft clayey silt, and very loose silt with occasional deposits of sand. The report recommended replacing soil to a depth of 1m underneath footings, and slabs on grade with structural fill. The report noted a shallow ground water table with anticipated ability to rise above ground level with periods of high precipitation. Preloading of fill was recommended for the site for a duration of 6 months prior to construction.

2.1.5 1999 Arena Architectural Assessment

A summary of the property including building square footage, room uses, conditions, and life safety concerns for the building at the time. The ground floor level of the structure was observed to be level with exterior grade and the grade did not slope away from the building. Roof drainage was noted as adequate. The assessment listed ongoing problems with the prior repairs of some wood column bases, the strengthening of flat roof beams, and general water ingress. Some fire safety concerns were noted related to the uses of the rooms at the time.

2.1.6 2000 Arena Fire Safety Recommendations Report

Gage Babcock and Associates reviewed the structure to Part 3 of the 1998 British Columbia Building Code and provided recommendations for improving the level of fire and life safety. The report recommended the removal of the mezzanine installed in 1975, the removal of all ‘not in use’ mechanical and electrical equipment, and the removal of the enclosures around unused rooms. The report detailed the addition of fire exits to the main arena and the creation of a fire exit plan. The buildings spatial separation on the north face of the structure was found to be inadequate however upgrading the structure was deemed prohibitively expensive. Recommendations to reduce storage areas and remove sources of ignition were made.

2.1.7 2016 Asbestos Materials Management Survey Report

An asbestos materials management survey was conducted by APEX EHS Services. The survey found vermiculite in the west addition CMU walls. Additionally, asbestos was found in the vinyl kitchen flooring and kitchen sink mastic. The immediate abatement of the asbestos containing materials (ACMs) in the west addition was recommended.

2.1.8 2016 Lead Paint Bulk Sampling Results Letter

Per the request of Okanagan Restoration on behalf of The Salmon Arm & Shuswap Agricultural Association, sampling for suspect lead paint was conducted. Lead paint was detected in limited quantities on the exterior and interior faces of the CMU walls in the west addition. Recommendations included the development of safe work practices, exposure plan, and risk assessments if the lead paints were to be handled.

2.1.9 2016 Asbestos Clearence letter

A letter by APEX EHS Services indicating that air samples from the interior of the building was clear of asbestos contamination while abatement was ongoing. APEX EHS Services did not design or supervise the asbestos abatement.

2.1.10 2023 Preliminary Structural Condition Assessment

In January of 2023 a preliminary structural condition assessment of the arena was executed by R&A Engineering. The assessment included a visual examination of existing wood structural members. No destructive testing was conducted, and the structure foundations were not reviewed. The report noted the trusses were showing signs of distress with splits observed in the truss webs. Additionally, due to apparent foundation settlement, the bases of the wood columns had been exposed to moisture allowing decay. R & A Engineering recommended that a detailed structural assessment be conducted to determine required repairs to the structural elements and building envelope. A feasibility study of repairing or replacing the roof structure was also recommended. Additionally, R & A recommended a life cycle analysis be conducted and a geotechnical engineer be consulted to address the building settlement.

2.2 Site Assessment

The on-site assessments were executed by Joey Funk, P. Eng. and Chris Thornton, E.I.T. from February 2024, to March 2024.

2.2.1 Visual Assessment

The visual assessment included a review of the building envelope and structure. The roof structure was assessed using a 45-foot articulating boom lift which allowed close observation of the roofing, roof deck, and trusses.

Minor intrusive investigation methods were used to determine the condition of various building components. Random bolted truss connections were disassembled to visually assess the condition of the truss hardware and wood material at the connection. Foundations were excavated in two random locations to visually assess their condition and examine the soil bearing conditions. Lastly, cores were cut into the east addition roof assembly to verify the roof construction.

Each building component was recorded, and their condition assessed and documented.

The condition of each building envelope and structural component was rated using the following criteria:

- Good Condition – No visual defects, component performing as intended.
- Fair Condition – Minor defects, component performing as intended.
- Poor Condition – Moderate defects, component not performing as intended, repair or replacement recommended.
- Failed Condition – Major defects or complete failure. Repair or replacement required.

2.2.2 Interior Alignment Survey

The interior alignment of the structural components of the arena was completed using a digital level, laser level, and visual sighting methods.

The general alignment of the trusses, associated bracing, and columns was completed by visually looking along the length of each member to determine how straight and plumb they were. Gross discrepancies were recorded.

A digital level and a laser level were then used to measure the alignment and plumbness of the trusses, associated bracing, and columns.

Lastly, the camber and sag of the trusses were surveyed.

The straightness and plumbness of structural members, and the deflection of the trusses, were evaluated against standard codes and engineering judgment based on the type and size of loading supported by the structural member. The Canadian wood design standard, CSA-086, does not include erection tolerances for timber columns. Therefore, the steel column erection tolerances outlined in the steel design standard, CSA S16-2014, were used as guidance in evaluating the plumbness of the timber columns.

2.3 Structural Evaluation

The structural evaluation consisted of field verification, computed-aided modelling, and design analysis of the existing structural members.

The structural members were measured on site to determine size, orientation, material, and end support conditions and compared against the original structural drawing specifications.

After verifying the truss layout and member sizes, a computer-aided model of the truss was created using Staad-Pro and design loads applied to determine member and connection forces.

The calculated member and connection forces were then compared to the member and connection capacities and their utilization reported.

3.0 Building Information

The following tables summarize the components of the building envelope and structure. The general condition of each component including photographic representation of the conditions observed are provided in the subsequent building condition assessment and structural assessment.

Table 1: Building Envelope Components	
Roofing	Modified bitumen SBS torch on roll roofing
Exterior Siding	Horizonal cedar lap siding Horizontal Hardi-plank lap siding Vertical metal cladding Plywood sheathing Stucco Painted CMU Soffit & Facia
Windows	Wood frames PVC frames Glazing
Doors	Solid wood Insulated steel Hollow steel Steel overhead door Glazing
Flashings and Sealants	Painted aluminium flashing Aluminum gutters Silicone, bitumen, and polyurethane sealers
Insulation	Vermiculite Fibreglass batt Polyurethane spray foam
Vapour Barrier	Unknown.

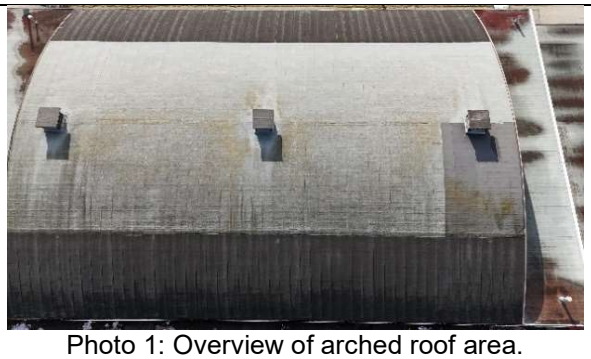
Table 3: Structural Components	
Roof Deck	Tongue and groove planking Plywood sheathing
Rafters	Douglas Fir 2x12 TJI engineered joist, unknown depth
Roof Trusses	Timber bowstring trusses with glue-laminated top and bottom chords and rough sawn timber webs and bracing.
Struts	Rough sawn D. Fir timber
Columns	Rough sawn D. Fir timber
Exterior Wall Framing	Concrete Masonry Unit (CMU) walls Wood framing

Interior Wall Framing	Concrete Masonry Unit (CMU) walls Wood framing
Mezzanine Framing	Tongue and groove planking on wood joist
Slab on Grade	Cast-in-place concrete.
Foundation	Concrete foundation wall on continuous strip footings Concrete pilaster on spread pad footings

4.0 Building Envelope Condition Assessment

4.1 Roofing

OBSERVATIONS	PHOTOS

SBS Torch-on Roll Roofing – Arena
• Center third of arched roof area
  ○ Roofing appears to be in fair condition. Photo 1.
  ○ Sanded surface appears weathered but still intact.
• Outer thirds of arched roof area (along eaves)
  ○ Roofing appears to be in poor condition.
  ○ Sanded surface has deteriorated and only the SBS membrane remains. Photo 2.
  ○ Large portions of the aggregate from the sanded surface have accumulated in the eavestroughs along the eaves of the arena.
  ○ Edge and end laps appear adequate, and the thermally welded edges are mainly intact.
  ○ Roofing terminates along eaves with a welded connection to the aluminum eave flashing. The eave flashing has a ¾" vertical upturn such that debris and water remain trapped at the eave, restricting natural drainage into the eavestroughs.
  ○ The roofing at the southeast corner is folded and is susceptible to water ingress. Photo 2.
	
	Photo 1: Overview of arched roof area.
	 
	Photo 2: Folded SBS at southwest corner. Note lack of sanded surface.

- East and west flat roof areas
    - Roofing appears to be in fair condition. Photo 3 and 4.
    - Sanded surface is intact.
    - End and side laps of roll roofing are intact and watertight.
    - Membrane extends vertically up rake walls, behind gable wall lap siding.
    - Standing water observed in numerous locations as a result of inadequate roof slopes. Photo 3 and 4.
    - 2-3 inches of standing water at the northwest corner of the roof
    - The scuppers are clear of debris.
    - Roof penetrations appear to be adequately sealed.

SBS Torch-on Roll Roofing – East Addition

- Roofing is in fair condition.
- Entire lower roof area was flooded at time of review. No leaks apparent within building interior suggesting roofing is watertight. Photo 5.
- Significant staining observed throughout.
- Poor drainage.

Photo 3: Flat roof at west end of arena. Ponding water observed.

Photo 4: East arena flat roof.

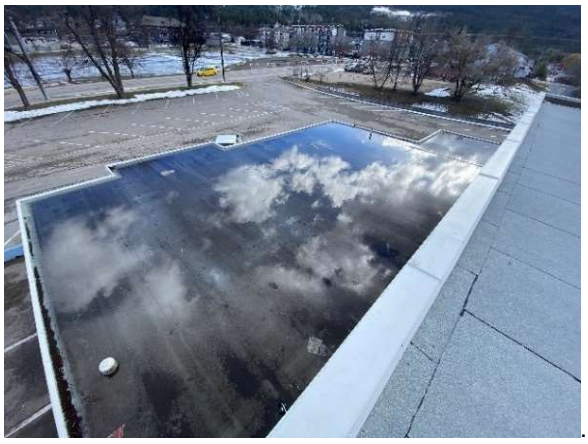
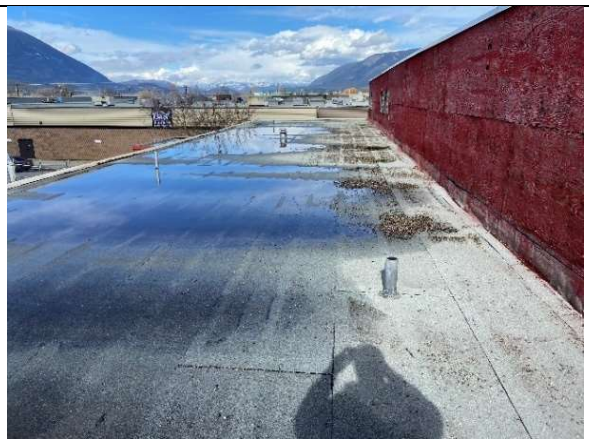


Photo 5: East addition lower roof flooded.

SBS Torch-on Roll Roofing – West Addition • Roofing appears to be in poor condition. Photo 6. • Sanded surface is deteriorated and has micro cracking throughout. Photo 7. • End and side laps of roll roofing are intact and watertight. • Membrane extends vertically up rake wall and is thermally welded to the painted plywood gable end. Bond failure between the roofing and painted plywood was observed. Photo 7. • Standing water observed in numerous locations as a result of inadequate roof slopes. Photo 6. • The scuppers are clear of debris. • Roof penetrations appear to be adequately sealed. • Large membrane blisters observed along the rake wall. Photo 7.	 Photo 6: West addition upper roof typical condition  Photo 7: Microcracking, bond failure, and blistering observed.

4.2 Exterior Siding

OBSERVATIONS	PHOTOS
Horizontal Cedar Lap Siding • The cedar siding covers the east, west and north sides of the arena, including the gable truss ends. • The lap siding is in failed condition throughout. • The painted finish is in failed condition and is peeling throughout. Photo 8. • Deterioration and decay observed throughout. • Severe deterioration and decay within 48 inches of grade. Photo 9. • Visible light shines through deteriorated lap siding throughout the arena. Photo 10. • Lap siding is fastened directly to studs with no sheathing or air barrier installed. • Lap siding extends below grade along east half of north wall. Photo 9.	 Photo 8: Typical condition of ceder lap siding.

Horizontal Hardi-plank lap siding

- The Hardi-plank lap siding is limited to the south wall of the arena and extends from grade to approximately within 5 feet of the eave. Photo 11.
- The siding is in fair condition throughout.
- The siding extends to grade along the east end of the arena. The manufacturer requires minimum 6-inch clearance from grade.
- The siding was installed over WRB and OSB sheathing.
- The bottom 6 inches of the OSB sheathing was saturated and has severe deterioration along the east half of the south wall.

Photo 9: Ceder lap siding severely deteriorated within 48” of grade.

Photo 10: Light entering through ceder lap siding.

Photo 11: Typical condition of Hardi-plank lap siding.

Vertical metal cladding

- The vertical metal cladding is limited to the upper 5 feet of the south wall of the arena.
- The metal cladding and associated trims and flashings are in good condition. Photo 12.
- The siding was installed over air barrier and OSB sheathing.

Plywood sheathing

- The west gable of the west addition is finished with painted plywood.
- The plywood is deteriorated and in poor condition. Photo 13.
- The paint is peeling throughout.
- Cut outs in the plywood exposing structural timber and bolted connections were observed.

Stucco

- The stucco siding is limited to the east addition of the building only.
- The stucco appears to be in fair condition with no significant cracking, delamination, or spalling. Photo 14.
- The stucco has a painted finish.

Photo 12: Vertical Metal Siding.

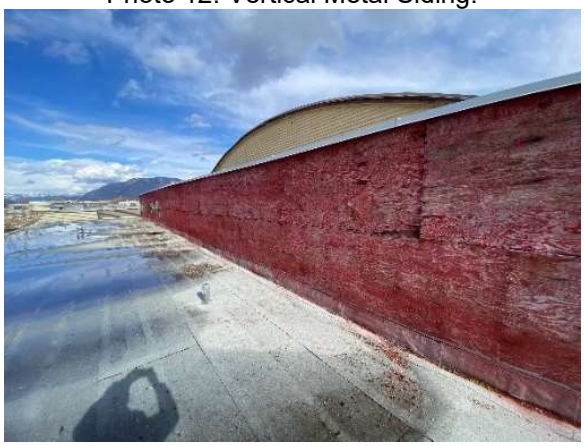


Photo 13: Typical condition of plywood sheathing.

Photo 14: Typical condition of stucco siding.

Painted CMU • The west addition is finished with painted CMU. • The paint is in fair condition throughout. Photo 15. • Minor impact defects noted in numerous locations. • Peeling observed near grade. • The condition of the CMU block is further discussed in the structural condition assessment later in this report. **Soffit & Facia** • The soffit and Facia along the gable end of the arena is painted wood. • The paint is in failed condition and the wood is deteriorated. Photo 16.	 Photo 15: Typical condition of painted CMU.  Photo 16: Deterioration present on painted facia board.

4.3 Windows

OBSERVATIONS	PHOTOS
Wood Frames • The exterior windows throughout the arena and the east side of the east addition are wood framed. • The wood frames are deteriorated and in poor condition. Photo 17. • Water staining on the interior side of the window frames suggests water ingress.	 Photo 17: Typical wood window frame condition

PVC Frames

- The east and west addition windows are mainly PVC framed. Photo 18.
- The frames are in fair condition with the exception of the south window in the east addition which is in poor condition.
- The interior windows throughout the building are mainly PVC and are generally in fair condition.

Glazing

- The window glazing throughout the building are single pane and double pane sealed units.
- The glazed units in PVC frames are generally in fair condition and well sealed.
- The glazed units in wood frames are in poor condition and poorly sealed.

Photo 18: Typical PVC window frame condition

4.4 Doors

OBSERVATIONS	PHOTOS
Solid Wood • The solid wood doors are located sporadically throughout the building interior. The doors are generally in fair condition. Photo 19. • The southwest corner of the wood shop has a sliding wood door. The door is in poor condition and is difficult to operate. • The south wall of the arena has a large exterior barn style sliding door. The door is wood framed with a painted plywood exterior. The paint is peeling, and the wood is deteriorated. The door hardware appears to be in fair condition.	 Photo 19: Solid wood door

Insulated Steel

- The exterior doors in the east and west addition are insulated steel doors.
- The doors and frames are generally in fair condition. Photo 20.
- The door seals, weather stripping, and door hardware are in fair condition.

Overhead Door

- The overhead door serving the vehicle bay in the west addition is in poor condition. Photo 21.
- The overhead door opener is not operational.
- The latch hardware for locking the overhead door is not operational.
- The door does not seal to the shop floor or door jamb.
- The door has mechanical damage from impact.

Hollow steel

- The emergency exit doors serving the arena and the west addition are hollow steel doors. Photo 22.
- The doors are in failed condition.
- The doors seals and weather stripping are in failed condition and/or missing.
- Door hardware failure was observed throughout.

Glazing

- The main entrance doors on the east wall of the east addition and the entrance door at the southeast corner of the east addition have glazing.
- The glazing is in fair condition. Photo 20.

Photo 20: Insulated steel door

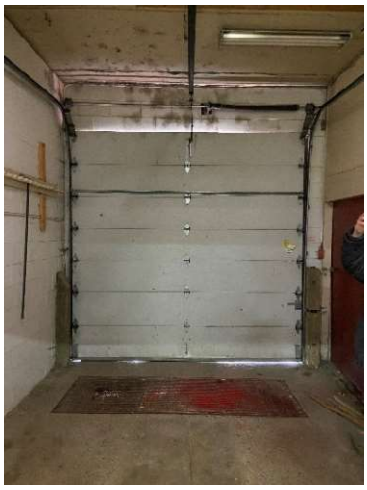


Photo 21: Overhead door


Photo 22: Hollow steel door

4.5 Flashing and Sealants

OBSERVATIONS	PHOTOS
Flashing • Aluminum flashing exists along the eaves and gable ends of the roofs. • The flashings are generally in poor condition. Photo 23. • Flashing fasteners missing in some locations. • Gable flashing at southwest corner of arena roof does not fully cover wood. Wood has deteriorated and flashing fasteners no longer engaged into substrate materials. Photo 23. • No head and sill flashing observed at windows and doors with the exception of the south wall of the arena. • Flashing at material transitions don't adequately protect against water ingress. • The metal flashings along the south wall of the arena, where the exterior siding has been replaced with metal cladding, are in fair condition. Photo 24. **Aluminum Gutters & Downspouts** • The arena is fitted with aluminum gutters along the eaves with 4 downspouts evenly spaced along each eave. Photo 24. • The gutters are generally in poor condition. • The gutters have 2-3 inches of debris accumulation. Much of the debris includes the aggregate surface of the SBS roofing system. Drain holes at downspouts were mostly clogged. • The downspouts are in failed condition. Downspouts missing or damaged in numerous locations. (Photo 25). • Downspouts no longer drain into designated stormwater piping. **Silicone, Bitumen, and Polyurethane sealers** • Majority of the exterior wall penetrations have not been sealed or flashed. • The caulking of the Hardi-plank siding on the south side of the Arena is in fair condition.	 Photo 23: Gable flashing with deteriorated substrate materials  Photo 24: Aluminium gutters and flashing along south arena wall.  Photo 25: Typical condition of gutter downspouts

4.6 Insulation

OBSERVATIONS	PHOTOS
Vermiculite • Based on the background data reviewed the west addition CMU walls are filled with vermiculite insulation. • The insulation could not be visually assessed. **Fibreglass Batt** • Fibreglass insulation in the rafter bays of the west addition was confirmed, but its condition could not be assessed due to ceiling finishes. • The east addition is assumed to have insulation between the roofing membrane and wood decking. Its condition could not be confirmed. • The east addition exterior walls are assumed to be insulated with fibreglass batt insulation. Its condition could not be confirmed. **Polyurethane Spray Foam** • The rafters above the offices at the northwest corner of the west addition are insulated with polyurethane spray foam insulation. • The insulation is in good condition. Photo 26.	 Photo 26: Polyurethane spray foam and TJI joists

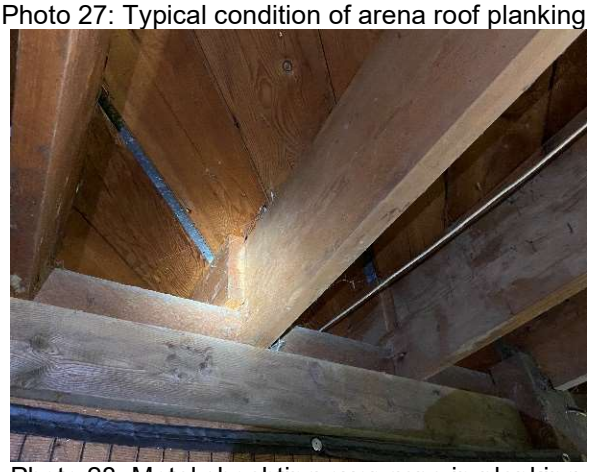
4.7 Vapour Barrier

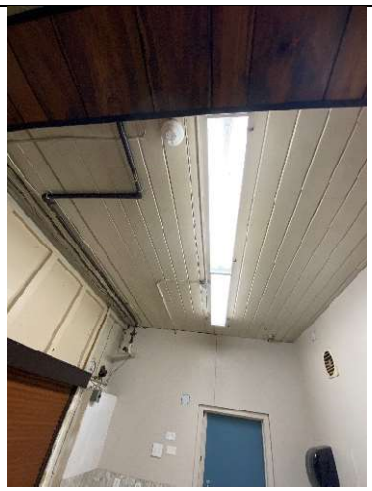
OBSERVATIONS	PHOTOS
• No vapour barrier was observed in the building wall and roof assemblies.	

5.0 Structural Condition Assessment

The following is a summary of the general condition of the structural components. The detailed arena truss assessment data collected in the field has been included in Appendix D for reference.

5.1 Roof Deck

OBSERVATIONS	PHOTOS
Tongue and Groove Planking • Arena Roof: ○ 1”x8” D. Fir diagonal planking throughout. ○ Planks are in fair condition. ○ Water/moisture staining was observed sporadically throughout. ○ No decay or rot was observed. ○ Shrinkage was observed throughout such that the tongue and grooves are not tight fitting. ○ Gaps up to ½” in width were observed in some locations in which the asphalt roofing could be seen. ○ Larger gaps and holes due to past deterioration of the planking have been covered with metal sheathing during past roofing repairs. Photo 28. ○ Moisture content of the planking throughout the arena ranges from 7-10%.	 Photo 27: Typical condition of arena roof planking  Photo 28: Metal sheahting over gaps in planking.

• East Addition
  ○ Planking is in fair condition. Photo 29.
• West Addition
  ○ The roof decking was not assessed due to roof and ceiling coverings.
 	
Plywood Sheathing
• Plywood sheathing was observed through numerous gaps in the arena roof planking.
• The extent and condition of the sheathing could not be observed.
	
	Photo 29: T&G planking, east addition.

5.2 Rafters

OBSERVATIONS	PHOTOS
2x12 Douglas Fir Rafters • The rafters are generally in good condition. • Water/moisture staining throughout. Photo 30. • The rafters are straight. • No excessive deflections were observed at the time of the assessment. Note that there was no snow accumulation on the roof at the time of the assessment. • Splitting of several rafters was observed. Refer to Appendix D which illustrates the approximate locations of rafters with observed splitting. Photo 31. • The bearing locations of the rafters on the top chord of the trusses are in good condition. No signs of bearing failure or lateral movement of the rafters were observed. • The rafters in the west addition were not visually assessed due to coverings. The rafters are assumed to be 2”x12” D. Fir members. **TJI Joists** • The rafters above the offices at the northwest corner of the west addition are TJI joists spaced at 16” on center. • The condition of the TJI joist could not be assessed as they are fully encapsulated by spray foam insulation with the exception of the bottom chords of the joists.	 Photo 30: Water staining observed on arena rafters.  Photo 31:Observed splitting in rafter

5.3 Roof Trusses

OBSERVATIONS	PHOTOS
Top Chord • The top chord of the bowstring trusses are 9-ply 5”x14$^{5/8}$” glulam arched members with an approximate curvature radius of 54’-7$^{3/16}$”. Photo 32. • The top chords are generally in good condition. • Water/moisture staining was observed throughout, but no signs of decay or rot were observed. • Moisture content ranged from 8-10% throughout the arena. • No crushing failures at rafter bearing locations were observed. • Minor checking was observed on most of the truss top chords. **Bottom Chord** • The bottom chord of the bowstring trusses are 6 ply 5”x9$^{3/4}$” glulam members. Photo 33. • The bottom chords are generally in good condition. • Water/moisture staining was observed throughout, but no signs of decay or rot were observed. • Moisture content ranged from 8-10% throughout the arena. • No crushing failures at rafter bearing locations were observed. • Minor checking was observed on most of the truss bottom chords. **Truss Webs** • The truss webs are rough sawn D. Fir members. Web sizes include 2”x6” and 2”x8” members. • Approximately 50% of the webs are in fair condition while the remaining 50% considered failed due to full depth splits at web to chord connections. Photo 34. • The truss webs are nominally straight with limited lateral bowing. • Approximately 25% of the web members have checking. Photo 35. • Moisture content ranged from 8-10% throughout the arena.	 Photo 32: Typical condition of top chord.  Photo 33: Typical condition of bottom chord. Note minor checking in 3rd lamnination.  Photo 34: Typical splitting at web to chord connection.

Top Chord Splice

- The top chord is spliced at the peak of the arched roof.
- The splice connections are in good condition with no signs of stress related failures or deterioration. Photo 36.

Bottom Chord Splice

- The bottom chords are spliced at midspan with glulam splice blocks.
- The splice blocks are in good condition. Photo 37.
- Minor checking was observed throughout.

Photo 35: Web member with checking along entire length.

Photo 36: Typical top chord splice.

Photo 37: Typical bottom chord splice.

Truss Bearing

- The truss bearing locations appear to be in good condition with no signs of deterioration. Due to the nature of the steel saddle connection at the truss bearing locations the actual condition of the timber within the saddle could not be reviewed in detail. Photo 38.1.

Bottom Chord to Top Chord Splice

- The steel splice plates are in good condition. Photo 38.1.
- The bottom chords within the splice plate connection could not be observed and end splitting could not be confirmed.
- Gaps between the top chord and bottom chord at the splice location ranged from ¼" to ½". This may have caused some end splits in the bottom chord which could not be confirmed.

Knee Braces

- The knee braces at the ends of the trusses are generally in fair condition with the exception of a few knee braces at the east end of the building which are in a failed condition due to end splitting. Photo 38.2.

Truss Bolts

- Surface corrosion on the connection hardware was observed throughout. Photo 39.
- Random connection bolts were removed and assessed. The bolts reviewed are all in good condition. Photo 40.

Photo 38.1: Truss bearing plate.

Photo 38.2 Typical knee brace.

Photo 39: Typical surface corrosion on connection hardware.

Photo 40: Typical bolt surface corrosion.

Truss Sway Bracing

- The truss bracing is generally in fair condition with the exception of the east braced bay (between trusses G and H).
- The sway braces in the east bay are laterally displaced 2 inches, at midspan, toward the south due to buckling.
- Brace to truss connections are generally in fair condition.

Truss Bottom Chord Bracing

- The bottom chord bracing consists of cross-bracing in the east and west bays and strut braces in the remaining bays.
- The strut braces are in fair condition throughout.
- The cross-bracing in the end bays are in poor condition. Due to their long span, they have sagged 2-3 inches. Photo 42.
- Brace to truss connections are in fair condition with limited splitting.

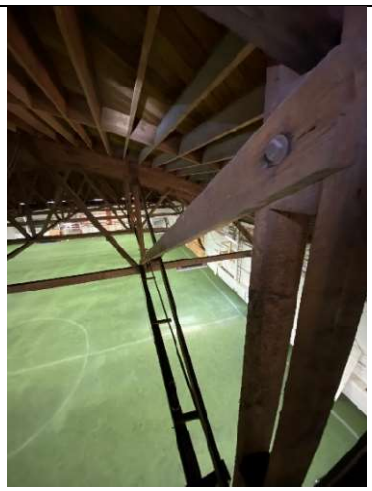
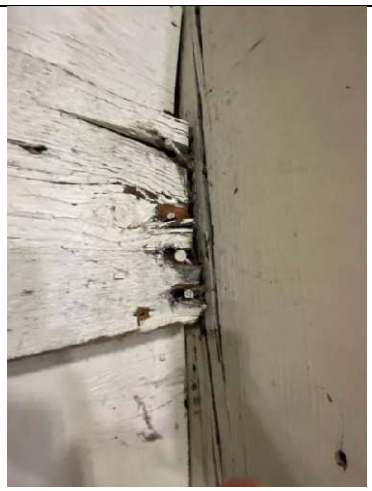


Photo 41: Typical sway bracing.

Photo 42: Typical bottom chord cross bracing.

5.4 Wall Struts and Bracing

OBSERVATIONS	PHOTOS
Struts • The struts span between the arena columns and are located at the bottom of the walls, approximately 6 feet above the arena floor, at the knee brace to column connection, and at the top of the walls. Photo 43. • The struts are generally in poor condition. • The struts located at the column bases on the east half of the arena are in failed condition due to severe decay. • Severe checking was observed throughout with checks measuring greater than ½" in width and 3" in depth. • Significant warping and twisting was observed throughout. • Strut to column connections have failed in many locations. The wood has split at	 Photo 43: Typical wall struts and bracing.

toenail locations and the members are disjointed from one another. Photo 44. **Bracing** • The walls of the arena have 4”x6” cross bracing. Photo 43. • The braces are generally in fair condition. • Checking was observed throughout. • Several brace to column and brace to strut connections have failed due to building movement and member twisting and warping.	 Photo 44: Strut to column connection.

5.5 Columns

OBSERVATIONS	PHOTOS
Arena Sidewall Columns • The columns are 10” x 16” D. Fir and extend from the foundation to the underside of the roof trusses. • The columns are generally in very poor condition. • Severe checking was observed throughout. Checks measured as large as ¾” in width and 3” in depth. Photo 45. • Some columns have end splitting at the base connection. • Moisture staining was observed throughout. Photo 45.2/ • The base of the columns on the east half of the arena are at/below grade and exposed to moisture. These columns have varying degrees of decay. The base steel brackets at these columns are corroded. Photo 46.	 Photo 45.1: Typical arena columns. Checking observed.  Photo 45.2 Typical end split at base of column.

	 Photo 46: Severe column base deterioration on east side of arena.

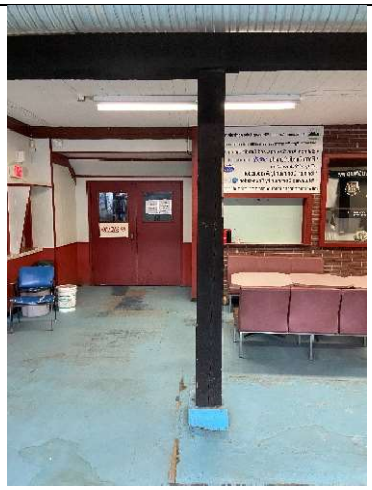
5.6 Exterior Wall Framing

OBSERVATIONS	PHOTOS

Concrete Masonry Unit (CMU) Walls
• The west addition CMU walls are generally in fair condition.
• Minor step cracking was observed above the exit door at the southwest corner of the west addition.
• Minor step cracking was observed on the west wall of the wood shop.
• The CMU walls are straight and plumb.
 	
Wood Framing
• East Addition
  ○ The exterior walls are generally in fair condition.
  ○ The exterior wall framing could not be visually assessed due to wall finishes.
  ○ Based on the background data reviewed and the site conditions, it is expected that the exterior walls are framed using conventional wood framing.
  ○ The walls are straight and plumb.
  ○ No concerning defects were observed.
• Arena
  ○ The infill framing between the columns, struts, and bracing is 2”x4” D. Fir studs spaced at 16” on center with plywood sheathing on the interior face.
  ○ The infill framing is generally in poor condition. Photo 48.
	
	Photo 47: Typical condition of exterior CMU walls.
	 
	Photo 48: Typical infill studwall framing seen on left, bearing on bottom strut, partially below grade. Studs clad with horizontal lap siding. No sill plate observed. Moisture staining throughout.

○ The south wall was sheathed with OSB on the exterior face during a previous siding replacement. ○ The bottom 6 inches of the OSB on the east half of the south wall is decayed due to moisture exposure.	

5.7 Interior Wall Framing

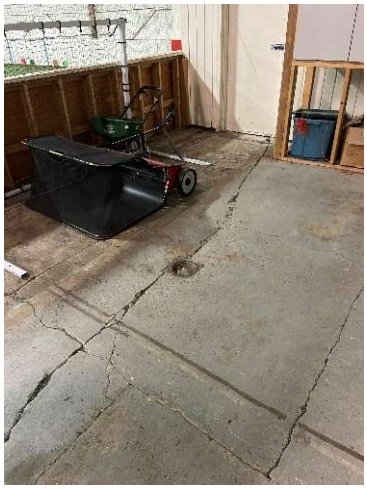
OBSERVATIONS	PHOTOS
Concrete Masonry Unit (CMU) Walls • The interior partitions in the west addition are CMU framing. • The walls are generally in good condition. • The walls are plumb and straight. **Wood Framing** • The interior partition framing could not be visually assessed due to wall finishes. • The walls are plumb and straight. • No significant cracking in wall finishes was observed. • The beam and column roof supports in the east addition are in fair condition with the exception of the south column which has mechanical damage at the base. Photo 50. • Checking in both the beams and columns was observed.	 Photo 49: East addition beam and column roof supports.  Photo 50: East addition south column with mechanical damage at base.

5.8 Mezzanine Framing

OBSERVATIONS	PHOTOS
• The mezzanine floor framing at the northeast and southeast corners of the arena could not be visually assessed due to floor and ceiling finishes.	

• The floors are generally level and stiff. • No significant defects in floor and ceiling finishes were observed.	

5.9 Slab on Grade

OBSERVATIONS	PHOTOS
• The floor slabs are generally in fair condition throughout the building. Photo 51. • Typical shrinkage and temperature cracking was observed throughout. • The concrete slab at the east end of the arena is in poor condition with cracking throughout and differential settlement. Photo 52. • The slabs throughout the east and west additions are nominally level. • The arena slab was surveyed. The slab elevation varies 1.5”.	 Photo 51: Observed sample section of slab underneath turf.  Photo 52: East end of the arena typcial slab cracking

5.10 Foundation

OBSERVATIONS	PHOTOS
East and West Additions • The additions are assumed to be supported on concrete frost walls and continuous strip footings. • Only the portions of the foundation walls above grade could be observed. • The foundation walls appear to be in fair condition. Photo 53. • No significant signs of differential settlement or cracking were observed. **Arena** • The arena foundations consist of concrete pilasters on spread pad footings. • Two pilasters and pads were partially excavated and confirmed to match the original design drawings. The pilaster and pads appeared to be in fair condition. No cracking or signs of instability were observed. Photo 54. • The top surface of the east half of the building pilasters are at or below grade. Photo 55.	 Photo 53: Foundation wall observed at grade.  Photo 54: Arena pilaster and pad footing.  Photo 55: Top of pilaster roughly 4” below grade.

5.11 Interior Alignment Survey

The interior alignment survey included checking the arena trusses, associated bracing, and support columns for plumbness and straightness. Furthermore, the trusses were surveyed to determine truss deflections.

The measurements were taken while the arena roof was free of any snow accumulation. Recorded data such as truss deflections and bowing of compression members are likely to increase under heavier loading conditions. Refer to Appendix D for collected survey data.

The trusses are generally plumb and straight throughout the arena. The truss camber ranged from 2.125" to 3". The original truss design drawings specified a 3" truss camber.

The bottom chord cross bracing located in truss bays A-B and G-H are sagged approximately 3 inches.

The vertical sway bracing in the truss bays G-H are bowed southwards approximately 2 inches.

The elevation of the truss bearing locations along the north side of the arena are within ¼" with the exception of truss H which is approximately 4" lower. The elevation of truss bearing locations along the south side of the arena are within ½" with the exception of truss E, G, and H which are 1.5", 2", and 2.25" lower, respectively.

The columns throughout the arena are nominally plumb in the east-west direction. Majority of the columns are slightly out of plumb in the north-south direction. Most notably, the north and south columns at truss G and H are 1.5"-2" out of plumb.

6.0 Structural Evaluation

The following discussion summaries the original loads used in the design of the structure and the design loading currently required by the British Columbia Building Code 2024 (BCBC 2024) and National Building Code of Canada 2015 (NBCC 2015).

6.1.1 Design Loads

The arena roof was originally designed for a uniform snow load of 40psf. Trusses A and H were designed for a dead load of 15psf whereas the remaining trusses were designed for 12psf.

The as-built weight of the arena roof has been estimated based on the observed roof assembly. The roof assembly observed is as follows with respective weights noted:

• 2-ply SBS roll roofing	2 psf
• 3/8" plywood	1.1 psf
• Asphalt Shingles	2.5 psf
• ¾" tongue and groove planking	2.2 psf
• 2x12 rafters @ 16" o/c	3.3 psf
• Trusses @ 20ft o/c	2 psf
Total Estimated Dead Load	15 psf

The total estimated dead load is conservative as it could not be confirmed if the original shingles had been removed prior to re-roofing with SBS. Furthermore, it is unknown whether the entire roof was sheathed with plywood prior to the SBS installation.

The design standards at the time did not include any provisions for earthquake loading. Furthermore, the National Building Code of Canada 1953 did not require buildings less than 50 feet tall to be designed for wind loads assuming they were constructed with a bracing system. The current building codes require that structures be designed with Lateral Force Resisting Systems (LFRS) to support these loads.

The snow, wind, and earthquake loads used to evaluate the structure have been calculated based on the BCBC 2024 and the application of Commentary L of the NBCC 2015.

6.1.1.1 NBCC 2015 Commentary L

Commentary L outlines the application of Part 4 of the NBCC for the structural evaluation and upgrading of existing buildings to ensure a level of performance that is consistent with the intent of the current NBCC.

Buildings which have been evaluated against the guidelines outlined in this commentary are generally considered acceptable even though they may not specifically meet all aspects of the current building code.

The commentary outlines a systematic approach to determine the minimum reliability level for a building based on its use, occupancy, and past historical performance. Based on the determined reliability level, the load factors are relaxed, while meeting the basic requirements for life safety and building performance as outlined within Part 4 of the NBCC.

Based on the building having an Assembly occupancy, a maximum number of people exposed to risk associated with structural failure exceeding 100, and a record of satisfactory past performance, the building is assessed to have a level 4 reliability level.

The following table is referenced from Commentary L, NBCC 2015, and outlines the load factor relaxations considered in the structural evaluation. Note that reliability level 5 is the highest and represents conformance to the current building code.

Principal Load Factors for the Structural Evaluation of Existing Buildings Other than Post-disaster Buildings

Reliability Level(1)	Load Type				
	Dead Load		Live Load(2) or Snow Load	Wind Load	Earthquake Load
	Active	Counteractive(3)			
	Principal Load Factors				
5	1.25	0.90	1.50	1.40	(4)
→ 4	1.20	0.92	1.40	1.30	(4)
3	1.15	0.95	1.30	1.20	(4)
2	1.11	0.97	1.20	1.10	(4)
1 or 0	1.08	1.00	1.00	1.00	(4)

(1) The reliability level is the sum of the indices for system behaviour, risk category and past performance in Table L-4.
(2) A reduction in the live load factor may be justified if the live load in question is controlled (e.g., a liquid in a storage tank); however, the reduced load factor must not be less than the smallest value in the Table.
(3) The counteractive value applies when the dead load acts to resist failure.
(4) See the Commentary section titled Earthquakes (Paragraphs 39 to 48) for guidance on earthquake loads.

Based on the above table, the load factors used in the structural evaluation are as follows:

- Dead Load Active 1.2
- Dead Load Counteractive 0.92
- Live/Snow Load 1.4
- Wind Load 1.3
- Earthquake Load 1.0

At present there is no requirement in Canada to seismically upgrade a building that is not being renovated. Buildings undergoing large renovations are required to be upgraded to various seismic force levels depending on their existing force resistance level.

6.1.1.2 Snow Loading

The current building codes require arched roofs to be designed for balanced, unbalanced, and partial loading.

The balanced load case assumes equal snow load across the full area of the roof.

The unbalanced load case assumes the displacement of snow from the windward side of the roof peak to the leeward side of the roof peak such that the snow load is zero on the windward side and increases from the peak to the eave of the leeward side of the roof.

The partial load case assumes 50% of the uniform snow load on half the roof and 100% of the uniform snow load on the remaining half of the roof.

Additional snow loading conditions are mandated where multi-level roofs are present due to drifting snow.

The arena roof steps down to a flat roof at each end. The east and west additions step down further from the flat arena roofs resulting in significant drift loads.

The snow loads used in the structural evaluation are as follows:

- Balanced 60.6 psf
- Unbalanced 0 psf @ peak increasing to 148.3 psf on leeward eave.
- Partial 30.3 psf on windward half, 60.6 psf on leeward half.
- Drift Loads
    - At arena arched to flat roof 237.7 psf with a drift length of 37'-6"
    - At arena flat roof to additions 106.5 psf with a drift length of 12'6"

6.1.1.3 Wind Loading

The wind loads were calculated based on the provisions of Commentary I in the BCBC 2018 using an hourly wind pressure having the annual probability of occurrence of 1-in-50 for the City of Salmon Arm equalling 8.1 psf.

6.1.1.4 Seismic Loading

Figure L-1 in Commentary L was used as the basis for earthquake loading considerations in the structural evaluation. Level 3 forces, which correlates to the use of spectral response acceleration values with a probability of exceedance of 5% in 50 years (1/1000 per year) were used.

The spectral response acceleration values used are as follows:

- Sa(0.2) 0.161
- Sa(0.5) 0.174
- Sa(1.0) 0.135
- Sa(2.0) 0.0895
- PGA 0.0654
- PGV 0.137
- Site Class E

6.1.2 Design Results

The structural evaluation of the arena trusses and columns, with the application of the design loads discussed above, have been included in Appendix E.

6.1.2.1 Superstructure

The evaluation of the superstructure compared the tension, compression, and bending moment capacities of the structural members against the respective factored forces. The general design analysis results of the structural members are summarized below:

- Arena
  - The rafters are 50% over capacity in bending during balanced loading. The remaining load cases exceed this value.
  - The truss top chords are generally 50% over capacity in compression and 200% over capacity is combined bending and compression.
  - The truss bottom chords are generally 75% over capacity in tension and 200% over capacity is combined bending and tension.
  - 70% of the truss webs fail in either compression or tension.
  - 75% of the truss web to chord connections fail.
  - The columns have sufficient capacity to support the current design loads.
  - The column to truss connections are 50% over capacity in tension.
  - The column to foundation connections are 80% over capacity in tension.
- East Addition
  - The tongue and groove roof planking are structurally adequate to support the current uniform snow load conditions, but not the drift load cases.
  - The roof beams have adequate strength to support the current design loads.
  - The roof beam support columns have adequate strength to support the current design loads.
- West Addition
  - The rafters are structurally adequate to support current uniform snow load conditions, but not the drift load cases.

The CMU walls of the west addition and the wood framed exterior walls of the east addition are generally in good condition and can adequately support the current design loads.

6.1.2.2 Foundation

The bearing pressure of the soil assumed in the original design of the arena was back calculated based on the original design loads and foundation pad sizes. A factored soil bearing pressure of 4000 psf would have been required to support the original design loads. Based on the current design loads a factored bearing capacity of 5,300 psf is required.

The foundation excavations and underlying in-situ soils exposed during the site investigation were reviewed by Evertek Engineering. Based on Evertek's investigation the in-situ soils have an estimated factored bearing strength of 2,500 psf. Therefore, the existing footing pads are approximately 200% over capacity under current design standards.

The preliminary geotech report prepared by Evertek has been included in Appendix F. The report provides further discussions regarding expected foundation settlements.

The east and west addition foundation sizes are unknown and therefore have not been evaluated in detail.

7.0 Discussion

The building envelope of the arena is in a failed condition and requires a full replacement. The building envelope of the east and west additions are in fair condition and can likely provide an additional 5-10 years of service with regular maintenance.

The arena structure is in very poor condition requiring immediate interim repairs to prevent collapse, and significant structural repairs and reinforcing throughout to meet current building code regulations. The east and west addition structures are in fair condition and can likely provide an additional 10-15 years of service with reinforcing and regular maintenance.

7.1 Building Envelope

7.1.1 Arena

The building envelope components are beyond the expected service life and replacement is necessary to provide protection of the structure.

The outer thirds of the arena roof membrane have no remaining sanded surfacing. The sanded surface is intended to protect the bitumen membrane from mechanical damage, weathering, and UV exposure. The rate of deterioration can be expected to increase due to the loss of the sanded surface.

The flat roof sections are generally in fair condition with the exception of some blistering, bond failure at headwalls, and poor drainage. Differential settlement of the building has resulted in poor roof drainage causing rain and snowmelt to accumulate on the roof.

The cedar lap siding does not provide adequate protection of the structural components of the exterior walls which has led to significant deterioration of primary structural elements. The lack of a weather resistant barrier (W.R.B.) between the structure and the lap siding has exacerbated the deterioration of the structure.

The lack of a perimeter foundation wall and adequate waterproofing along the base of the exterior walls has led to water ingress causing decay of the lap siding, primary structural members, and secondary structural members.

The painted plywood gable end sheathing of the flat roof sections is deteriorated and does not adequately protect the primary and secondary structural elements from moisture ingress.

The updated lap siding on the south side of the arena is in fair condition with the exception of the area within 12 inches of grade. Hardi-plank siding in not intended to be installed within 6 inches of grade. Pre-mature deterioration of the siding within this area can be expected. Early signs of deterioration are evident along the base of the wall as the OSB backing to which the siding is mechanically fastened to has significant decay.

7.1.2 East Addition

The east addition building envelope components are generally in fair condition.

The SBS roof appears to be watertight as no leaks were observed inside the building. Poor drainage is evident as water and snowmelt accumulates on the roof. Poor drainage is of moderate concern as it can lead to premature failure of SBS roofing systems.

The exterior stucco finishes are intact and provide adequate protection against water ingress.

7.1.3 West Addition

The west addition building envelope components are generally in poor condition.

The vertical upturn of the membrane at the headwall of the arena gable has delaminated from the plywood sheathing and blistering of the membrane has occurred. Blistering occurs when the membrane delaminates from the substrate and a ‘bubble’ of air is formed between the membrane and the substrate.

The SBS roof appears to be watertight as no leaks were observed inside the building. Poor drainage is evident as water and snowmelt accumulates on the roof. Poor drainage is of moderate concern as it can lead to premature failure of SBS roofing systems.

The CMU walls are mainly intact and provide adequate protection against water ingress.

7.2 Structural

7.2.1 Arena

The split rafters observed randomly throughout the arena can be attributed to drying shrinkage and bending stress failures.

Drying shrinkage refers to the shrinkage of wood members during the drying process. During drying, stresses develop in the wood fibres resulting in cracks. Common types of cracking include checks and splits.

Checks occur lengthwise along a wood member, typically parallel to the grain, and are usually shallow. Checks are typically superficial and do not significantly affect the strength of wood.

Splits involve the separation of wood into two separate pieces of wood and cause a significant reduction in strength. Splits generally occur as a result of overstressing, impact, or defects such as knots, however, excessive drying can also cause splitting.

The split rafters were located randomly throughout the arena, not concentrated, suggesting that the splits are related to excessive drying and defects rather than overstressing. Most of the rafters have performed well throughout the life of the building with no visible defects besides staining.

The defects observed on the top and bottom chords of the trusses include minor checking and delamination. The checking observed can be attributed to drying shrinkage as discussed above.

Glue-laminated timber, also known as glulam, are structural engineered wood products made up of multiple layers of wood glued together. Delamination of glulam members refers to the separation of the layers resulting in loss of structural integrity. Common reasons for delamination include moisture exposure, manufacturing defects, mechanical damage, over stressing, and decay.

The minor delamination observed in the glulam truss chords can be attributed to past moisture exposure and possible overstressing.

Moisture staining was observed throughout the arena. Based on the background information, the arena has a history of dealing with condensation related to the ice rink. The staining observed can likely be attributed to the historic condensation challenges and past roof leaks.

Delamination of the chords due to overstressing is also probable as the allowable material stresses used in the 1950s for the design of glulam members was overestimated by approximately 30% This has led to numerous failures of large span timber trusses in the past.

Approximately 50% of the truss webs were observed to have end-splits. The splitting can be attributed to drying shrinkage, as discussed earlier, and stress related failures. The ends of the webs are cut

perpendicular to the grain increasing drying potential and therefore more susceptible to splitting. Furthermore, the split-ring connections between truss chord and webs concentrate the stresses near the end of the webs often resulting in splitting.

The capacity of split ring connections is reduced in locations where the split in the wood member passes within ¼" of the split ring, the split extends through the full depth of the member, and measures 3/64" (1.2mm) in width at the split ring. The capacity reduction is related to the loss of bearing area between the split ring and the wood member. The splits observed in the truss webs generally pass through the split rings, extend through the full depth of the member, and measure at least 3/64" in width at the split ring.

The checking of the arena columns can be attributed to drying shrinkage as discussed earlier. The checking is extensive and of moderate concern since the checks extend to the end of the members propagating into splits at the end connections.

The splitting observed at the end of several columns can be attributed to drying shrinkage and overstressing. Like the truss webs, the cut ends of the columns have a higher drying potential due to being cut perpendicular to the grain. The bolted connections at the base of the columns and the split ring connections at the top of the columns are areas of stress concentrations which have exacerbated the splitting at the column ends. Splits extending through the bolted and split ring connections can be expected to decrease the capacity of the connection as discussed earlier.

The deterioration of the structural column bases and grade level struts spanning between columns is a direct result of inadequate ground clearance and protection against moisture. The struts and column bases on the east half of the arena are at or below grade, exposing them to moisture, and leading to decay. Furthermore, the damaged downspouts discharge water directly against the base of the building exacerbating moisture exposure.

As discussed in the geotechnical report, the anticipated settlement of the foundations throughout the life of the building is approximately 4 inches. Although not addressed in detail in the background documents reviewed, the settlement has likely been a contributing factor to the column base elevations and poor site drainage.

The decay of the column bases has resulted in the settlement of the trusses on the east half of the building. Most notably, truss H, which has settled approximately 4 inches. The differential movement between truss G and truss H has resulted in stress concentrations in the truss bracing resulting in localized buckling of the vertical sway bracing. The settlement has also been the cause for poor roof drainage discussed earlier.

The moisture content of the wood framing throughout the arena generally ranged from 8-10%, well within the 19% maximum outlined in the building code. The base of the columns on the east half of the arena had moisture readings over 28%, the average fibre saturation of wood. Generally, decay and fungi growth will begin as moisture content exceeds fibre saturation.

7.2.2 East Addition

The roof and wall framing of the east addition could not be observed due to exterior and interior finishes. In these cases, the wall and ceiling finishes are reviewed for defects and misalignment. Structural issues will typically manifest as cracks and defects in the wall and ceiling finishes. Misalignment and large deflection of walls and ceilings typically raise concerns regarding the structure.

Based on limited observed defects in the ceiling and wall finishes, the structure is considered to be performing well.

The damage of the south timber roof support column in the reception area appears to be related to mechanical damage. The damage has reduced the cross-sectional area of the column decreasing its axial capacity.

7.2.3 West Addition

The roof framing could not be observed due to exterior and interior finishes. The roof and ceiling finishes were visually reviewed for defects, misalignment, and excessive deflections. Based on limited observed defects in the ceiling and roofing finishes, the roof structure is considered to be performing well.

Defects of CMU walls considered to be of structural consequence typically include step cracking along grout joints, dislodged blocks, lateral and vertical movement of walls, and grout deterioration.

The minor step cracking observed in the west addition walls is likely a result of differential foundation moments and not of structural consequence.

7.3 Roof and Site Drainage

The roof drainage throughout the facility is in failed condition due to building settlement, column decay, lack of maintenance, and vandalism.

The eavestroughs serving the arena have significant debris accumulation reducing flow capacity and clogging the discharge openings into the downspouts. The eavestroughs are prone to overflowing during intense rainfalls.

The downspouts are damaged throughout with many missing sections within 10 feet of grade. The missing sections can likely be attributed to vandalism and mechanical damage during large windstorms. The damaged downspouts at the northeast corner of the arena are a result of settlement of the building due to column decay discussed earlier.

Several of the downspouts no longer drain directly into the stormwater collection system along the north and south sides of the building. The roof runoff drains directly against the base of the building resulting in ponding due to inadequate site grading.

The grading around the east and west additions generally slopes away from the building. The grading along the north side of the arena is relatively flat with minimal positive drainage away from the building. The grade along the south side of the area slopes towards the building. The poor grading on the north and south sides of the arena results in the accumulation of rainwater and snowmelt along the building. The 1999 building information report noted that the site was relatively flat without positive drainage away from the building. This would suggest the site drainage has likely been inadequate throughout the life of the building. The building settlement discussed in the geotech report has also been a contributing factor to the poor site drainage.

The inadequate roof and site drainage has exacerbated the deterioration of the building envelope and primary and secondary structural elements.

7.4 Structural Evaluation

The facility does not meet the current design standards for resistance against vertical and lateral loads.

The structural capacity of building materials and design loads on structures have undergone significant changes in the last 7 decades as building codes and standards developed through analysis of historical data, testing, research, and development.

The most notable changes in relation to the arena include the decrease in allowable stresses of graded timber, unbalanced snow loading conditions, and consideration of snow accumulation at stepped roofs.

Notwithstanding the application of reduced load factors based on Commentary L of the NBCC 2015, the building is structurally inadequate to support current snow, wind, and earthquake loading.

As discussed earlier, Commentary L allows the consideration of past performance in the evaluation of existing structural members. Considering the past performance of the arena rafters, their current condition, the impact of a local failure, and the associated risk to occupants, the arched roof rafters can be considered acceptable. A local failure of the rafters is not expected to cause a catastrophic rupture or collapse of the building. Notwithstanding, the rafters are under capacity and can be expected to undergo significant deflections and deformations under high snow loads which could cause damage to the roof membrane.

The design results for the typical arena truss, trusses B through G, have been presented in Appendix E. The results for trusses A and H have been omitted as these two trusses are grossly inadequate due to the drift loading on the flat roof areas of the arena. Reinforcing of trusses A and H is not feasible, and replacement of the flat roof areas will be required.

The design results include the original truss forces, new truss forces, truss capacities, truss unity checks, and connection unity checks. Structural elements with a unity of 1.0 or less are considered to be structural adequate. Structural elements with a unity greater than 1.0 are considered to be structural inadequate.

Two unity checks have been included for the tension and compression load cases, axial and combined axial and bending. The axial unity checks consider axial member forces only, axial and bending unity checks consider axial and bending forces occurring simultaneously. The latter case would most notably apply to the top truss chord since the rafters bearing on the chord cause bending forces.

It should be noted that a unity between 1.0 and 2.0 doesn't necessarily represent a member failure. The calculation of the applied loads includes load factors, as discussed earlier, which inflate the design loading to provide a level of safety. Furthermore, member capacities are reduced with the application of resistance factors, further increasing the level of safety. The resulting range between the 'design capacity' and 'failure capacity' can be considered a 'no go zone'. Once in this zone, structural members can undergo excessive deflections and other serviceability issues prior to reaching their failure point. An example of this would be the buckling observed on the vertical sway bracing between trusses G and H. Although the braces have not physically broken, they are considered to be failing due to excessive deflection related to buckling.

Further consideration must also be given to members with unity checks exceeding 2.0. Failure of these members would be expected should a historic snow event be followed by high winds. The reported unity checks are based on worst case loading conditions which would represent a 1-in-50-year snowfall event followed by a 1-in-50-year wind event. Statistically, this weather scenario would have occurred 1.34 times since the original construction of the arena. Considering a catastrophic failure related to roof loading has not been historically recorded or observed, the building has likely never experienced this worst-case loading scenario.

Failure of a truss would likely result in the catastrophic failure of a large portion of the arena roof or possibly a complete collapse. Therefore, reinforcing of the trusses to meet the current building code design loading would be required. Cost effective reinforcing methods of bowstring timber trusses include post-tensioning of the bottom chord with steel cables, replacement of webs with split ends, increasing the net area of the truss members, increased truss bracing, and adding gussets to connections.

The arena columns are generally structurally adequate with the exception of the columns with observed decay. The decayed posts will require repair/replacement and the foundation raised to bring the column base elevations above grade.

Considering the level of effort required to replace the decayed columns, historic evidence of column decay and replacement, the root cause of the decay being related to the elevation of the foundations, and the inadequacy of the foundation based on soil bearing capacities, replacement of the foundation should be considered. In addition to increased pad and pilasters sizes at each column, continuous frost walls on strip footings should be used to elevate the base elevations of the exterior walls above grade and provide adequate support.

The arena roof and wall bracing do not meet the current code requirements for a LFRS. Additional truss bracing and a combination of braced bays and shear wall segments will be required to provide the necessary LFRS.

8.0 Recommendations

Based on the background information, detailed site assessment, structural evaluation, and the topics discussed herein, the building envelope and structural systems are generally considered to be in poor condition and at the end of their useful service life. Significant investment into the building envelope and structure is required prior to interim occupancy and extending the useful life of the facility.

It is the opinion of the undersigned that permanent repairs to the building envelope and structure with the intent of extending the useful service life of the facility is not a viable solution and replacement should be considered. This opinion is based on the extensive effort and cost to replace the existing foundation and the flat roof sections of the arena, the extensive truss repairs, and the replacement of the building envelope. Furthermore, the extensive remediation will trigger the requirement to upgrade the existing building to current codes in relation to fire and life safety. Costs related to the latter are not considered in this report as they will be further analyzed in the next phase of the project, the Life Cycle Assessment.

Two repair recommendations have been prepared. Repair recommendations for partial occupancy and repair recommendations for full occupancy. The intent of partial occupancy is to maximize the occupancy with the minimum level of repairs which will allow safe use of the building within certain weather conditions and seasons. The intent of full occupancy is to provide the minimum level of repairs which will allow safe use of the building year-round.

8.1 Repair Recommendation - Partial Occupancy

The following are the minimum structural repairs required prior to permitting occupancy in the arena:

- Jacking of truss H to be within 1 inch of truss G elevation.
- Installation of shoring at the north and south ends of trusses F, G, and H.
- Installation of cable cross bracing along each side of the arena.
- Clean eavestroughs along the north and south sides of the arena.
- Replace downspouts on north and south sides of arena and tie into existing stormsewer system.
- Installation of video surveillance on all roof areas.
- Installation of wind speed monitoring system.

Notwithstanding the implementation of the repairs outlined above, partial occupancy would be restricted to the following conditions:

- Occupancy limited to March through November.
- No occupancy permitted during snow accumulation on the roof.
- No occupancy permitted during forecasted and measured wind gust speeds exceeding 40 km/hr.
- Real-time data of the roof video feed and wind speed monitoring broadcasted to the facilities operation manager.
- Updating the City of Salmon Arm’s Operations Manual of the facility to include the conditions noted above.
- Annual visual assessment of the arena by a structural engineer, prior to occupancy following the winter season, to determine any significant changes in the building condition.

- The implementation of permanent repairs outlined in Section 8.2 below by the year 2030.

It should be noted that the shoring of trusses F, G, and H will impede on the playable turf area. It is anticipated that the shoring will take up approximately 240 square feet of the turf area at both the northeast and southeast corners of the playing field.

The expected cost related to the minimum repairs outlined above is $89,700. A class D estimate has been attached in Appendix G.

8.2 Repair Recommendation - Full Occupancy

The following are the minimum structural repairs/replacements required prior to permitting full occupancy of the building year-round. Due to the nature and extent of the structural repairs required in this recommendation, building envelope repairs/replacements have been included. The repairs/replacements outlined below will be considered a 'major renovation', as defined by the building code, triggering the requirement to upgrade the fire and life safety systems. A brief list of the fire and life safety upgrades that can be expected has been provided but is not considered to be an exhaustive list. Furthermore, the opinion of costs provided does not include the costs associated with the fire and life safety upgrades. These costs will be analyzed in the Life Cycle Assessment.

- Structural Repairs
    - Arena Roof
        - Reinforce all defected arena rafters.
        - Reinforce truss top chords.
        - Post-tension bottom truss chords.
        - Replace truss webs with split ends.
        - Reinforce truss webs.
        - Install gussets at web to chord connections.
        - Replace flat roofs on east and west ends of arena.
    - Arena Exterior Walls
        - Remove exterior walls along north and south sides of the arena.
        - Install new stud framed shearwalls supported on new concrete frost walls along north and south sides of the arena.
        - Install steel braced frames at east and west ends of arena.
    - Arena Foundation
        - Remove 10 feet of interior slab on grade along north and south sides of the arena.
        - Remove existing pilasters and pad footings.
        - Install new pad footings.
        - Install new continuous strip footings.
        - Install new frost walls along the north and south sides of the arena extending a minimum of 6" above grade.
        - Repair interior slab on grade.
        - Replace stormwater system and add weeping tile system.
    - East and West Additions
        - Reinforce rafters.
        - Replace damaged column in reception area of east addition.

- Building Envelope Repairs
    - Arena
        - Replace SBS roof membrane.
        - Replace eave and gable flashing.
        - Replace soffit and facia.

        - Replace eavestroughs and downspouts.
        - Replace plywood sheathing on truss gable ends.
        - Install weather resistant barrier on new exterior walls and gable ends.
        - Install new lap siding on exterior walls and gable ends.
        - Replace all doors and windows.
    - East and West Additions
        - Replace SBS roof membrane.
        - Replace parapet flashing, scuppers, and downspouts.
        - Repair wall penetrations.
        - Selective replacement of windows and doors.
        - Repaint exterior stucco and CMU surfaces.

- Anticipated Fire and Life Safety Upgrades
    - Installation of a fire sprinkler system.
    - Upgrades to the existing fire alarm system with integration of the sprinkler system.
    - Provisions for barrier free access.
    - Replacement of the emergency lighting system.
    - Upgrade of walls requiring fire-resistance ratings.

The expected cost related to the repairs outlined above is $2,778,000. A class D estimate has been attached in Appendix G. As previously mentioned, the costs related to the fire and life safety upgrades have been excluded from this cost estimate.

The building envelope repairs, and opinion of cost outlined above have not considered the heritage status of the facility. It is assumed that since the south side of the arena has been re-clad with Hardi-plank, no reservations exist against the replacement of the remaining exterior cladding with Hardi-plank lap siding. Should the heritage registrar require the exterior cladding replacement to be cedar plank siding, the recommendations and associated cost estimates would be amended accordingly.

9.0 Conclusion

Based on the historical data reviewed, site observations made, and the structural evaluation, the building envelope and structure are generally in poor condition and beyond their intended service life. Significant financial investment will be required to extend the useful service life of the building.

As stated in Section 8.0 Recommendations, it is the opinion of the undersigned that repairs to the building envelope and structure is not a viable option and demolition or replacement should be considered. Had the existing arena foundation consisted of a conventional perimeter foundation wall extending a minimum of 6 inches above grade, replacement of the foundation may not have been required. This would have increased the feasibility of repairs to extend the service life of the facility.

The repair recommendations and conditions outlined in Section 8.1: Repair Recommendation – Partial Occupancy, shall be designed and construction reviewed by a structural engineer prior to re-opening of the Memorial Arena. Use of the offices and welfare areas in the east and west additions will be granted once truss F, G, and H have been shored and all access points into the arena have been locked and barricaded. Access into the arena will only be granted once the shoring and bracing has been completed.

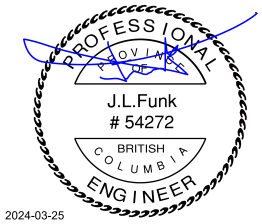
BAR Engineering and the undersigned reserve the right to amend the opinions outlined in this interim report following the completion of the Life Cycle Analysis, Demolition Estimate, and Replacement Estimate scheduled to be completed at the end of April 2024.

This interim report is not intended to provide an opinion regarding responsibility of any party in causing or contributing to the observed condition. Any comments or conclusions within this report represent the opinion of the undersigned, which is based upon the historic documents provided, the site assessment, the structural evaluation, professional engineering judgement, and industry standards.

This report has been prepared for the exclusive use of the City of Salmon Arm and their authorized users for the specific application outlined in this report. Any use which a third party makes of this report, or any portion of this report, is the sole responsibility of such third party or parties. BAR Engineering and the undersigned accept no responsibility for damages suffered by any third party resulting from unauthorized use of this report.

Respectfully Submitted,
BAR Engineering Co. Ltd.

Per:



Joey Funk, P. Eng.
Senior Engineer
Oakangan Divison

Reviewed by:

PERMIT TO PRACTICE
BAR ENGINEERING CO. LTD.
PERMIT NUMBER: 1001776
Engineers and Geoscientists BC

Whit Saretsky, P. Eng.
Senior Engineer
Buildings Division

10.0 References

[1] British Columbia Building Code 2024, BA 2023 10, March 8, 2024

[2] National Building Code of Canada 2020, NRCC-CONST-56435E, 2020

[3] National Building Code of Canada 2015, CNRC 56190, 2018

[4] National Building Code of Canada 1953, CNRC

[5] Evaluation Maintenance and Upgrading of Wood Structures, American Society of Civil Engineers, New York, NY, 1982

[6] A. Newmen, Structural Renovation of Buildings, New York, NY, USA, Mcgraw Hill, 2001

[7] P. C. Gilham & B. A. Matthias, "An Update on Bowstring Truss Issues", Western Wood Structures Inc., Tualatin, OR, 2009

[8] P. C. Gilham & T. D. McKee, "Bowstring Trusses 'Fail' to Meet Current Code Requirements", Western Wood Structures Inc, Tualatin, OR, 2007

[9] Design Guide for Timber Roof Trusses, Timber Frame Engineering Council, Alstead, NH, 2020

APPENDIX A

Site Plan

Floor Plan

Arena Roof Framing Plan

PARTIAL SITE PLAN

BAR ENGINEERING
#201, 2540 - 53 Avenue Vernon, B.C. V1T 9W8

CLIENT:

CITY OF SALMON ARM

SEAL:

PERMIT:

No.	BY	ENG	APR	DESCRIPTION	DATE
01	JLF	JLF	WS	ISSUED FOR INFORMATION	2024-03-25

PROJECT:

STRUCTURAL ASSESSMENT &
LIFE CYCLE ANALYSIS
MEMORIAL ARENA

LOCATION:

351 3RD STREET SOUTHWEST
SALMON ARM, BC

DRAWING NAME:

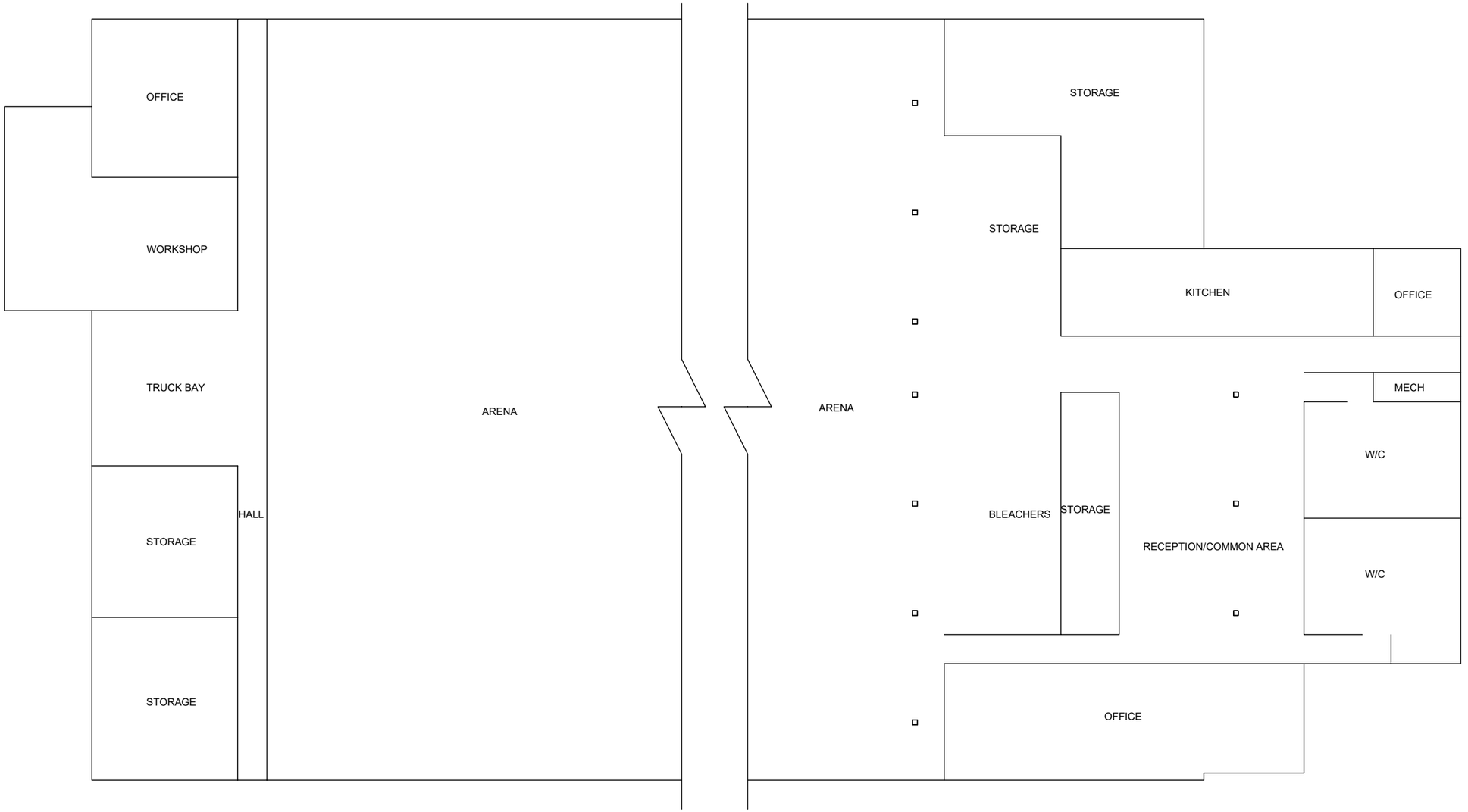
PARTIAL SITE PLAN

PROJECT NO.:

24VR-600400

DRAWING NO.:

SHT-00



FLOOR PLAN

#201, 2540 - 53 Avenue Vernon, B.C. V1T 9W8

CLIENT:

CITY OF SALMON ARM

SEAL:

PERMIT:

No.	BY	ENG	APR	DESCRIPTION	DATE
01	JLF	JLF	WS	ISSUED FOR INFORMATION	2024-03-25

PROJECT:

STRUCTURAL ASSESSMENT &
LIFE CYCLE ANALYSIS
MEMORIAL ARENA

LOCATION:

351 3RD STREET SOUTHWEST
SALMON ARM, BC

DRAWING NAME:

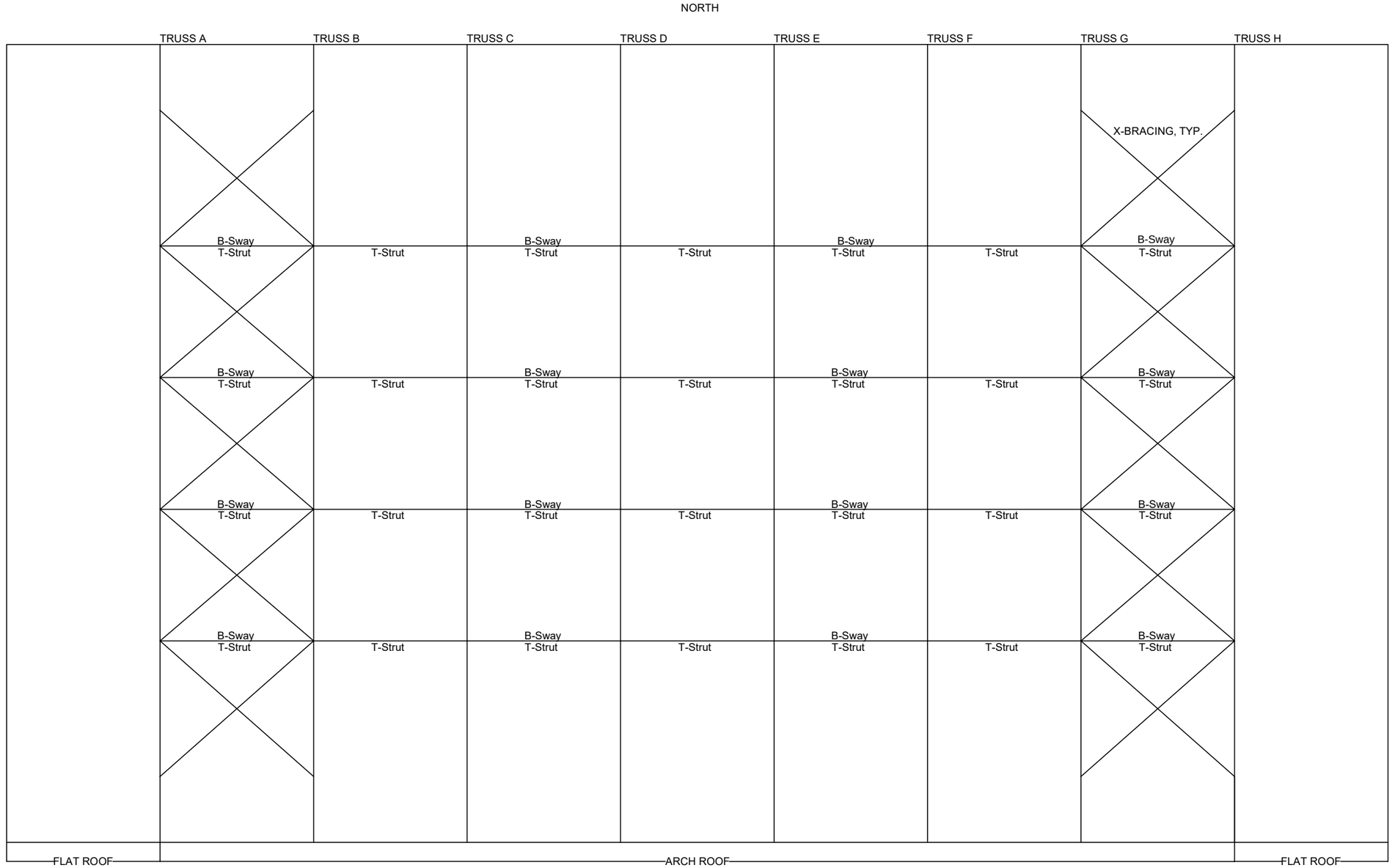
FLOOR PLAN

PROJECT NO.:

24VR-600400

DRAWING NO.:

SHT-01



ARENA ROOF PLAN

LEGEND

B-SWAY: VERTICAL SWAY BRACING
T-STRUT: TEE STRUT BRACING BETWEEN BOTTOM CHORDS
X-BRACING: CROSS BRACING BETWEEN BOTTOM CHORDS

BAR ENGINEERING
#201, 2540 - 53 Avenue Vernon, B.C. V1T 9W8

CLIENT:

CITY OF SALMON ARM

SEAL:

PERMIT:

No.	BY	ENG	APR	DESCRIPTION	DATE
01	JLF	JLF	WS	ISSUED FOR INFORMATION	2024-03-25

PROJECT:

STRUCTURAL ASSESSMENT & LIFE CYCLE ANALYSIS
MEMORIAL ARENA

LOCATION:

351 3RD STREET SOUTHWEST
SALMON ARM, BC

DRAWING NAME:

ARENA ROOF FRAMING PLAN

PROJECT NO.:

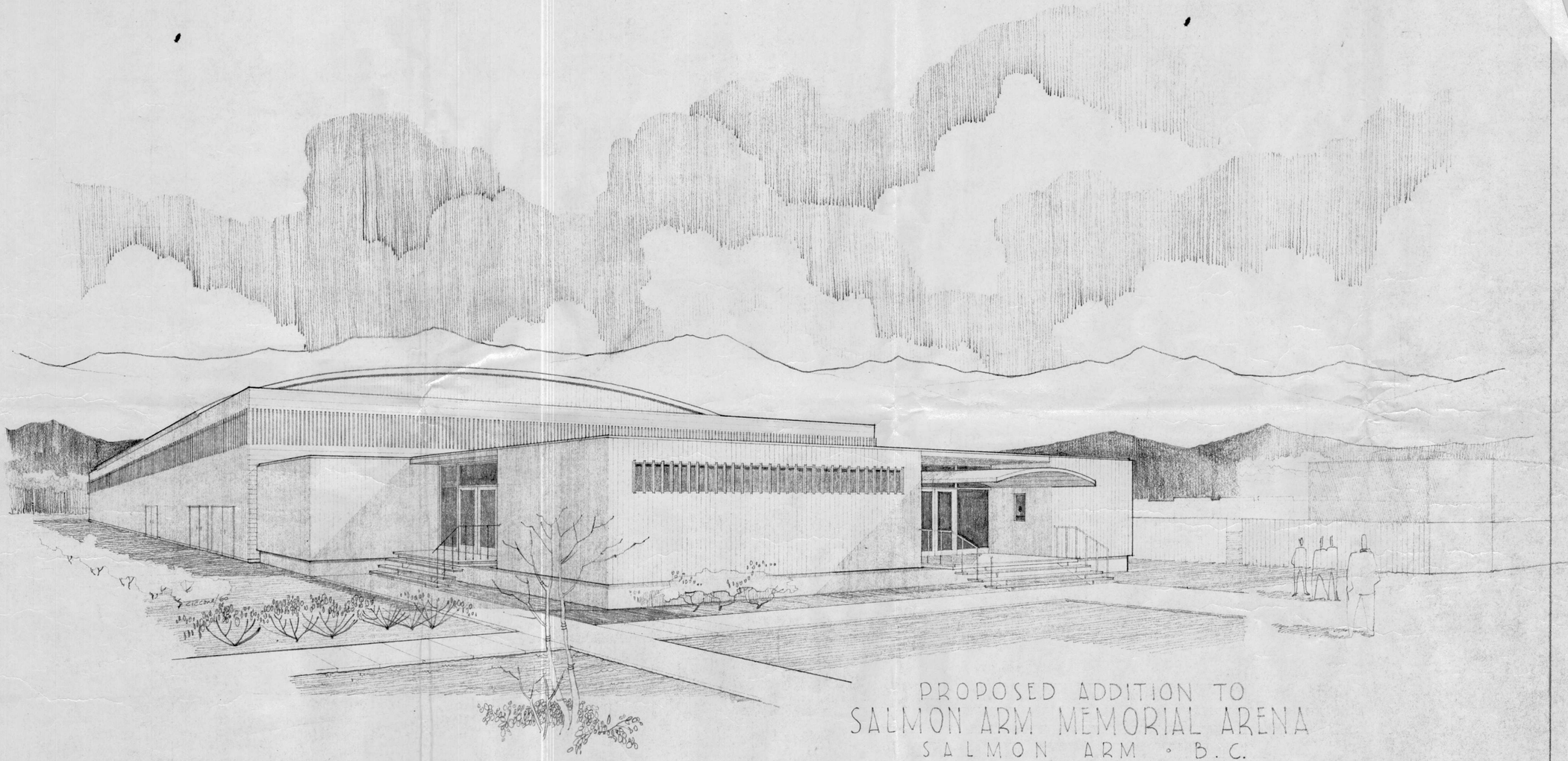
24VR-600400

DRAWING NO.:

SHT-02

APPENDIX B

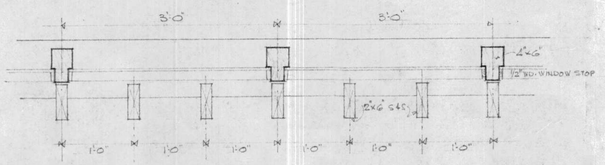
Original Construction Plans, Partial



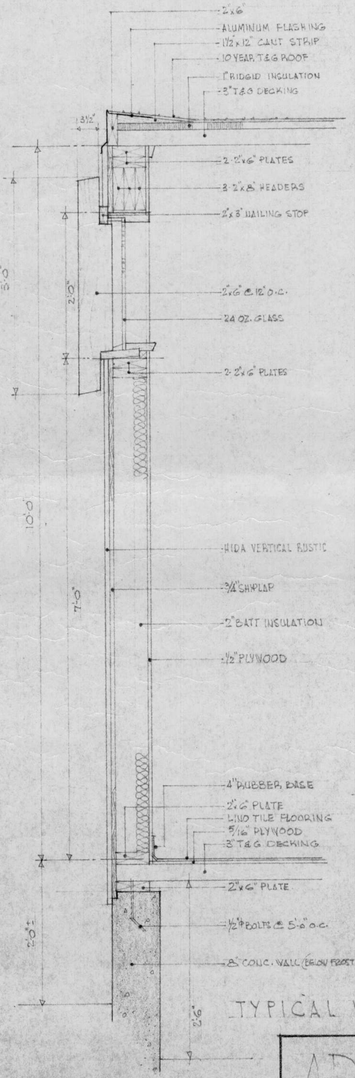
PROPOSED ADDITION TO SALMON ARM MEMORIAL ARENA

SALMON ARM • B.C.

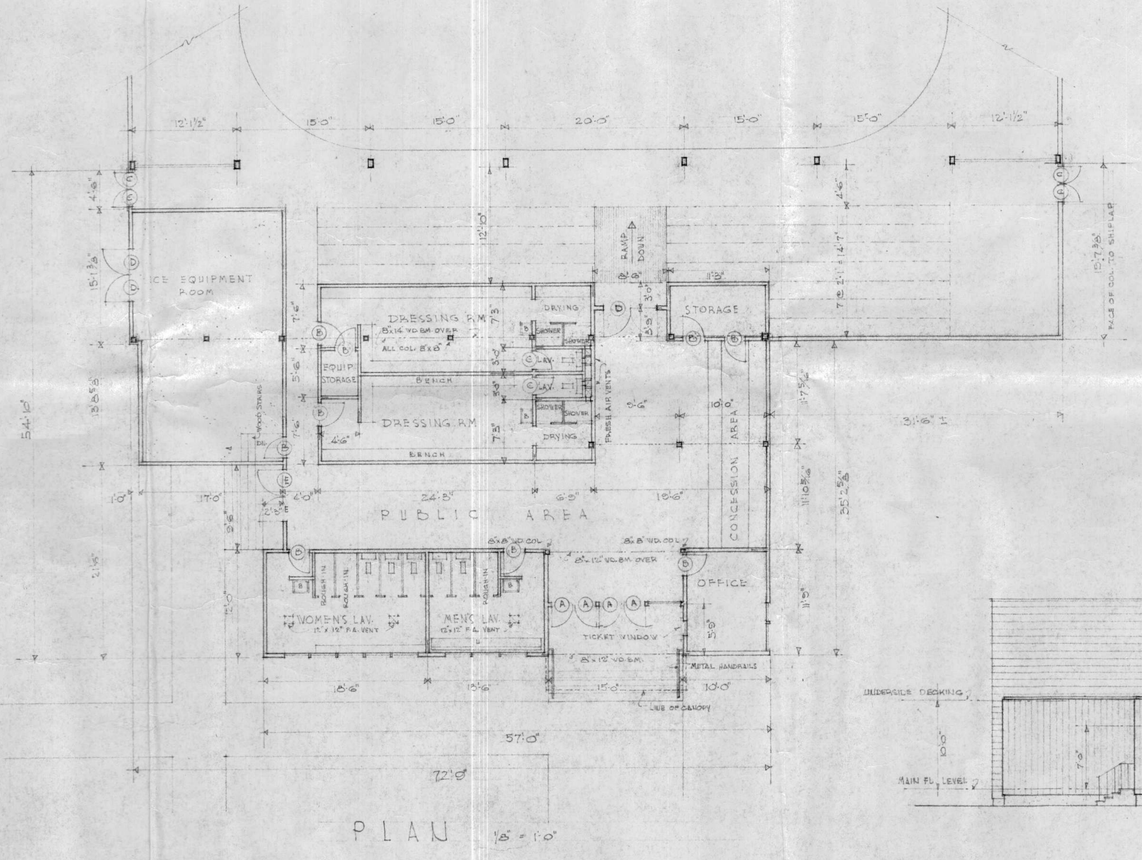
ALAN GRAY, STILWELL & LOBBAN
ARCHITECTS • VANCOUVER B.C.



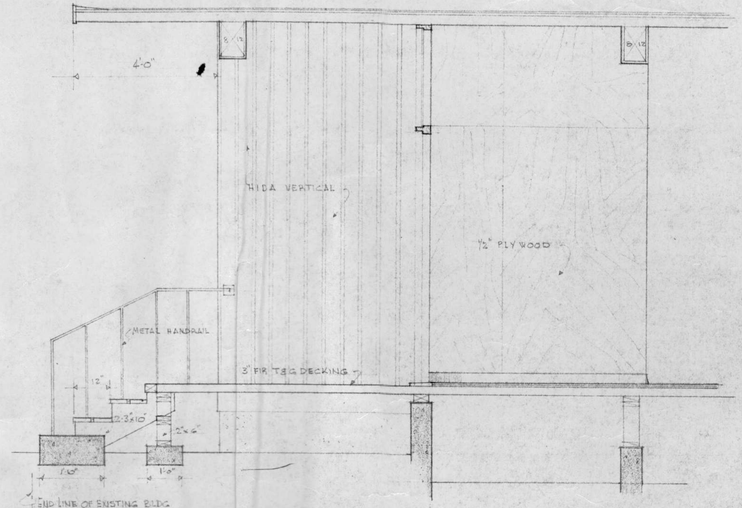
WINDOW SECTION 1"=1'-0"



TYPICAL WALL SECTION 1"=1'-0"

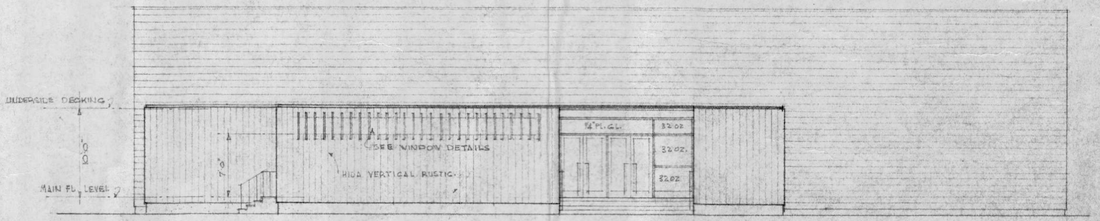


PLAN 1/8" = 1'-0"



ENTRANCE SECTION. ½"=1'-0"

SIDE ELEVATION ⅛"=1'-0"



FRONT ELEVATION ⅛"=1'-0"

ADDITION TO SALMON ARM MEMORIAL ARENA SALMON ARM B.C.

ALAN GRAY, STILWELL & LOBBAN ARCHITECTS
325 HOWE ST. VANCOUVER 1 B. C.

REVISIONS	DATE	DRAWN BY	CHECKED BY	JOB. NO.	SHT. NO
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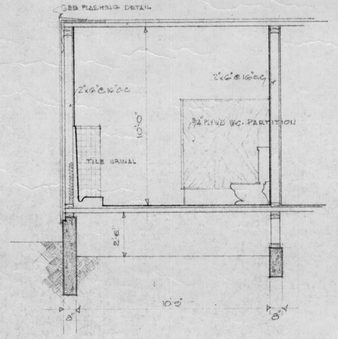
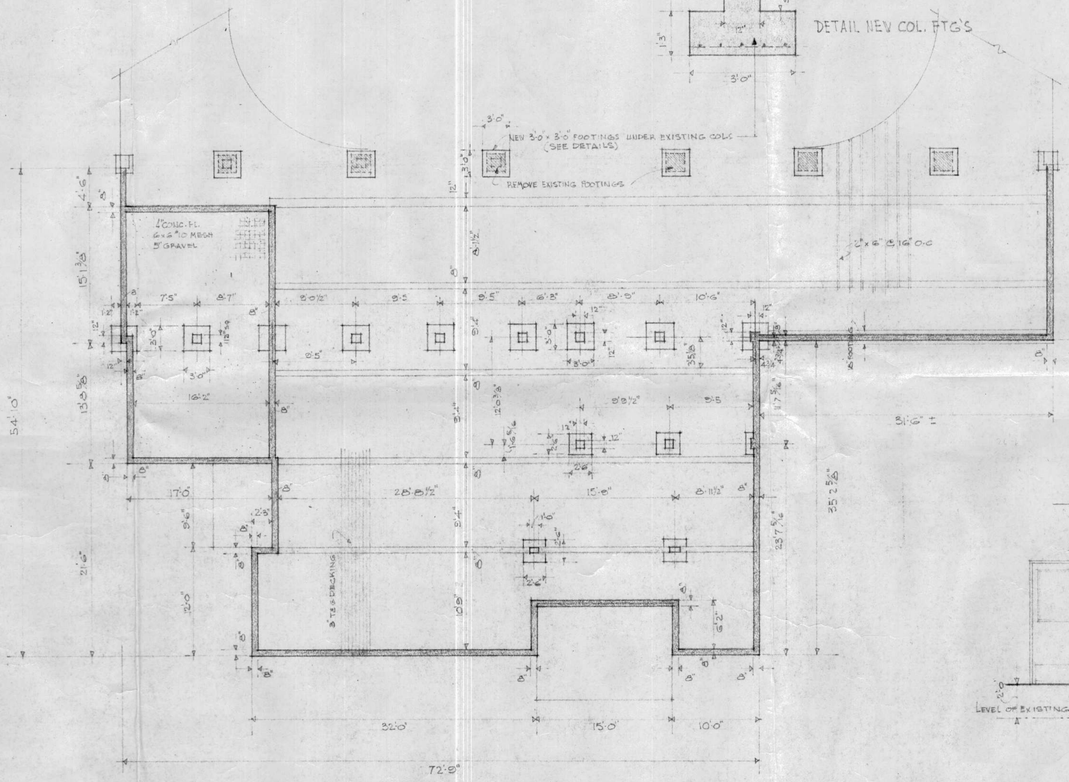
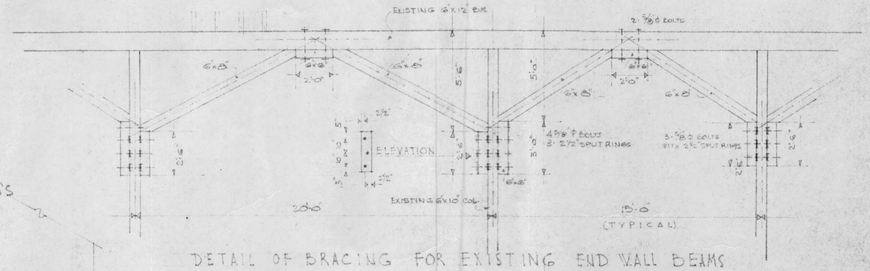
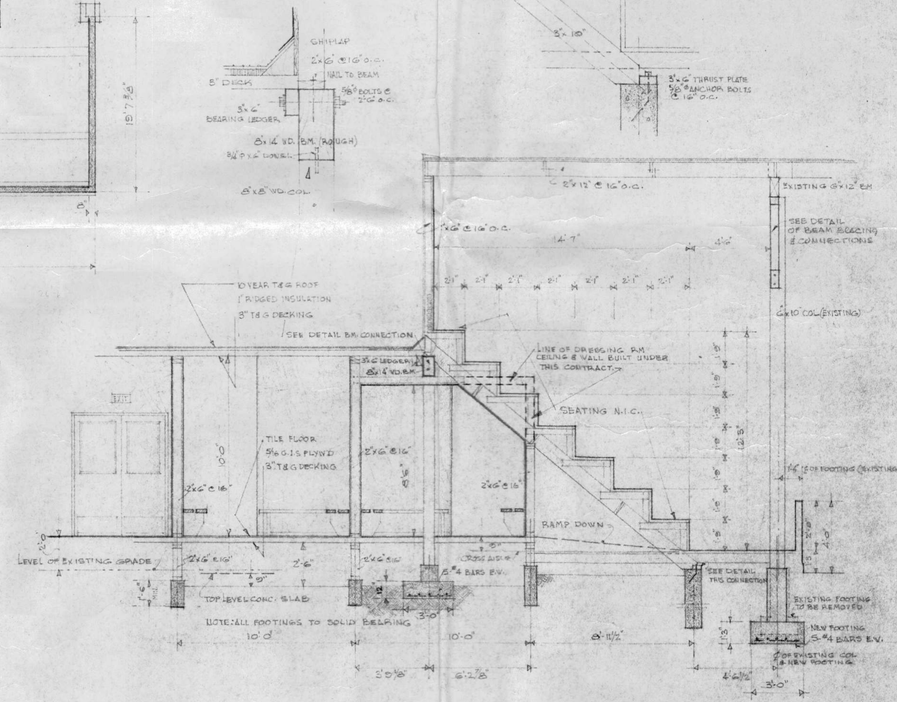




FOUNDATION PLAN 1/8" = 1'-0"



DETAIL OF BRACING FOR EXISTING END WALL BEAMS



PART CROSS SECTION 1/4" = 1'-0"

ADDITION TO SALMON ARM MEMORIAL ARENA SALMON ARM B.C.

ALAN GRAY, STILWELL & LOBBAN ARCHITECTS
325 HOWE ST. VANCOUVER 1 B. C.

REVISIONS	DATE	DRAWN BY	CHECKED BY	JOB NO	SHT. NO
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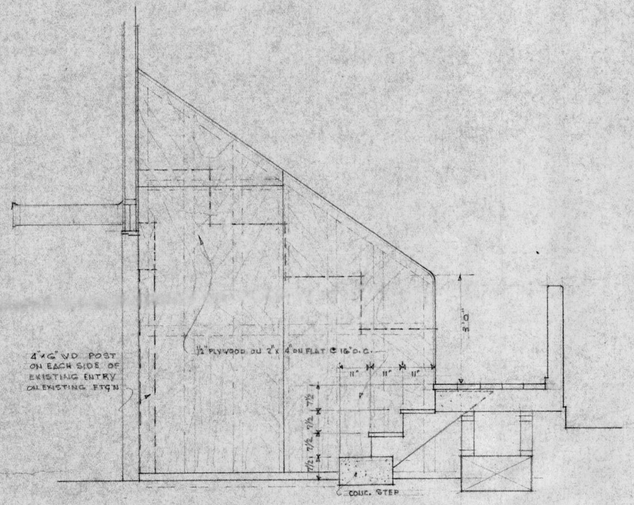

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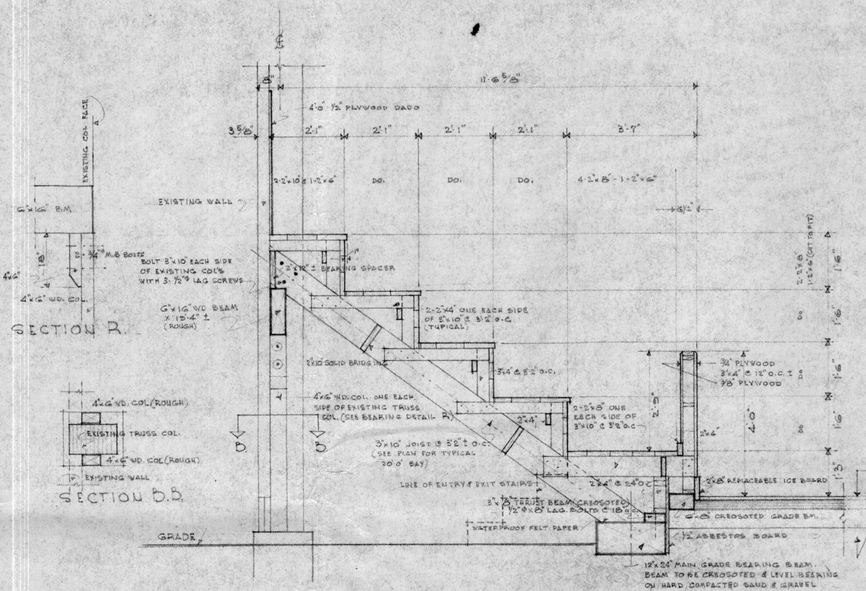
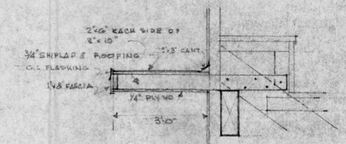


SECTION B.B.

SECTION B.B.



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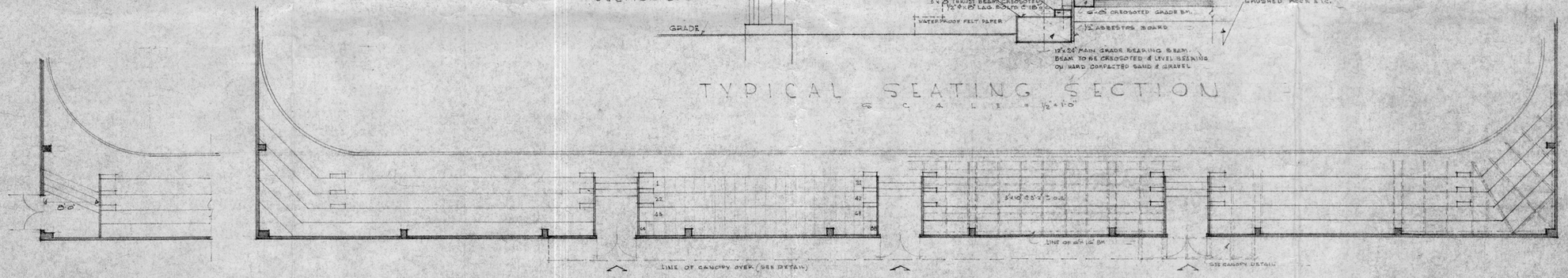

ALTERNATE ENTRY

PLAN - HALF - SEATING

TOTAL SEATING 800

SEATING PLAN SECTIONS & DETAILS

SALMON ARM MEMORIAL ARENA FOR SALMON ARM B. C.

ALAN GRAY, STILWELL & LOBBAN
ARCHITECTS
365 HOWE ST. VANCOUVER 1, B.C.

DATE	REVISIONS	JOB NO.	DATE	SHT. NO.
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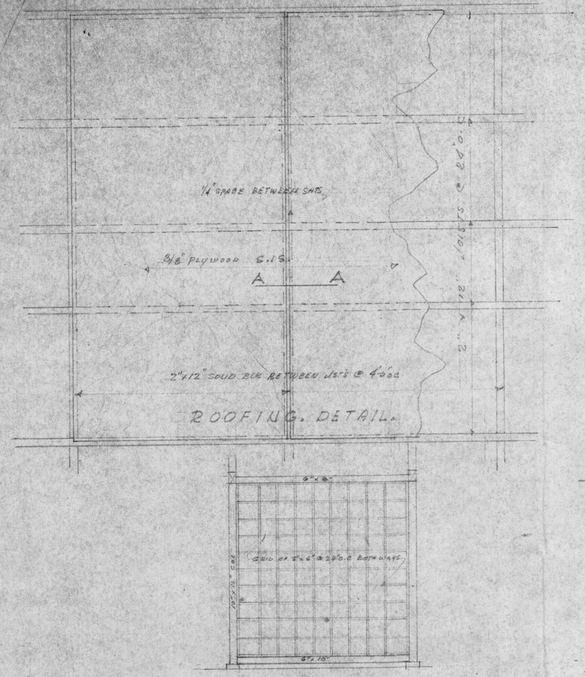
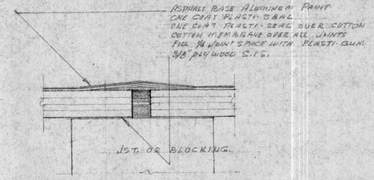
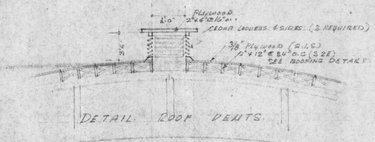


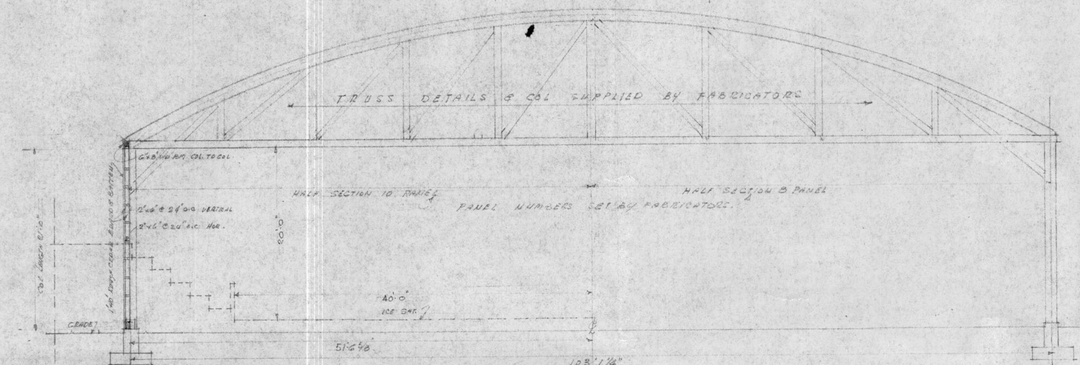
ROOFING. DETAIL.

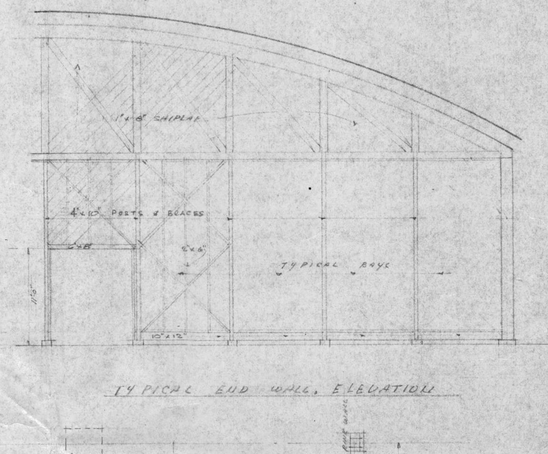


TYPICAL JOINT DETAIL ROOFING
SECTION A.A.

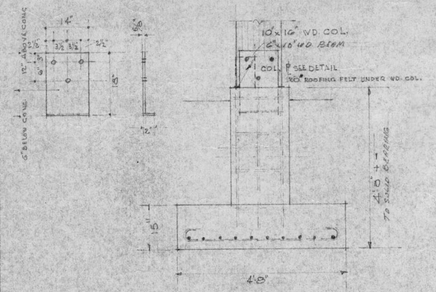


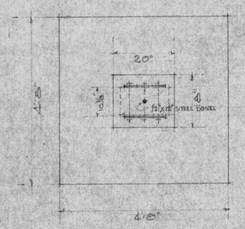
DETAIL ROOF VENTS





TYPICAL END WALL ELEVATION



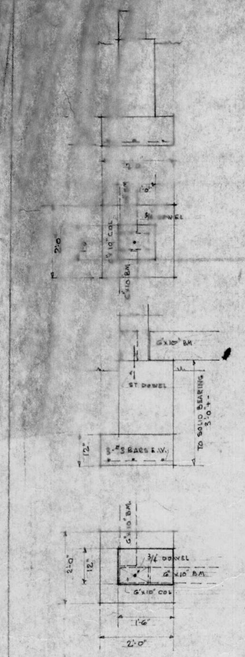


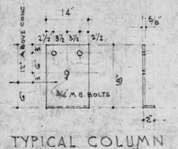
FOUNDATION SECTIONS & DETAILS

SALMON ARM MEMORIAL ARENA FOR SALMON ARM B. C.

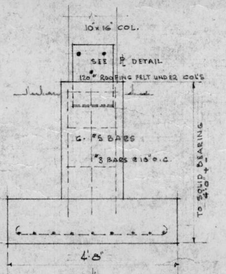
ALAN W. GRAY, M.R.A.I.C.
ARCHITECT
1401 VANCOUVER BLOCK
VANCOUVER 2, B. C.

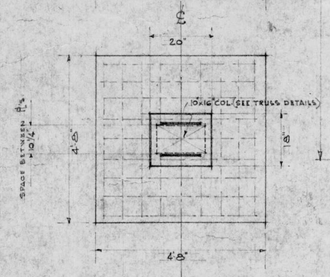
SHEET No.	JOB No.	DRAWN	DATE
1	176	N.R.S.	June 1956
	SCALE	CHECK	REVISIONS
	1/8"=1'-0"		JUNE 15/56



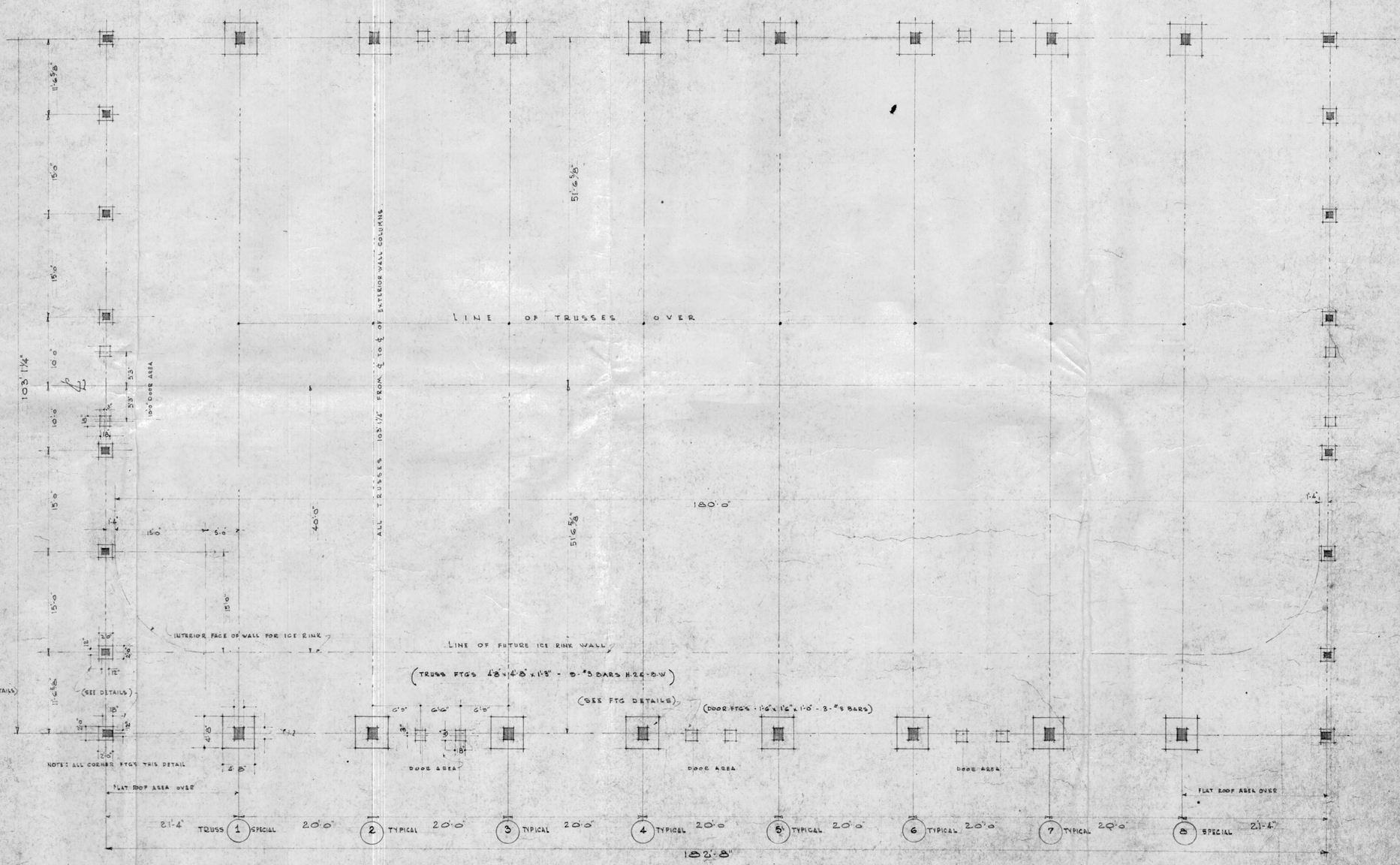


TYPICAL COLUMN CONNECTION PL.





TRUSS. FTG. DETAILS.
1/2" = 1'-0"

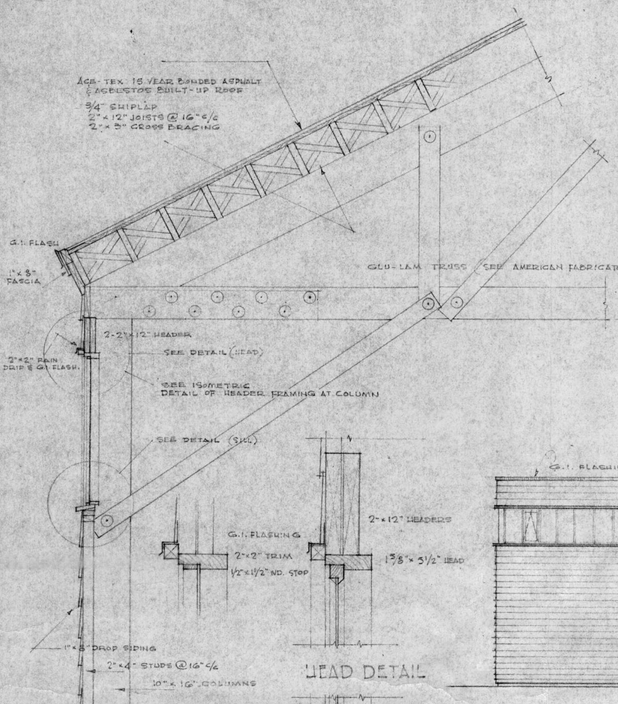


FOUNDATION. SECTIONS. & DETAILS.

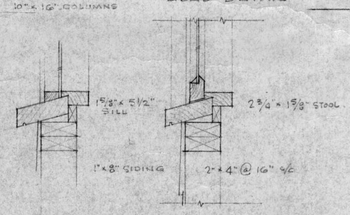
SALMON. ARM. MEMORIAL. ARENA. FOR. SALMON. ARM. B. C.

ALAN W. GRAY, M.R.A.I.C.
ARCHITECT
1401 VANCOUVER BLOCK
VANCOUVER 2 B. C.

SHEET No.	JOB No.	DRAWN	DATE
1	176	NHS	JUNE 1956
	SCALE 1/8"=1'-0"	CHECK	REVISIONS June Plans Stamped 8/2/56

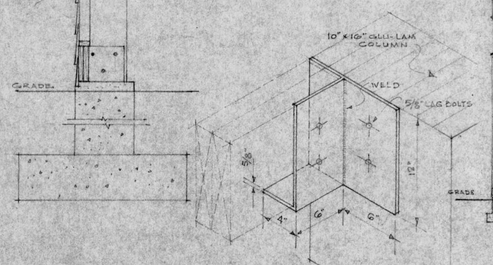


HEAD DETAIL

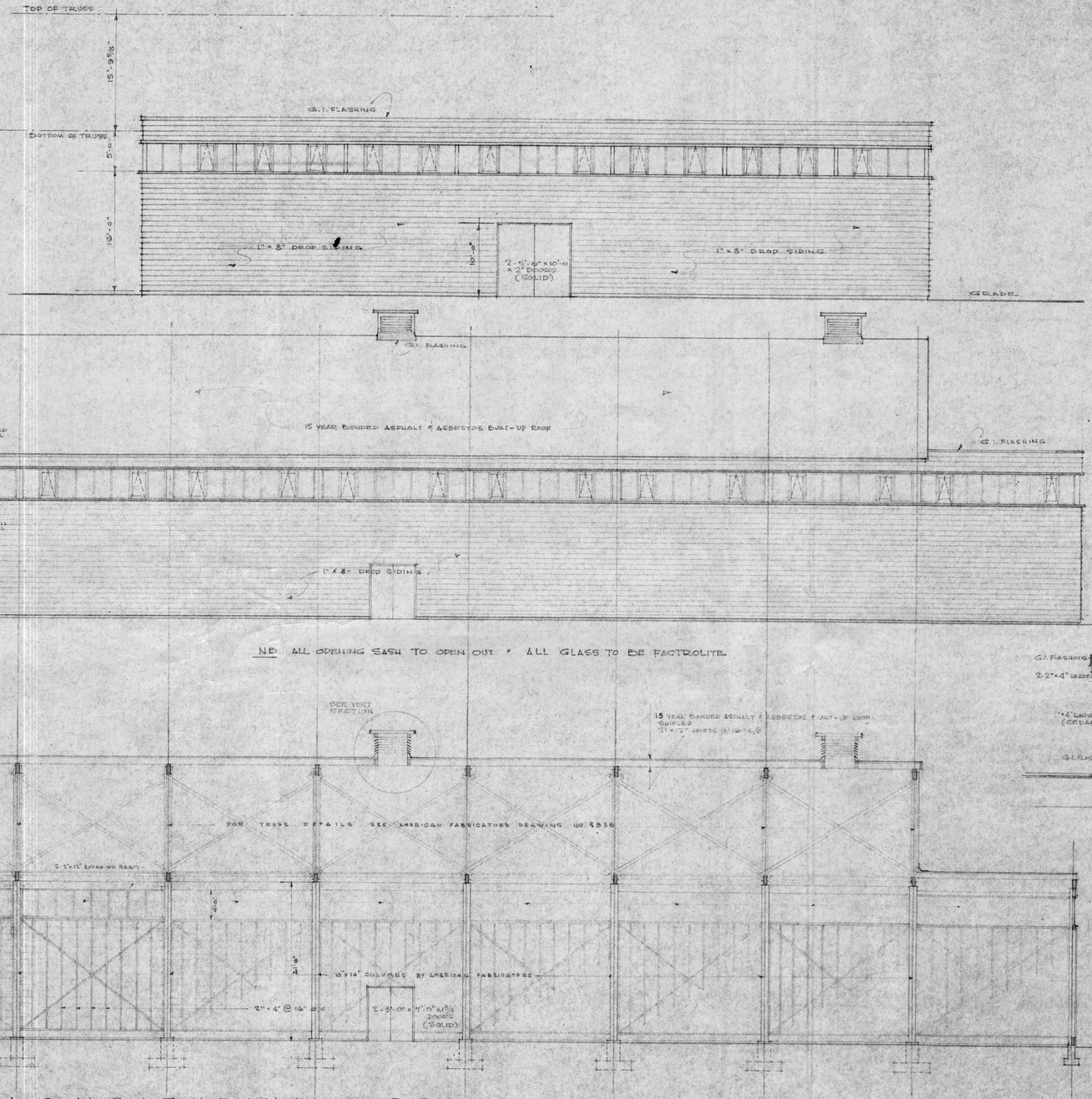


SILL DETAIL

WINDOW DETAILS
1 1/2" = 1'-0"

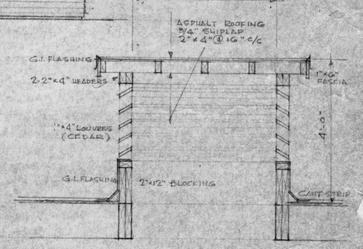


ISOMETRIC VIEW OF ST. R TO TAKE HEADERS AT COLUMN 1 1/2"=1'-0"



LONGITUDINAL SECTION

NB ALL OPENING SASH TO OPEN OUT & ALL GLASS TO BE FACTROLITE.

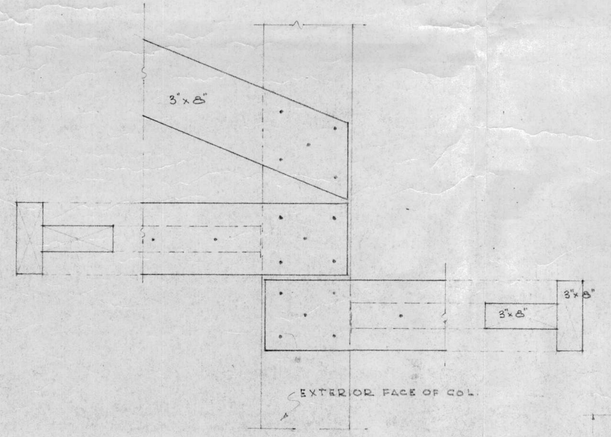


VENT SECTION
SCALE 1/2"=1'-0"

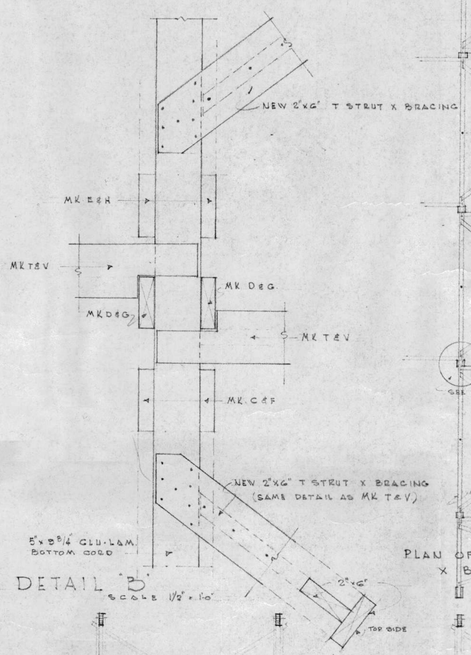
FOUNDATION · SECTIONS & DETAILS ·

SALMON ARM MEMORIAL ARENA · FOR SALMON ARM · B.C. ·

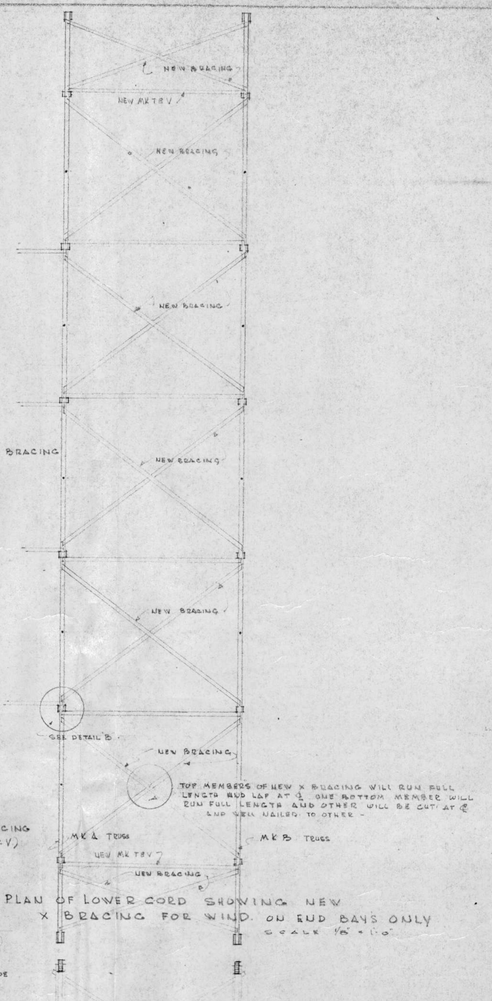
2 | 176 SHOWN | MARCH 12 1957



DETAIL "A"
SCALE 1½" = 1'-0"

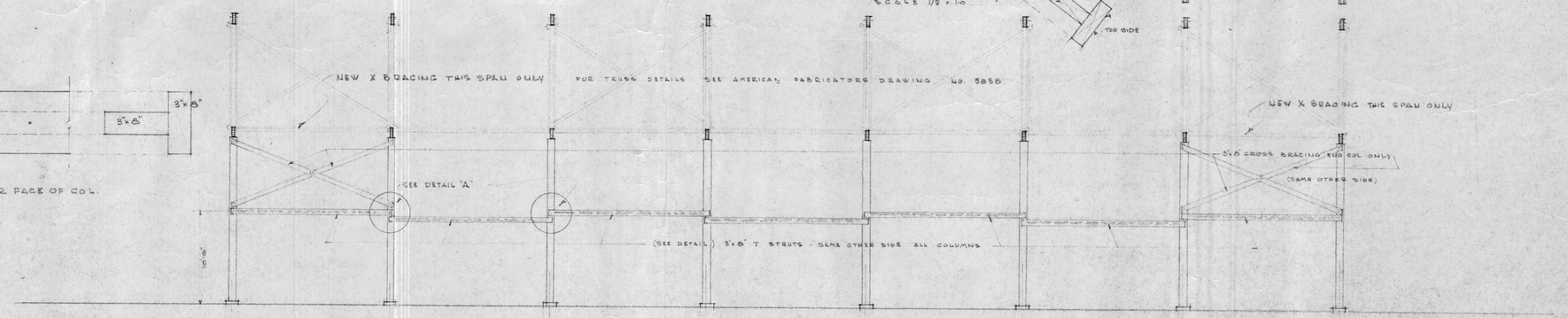


DETAIL "B"
SCALE 1½" = 1'-0"



TOP MEMBERS OF NEW X BRACING WILL RUN FULL LENGTH AND LAP AT ½. ONE BOTTOM MEMBER WILL RUN FULL LENGTH AND OTHER WILL BE CUT AT ℄ AND WELL NAILED TO OTHER.

PLAN OF LOWER CORD SHOWING NEW X BRACING FOR WIND ON END BAYS ONLY
SCALE 1/8" = 1'-0"



SIDE - ELEVATION - (SHOWING COLUMN BRACING FOR WIND)
SCALE 1/8" = 1'-0"

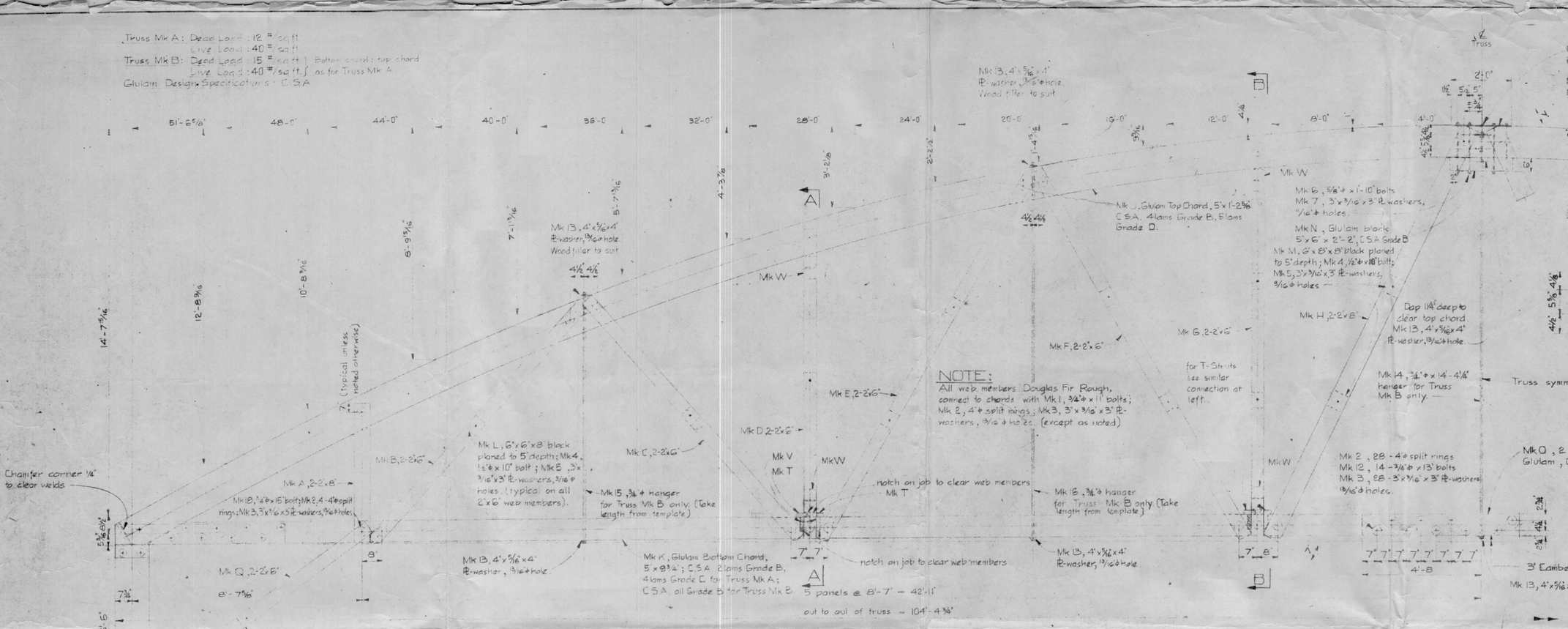
BRACING . DETAILS . COLUMNS & TRUSS.

SALMON ARM MEMORIAL ARENA . FOR SALMON ARM . B.C.

ALAN GRAY, STILWELL & LOBBAN
ARCHITECTS
325 HOWE ST. VANCOUVER 1 B.C.

DATE	REVISIONS	JOB NUMBER	DATE	SHEET
		176	APRIL 17/87	3
		DRAWN BY N.H.S	CHECKED BY	

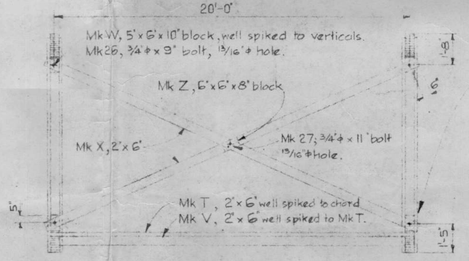
Truss Mk A: Dead Load: 12 #/sq ft
Live Load: 40 #/sq ft
Truss Mk B: Dead Load: 15 #/sq ft } Bottom chord: top chord
Live Load: 40 #/sq ft } as for Truss Mk A
Glulam Design Specifications: C.S.A.



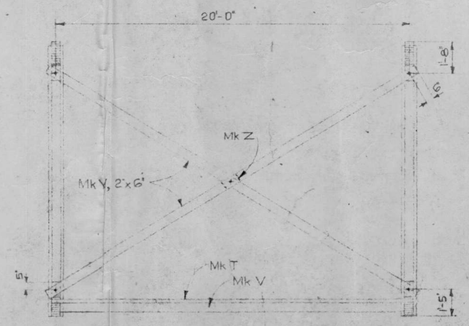
NOTE:
All web members Douglas Fir Rough, connect to chords with Mk 1, ¾"ϕ x 11" bolts; Mk 2, 4"ϕ split rings; Mk 3, 3"x3/16"x3" ℄ washers, 13/16"ϕ holes. (except as noted)

for T-Struts see similar connection at left.

6 TRUSSES MK A
2 TRUSSES MK B

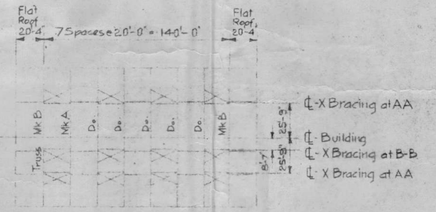


CROSS BRACING at A-A
8 THUS



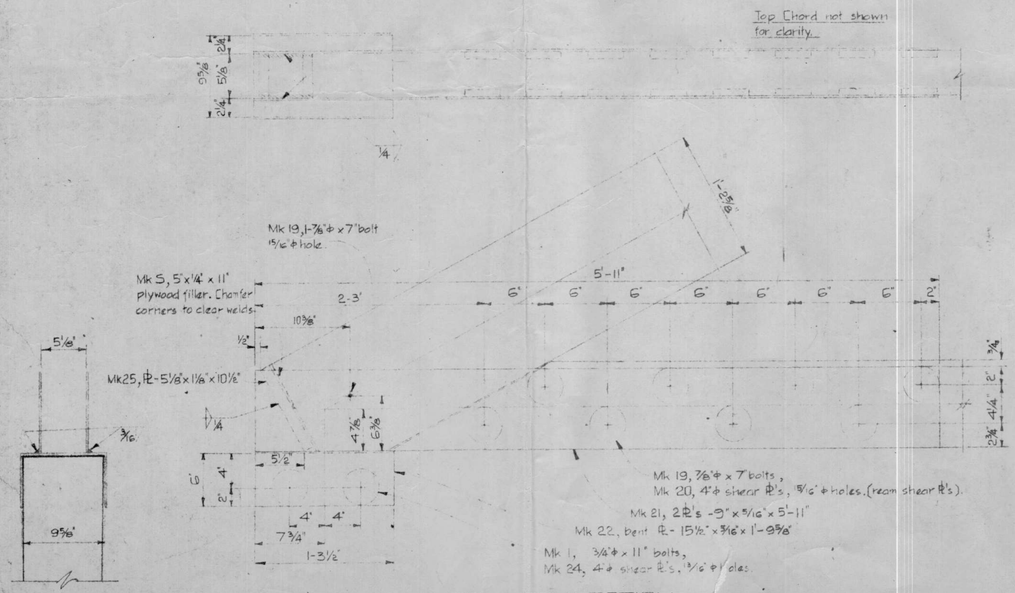
CROSS BRACING at B-B
similar to A-A except as noted.
4 THUS

Holes in ends of diagonal bracing to be drilled in field. Holes in truss verticals for diagonal bracing to be drilled in shop.



KEY PLAN

NOTES:
All bolted connections in wood to have cut washers (Mk 23, ¾"ϕ), unless noted otherwise.
All bracing to be Douglas Fir, Rough, C.S.A. Structural.
All bolts should be inspected and tightened if necessary by owner at least once per year.
Adequate lateral restraint of top chord to be provided by others; Toenailing joists is not considered adequate.
T-Struts on lower chord to extend to end walls.



HEEL CONNECTION
16 THUS

APPROVAL
Details and Dimensions correct as shown
CONTRACTOR
By
Details and Dimensions correct with noted changes
CONTRACTOR
By

THIS DRAWING IS SENT TO YOU FOR YOUR DIMENSIONAL CHECK. AMERICAN FABRICATORS LTD. WILL NOT ACCEPT LIABILITY OR BACK CHARGE FOR ANY CHANGE NOT SHOWN ON THIS PRINT.

GLULAM SPECIFICATIONS

Type of Glue	Casein
Lbr. Grade	C.S.A. close grain, as noted.
Appearance Grade	C.I.T.C. Industrial
Lamination Size	1⅜"
Wrapping	no
Sealcote	1 coat
Crating	—
End Sealer	yes
Camber	3"
Fabrication	as noted
Hardware	yes
Approved by	Date

ALL DIMENSIONS TO BE VERIFIED BY APPROVING AGENT

CHOUKALOS, WOODBURN, HOOLEY & McKENZIE LTD.
CONSULTING ENGINEERS
435 West Broadway, Vancouver 10, B.C.

AMERICAN FABRICATORS LTD.
FOOT OF BYRNE ROAD, SOUTH BURNABY DEXTER 0830

JOB NAME
SALMON ARM ARENA, Salmon Arm, B.C.

DRAWN E.W.P.	SCALE ⅛", 1½" = 1'-0"	REVISIONS	DATE
CHECKED			
APPROVED			
DATE			
ARCHITECT			
CONTRACTOR		NO.	5838

MAY 21/57

APPENDIX C

Background Documents

Arena

Lowell A. Paul, P. Eng,
R.R. 4, ARMSTRONG, BRITISH COLUMBIA, CANADA
VOE 1BO (604) 546-3422

January 13, 1984

3203 - 0351

District of Salmon Arm
Box 40
Salmon Arm, B.C.
VOE 2TO

Attention: Gary Spence

Re: Salmon Arm Centennial Arena

Gentlemen,

On December 13, 1983 we performed the first of two inspections recommended to you in our letter of December 5, 1983.

Because of time restrictions just two of the large roof trusses were examined and these appeared to be in good condition. We examined as much of the roof structure as time and equipment allowed and could find no signs of failure.

The columns and building were examined at ground level and the observations are contained in the attached report from Gordon Wilson Associates Inc. It was also reported by Mr. Wilson that there were some loose boards and debris under the grand stands that should be cleaned up as these will probably rot and could infect the structure.

Measurements were taken of the truss and truss members for further analysis of the structure. Subsequently the original drawings of the truss were located and the measured dimensions were compared. The original truss called for 3" of camber and our measurement indicated a camber of $2\frac{1}{4}$". This would indicate that the settlement within the truss itself is practically nil as some loss of camber would be expected with the addition of the weight of the roof purlins and sheathing.

The roof system adjacent to each end of the arched roof consists of 2 X 12 joists spanning the twenty feet. This portion of the roof is within the shadow of the arches and the code recommends that the roof should be designed to support the loads imposed by snow drifting up against the "gable" end of

the arch section. Our calculations indicate that this portion of the roof is no longer in compliance with the snow loading recommended for this area. The system is satisfactory for a uniform load of 47 psf as recommended for flat roofs in this area. This indicates that the snow should not be allowed to remain in drifts on this portion of the roof.

The large bow-string arch trusses were designed for a dead load (the weight of the structure itself) of 12 psf and a snow load of 40 psf. The 12 psf appears to be correct whereas the presently recommended snow load is 47 psf. The trusses would appear to be overloaded if the recommended snow loads were imposed on them. These trusses were designed by the consulting engineering firm of Choukalos, Woodburn, Hooley & McKenzie Ltd. of Vancouver in 1957. It is our understanding that this firm is still in business and could possibly be of assistance in providing recommendations as to whether upgrading of the trusses is adviseable at this time.

A note in the original truss drawings indicates that the "bolts should be inspected and tightened if necessary by owner at least once per year".

It is therefore recommended that:

1. The consulting firm of Choukalos, Woodburn, Hooley & McKenzie Ltd. be contacted and asked for an estimate of the cost to review this original design and make recommendations as to possibly upgrading the trusses.
2. Do not allow snow to accumulate in unusually high amounts on any portion of the roof (arch or flat).
3. Perform a thorough inspection of every truss and every connection after the ice is out of the arena and we are able to reach all these points from ladders or portable scaffolds.
4. Perform an inspection of the foundation and excavate if necessary to expose questionable areas of the foundation.
5. Repair and protect present areas where the siding and columns are decomposing.
6. Remove any boards or debris that are in contact with the soil.

With your permission we would be pleased to contact the firm of Choukalos, Woodburn, Hooley & McKenzie and discuss our observations of the trusses and solicit their assistance and recommendations in upgrading the trusses so that they comply with the present building code.

Very truly yours,

Lowell A. Paul

Lowell A. Paul, P. Eng.

Enclosure

MEMO

TO: Wayne Buchanan, Administration

FROM: Gordon Isaac, Building Department

DATE: April 19, 1994

SUBJECT: Review of Ice Arena at 351 - 3 Street SW
Legal: Lot 1, Plan 45452, Section 14-20-10

Property file

As requested, the site review of this premise has been completed with respect to the following items (with comment):

1. Structural Soundness:

Past years have required structural maintenance along with major repairs of load bearing (roof columns) framing members. Interior columns continue to experience frost heave damage and moisture migration into untreated wood causing wood decay.

Several major (exterior) wall columns supporting main roof girder trusses have indicated interior wood decay as noted in a bore test at several inches above the column base. Further testing by a structural engineer for all columns is recommended to determine life expectancy prior to replacement of the column bases.

A structural report of Jan. 13/84 from Mr. Lowell Paul, P.Eng. is attached indicating arch roof trusses were designed for a live snow loading criteria of that period for 40 lbs./sq.ft. The Canadian Climate Centre of Environment Canada has recently upgraded the G.S.L. to 70 lbs./sq.ft. for a required live snow load design of 56 lbs./sq.ft. The roof systems, flat and arch, must be monitored to prevent excessive live snow loads occurring (snow clearing required). The roof(s) are no longer in compliance with the snow loading recommended for this area.

The "curtain walls" located between exterior wood (roof) columns are also in need of repair at the base sill beam due to wood decay. This item is not considered of immediate concern.

Several public walkway access areas are in need of immediate replacement due to wood decay.

Guard rails between ice surface and bleachers and walkways are experiencing considerable frost heave at inspection time. The framing members are of untreated wood and subject to continuous wetting. The maintenance problem with replacement of the guard rail is known to be continuous and because of original design, cannot be corrected without major expense. The bleacher system ties into and supports the guard rail system. Behind the bleacher, inspection showed wood decay to base wood frame members and 2" of frost heave off the concrete slab (ice level).

The exterior wall siding has been installed without wall sheathing paper and correct base flashings, permitting extensive wetting of structural framing members. A high humidity condition was noted within the space(s) between exterior walls and bleacher system due to bare, moist ground exposure and no ventilation. Attempts to control "drafts" from exterior walls into the bleachers has created a new moisture problem not readily solved resulting in the humidity buildup.

. . . 2

2. Life Safety Considerations:

(a) "Storage area" needs have been located under bleachers without required fire rated separation between seats and storage space.

(b) Interior stairs serving bleachers storage rooms and office rooms do not meet Building Code standards for rise, run and graspable handrail requirements of a public (A-2) premise.

(c) "Exiting" requirements have been upgraded in recent years with required compromise to facilitate a minimal acceptable standard for the "use" of an ice arena. As an exhibition building utilizing the ice surface floor area, the existing exits dictate the allowable occupant load permitted.

(d) "Exits" from north building face lead somewhat hazardously into a side street, 3rd Ave. SW (without boulevard and sidewalk).

3. Energy Efficiency:

There is little insulation value to be credited to this premise for the purpose of insulating against summer hear or for those heated rooms in the winter months serving lobby, washrooms, office spaces and dressing rooms, in particular.

4. Building Requirements for Persons With Disabilities:

This premise is not designed for viewing, changeroom and washroom use by persons with a wheelchair, and difficult for use by persons with hand and/or leg disabilities.

5. Other Items:

Parking requirements are minimal and create considerable congestion in the immediate area and, in particular, winter months lessen available spaces which must be derived from adjacent private commercial property and undeveloped boulevards of streets.

Find attached "history" memo of Mr. Lyle Parlour (July 15/91) as further information; also attached, inspection review of Mr. Lowell Paul, P.Eng.

Gordon R. Isaac

GRI/ha

Attach.

memos.gri

Golder Associates Ltd.

243-1889 Springfield Road
Kelowna, B.C., Canada V1Y 5V5
Telephone (604) 860-8424
Fax (604) 860-9874

REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED R.C.M.P. BUILDING
NORTH OF 5TH AVENUE, S.W.

SALMON ARM, BRITISH COLUMBIA

Submitted to:
British Columbia Buildings Corporation
No. 300- 1475 Ellis Street
Kelowna, B.C. V1Y 2A3

DISTRIBUTION:

4 copies -	British Columbia Buildings Corporation Kelowna, B.C.
2 copies -	Golder Associates Ltd. Kelowna, B.C.

September 17, 1996

962-4190

Golder Associates Ltd.

243-1889 Springfield Road
Kelowna, BC., Canada V1Y 5V5
Telephone (604) 860-8424
Fax (604) 860-9874

Golder Associates

September 17, 1996 Our Ref: 962-4190

British Columbia Buildings Corporation
No. 300 - 1475 Ellis Street
Kelowna, British Columbia
V1Y 2A3

ATTENTION: Mr. M. Jereb

RE: GEOTECHNICAL INVESTIGATION
PROPOSED R.C.M.P. BUILDING,
NORTH OF 5TH AVENUE, S.W.
SALMON ARM, BRITISH COLUMBIA

Dear Sir:

As requested, Golder Associates Ltd. have completed a geotechnical investigation at the above referenced site. The purpose of the work has been to determine the subsurface soil and groundwater conditions at the site of the proposed R.C.M.P. building, and based on our interpretation of this information to provide geotechnical comments and recommendations regarding construction of the proposed facility.

The field work for the current investigation was completed on August 29, 1996, during which time a total of three shallow augerholes were drilled around the proposed building footprint, as shown on Figure 1, in Appendix "A". The augerholes were advanced to depths of about 6 m using a truck mounted drill rig and hollow stem augers. Standpipe piezometers were installed at each augerhole location to permit monitoring of ground water levels. The stratigraphy at each augerhole was recorded in the field by a member of our geotechnical staff. Representative samples of the various soil deposits were recovered and returned to our Kelowna laboratory for further examination and testing. Laboratory testing has consisted of Atterberg limit testing together with moisture content determinations. The results of the drilling and laboratory testing are summarized on the Record of Borehole sheets and Plasticity Chart (Figure 2), in Appendix "A".

A previous investigation was carried out by Golder Associates in March 1996, as summarized in a report dated August 14, 1996 (our reference 962-4042). This investigation was carried out at an initially proposed building site located in the fair grounds across 5th Avenue, south of the present site. The previous investigation included one borehole to a depth of 25.9 m and four augerholes to depths of 4.6 m at the approximate locations shown

on Figure 3, in Appendix "B". Copies of the previous borehole logs are attached in Appendix "B" for your reference.

1.0 PROPOSED DEVELOPMENT

It is understood that the proposed R.C.M.P. building will consist of a single storey at grade structure covering a footprint of about 1000 m^2. The proposed site is typically low lying and may be subject to seasonal flooding. It is expected that the overall site grade may be raised to a level slightly higher than the existing adjacent streets. Details of the magnitude and layout of design loads were previously provided by MSS Engineering in conjunction with our original investigation as carried out in March 1996.

2.0 SITE CONDITIONS

2.1 Surface Conditions

The site of the proposed development is generally flat-lying with a paved parking area to the west, horse barns to the southwest, and an ice arena to the northeast. The area is generally low lying relative to the existing adjacent street grades, resulting in limited surface drainage. Observations indicate that the site is up to about 1 m lower in grade than 5th Avenue SW.

2.2 Subsurface Conditions

Detailed descriptions of the soil conditions observed in the augerholes are provided on the attached Record of Borehole summary sheets. A brief description of the observed subsurface conditions is presented below.

The site is surfaced by a thin root mat which overlies a firm desiccated clayey silt deposit with occasional root fibres that varies in thickness from 0.6 to 1.2 m at the borehole locations. Some evidence of desiccation was noted to extend up to a depth of about 1.7 m at AH 1. Underlying the firm clayey silt deposit, the soil conditions typically consist of a very soft to soft silty clay with occasional thin sand seams or lenses. A 10 and 12 cm. thick sand layer was encountered overlying the soft silty clay deposit at AH 1 and AH 2, respectively. These silty clay deposits extend to depths of 2.4 to 3.3 m, at the borehole locations, and are underlain by an interlayered sequence of very loose silt, soft to very soft clayey silt and very loose silt with a trace to some clay. Each of the current auger holes were terminated in this interlayered sequence at a depth of 5.94 m below the existing ground surface.

The results of the laboratory testing indicate that moisture contents in the upper very soft silty clay deposit varies from about 41.6 to 62.3 percent, averaging 53.5 percent at the

sample locations. Moisture content determinations for the underlying interlayered sequence varied between 31.9 and 47.5 percent, averaging 41.6 percent.

2.3 Ground Water Conditions

Groundwater levels measured on September 3, 1996, ranged from about 0.85 to 3.8 m below ground surface at the borehole locations. However, at the time of the field investigation, the groundwater level at each augerhole was estimated to be at about 1.4 m below existing ground surface. Based on these observations, it is probable that the groundwater levels had not yet stabilized after installation of the standpipe piezometers. It is further expected that variations in the groundwater table will occur on a seasonal basis and following periods of extended precipitation.

3.0 DISCUSSION

Based on the results of the geotechnical investigation, construction of the proposed development is considered feasible. The following presents our comments on preparation of the site together with details of foundation recommendations for use in development of the proposed structure.

3.1 Site Preparation

Based on the results of the investigation, it is recommended that prior to development all surficial organic soils and any existing fill materials be completely subexcavated from within the plan area of the proposed structure and parking areas. Further to the foregoing, it is recommended that additional subexcavation be undertaken to permit minimum thickness of granular fill as follows:

- 1.0 m below proposed footings and slabs-on-grade,
- 0.5 m below proposed parking areas and roadways

It is recommended that the base of subexcavations be inspected by a geotechnical engineer, prior to the placement of granular fills. Where areas of very soft or saturated deposits are encountered at the base of subexcavations, further excavation, or a non-woven geotextile separator may be required to permit compaction of proposed granular fills. The base of proposed subcuts should be graded and drained to prevent ponding of water.

3.2 Grade Fills

The current observations together with the results of the previous investigation indicate that the groundwater table is relatively shallow and that it may rise to near ground surface following spring runoff or periods of high precipitation. Further to the foregoing, it is

expected that site grading plans will require up to about 1.0 m of fill to raise site grades above that of the adjacent roads so as to limit potential concerns relative to long term flooding. Considering the nature of subsurface deposits at the site, the placement of fill to levels in excess of the existing ground surface will result in some settlement of the underlying very soft to soft compressible silt and clay deposits.

Fill material used within proposed subcuts and to bring the site to design grade, should consist of well graded 200 mm minus sand and gravel, having less than 8 percent passing the US No. 200 Standard sieve. It is recommended that the maximum gravel size be reduced to 75 mm, within 200 mm of the underside of proposed pavement structures and base courses for concrete slabs.

All granular fill should be placed and compacted in horizontal lifts not exceeding 300 mm in thickness. Granular fill placed within the upper 1.0 m beneath footings and floor slabs and within 0.5 m below pavement areas should be compacted to a minimum of 100 percent of Standard Proctor maximum dry density (ASTM D698). All fill placed outside of the proposed building and asphalt pavement areas may consist of native materials compacted to about 95 percent Standard Proctor maximum dry density. It is recommended that compaction testing be undertaken relative to all structural fills during construction.

3.3 Foundation Design - General

Based on a review of the current and previous geotechnical information, a significant thickness of very soft/soft and loose lacustrine deposits exists at the site. It is our opinion that construction of the proposed building over these soil conditions without prefoundation treatment will result in unacceptable total and differential settlements. In order to reduce post construction settlements due to compression or consolidation of the underlying deposits, it is recommended that the building site be preloaded. As an alternate to preloading, pile foundations could be considered, however, this approach is not expected to be economic, and additional field work would be required to further define the consistency of the deep underlying deposits.

3.3.1 Preload Fill

Design height requirements for the preload fill will depend on selected floor slab elevations, and on the desired timing for start of construction. For preliminary design, it is expected that the preload may have to be about 4.0 m above the design floor slab level within the proposed building area. The crest of the preload fill should extend not less than 2 m outside the limits of the proposed structure. Preloading to grades in excess of the design levels in the parking area and in areas within 10 m of the proposed structure are not considered necessary provided that final grade fills are established in theses areas at the same time as the building preload fill.

Considering the nature of the very soft silt and clay deposits at the site, preliminary estimates based on our experience and on the previous laboratory consolidation testing indicate that preload fills may be required for a period of about 3 to 6 months prior to construction. The design preload duration depends on the weight of the applied preload relative to the design loads and is controlled by the consolidation characteristics of the underlying soil deposits. Details of the proposed site grade would be required to permit more detailed assessment of the required preload height and duration. Grade settlements under the influence of preloads should be monitored subsequent to placement. The actual minimum preload duration required should be determined by an analysis of time/settlement relationships obtained from monitoring of the settlement gauges installed in the preload fill.

Subsequent to the preload fill induced settlements, an additional thickness of structural fill will likely be required to facilitate the proposed design elevations. It is recommended that the granular fills be initially constructed to the design grades required for base of underslab gravel courses. Subsequent to the removal of the preload fill, the upper surface of the granular fills should be recompacted to 100 percent of Standard Proctor maximum dry density and additional granular fill should be placed and compacted as required to reestablish the proposed design grades.

3.3.2 Strip and Pad Footings

Where the proposed structure is designed on the basis of conventional strip or pad footings, footings should be located not less than 0.75 m below proposed final grades, and should be underlain by not less than 1.0 m of structural fill placed and compacted in accordance with Section 3.2. To facilitate the compaction of the granular fill materials proposed for the base of the footing trenches, it may be necessary to place a non-woven geotextile filter fabric prior to the placement of the initial lift. Further assessment of this procedure can be reviewed during construction. Subexcavated footing trenches should have a minimum width equal to three times the design footing width. Upon the completion of preloading and granular fills as noted above, the allowable bearing pressure for the design of strip and pad footings may be taken as 95 kPa.

3.4 Earthquake Assessment

The proposed site is considered to be located within Seismic Zone 1 of the current B.C. Building Code (1992), one of the lower risk zones. Based on the results of the investigation, it is recommended that foundations be designed using a foundation factor, F, of 2.0 considering that the site is underlain by extensive deposits of soft to firm clayey silt to silty clay.

The 1992 Canadian Foundation Engineering Manual and the supplement to the 1990 National Building Code recommend a design peak ground acceleration for the area of the

proposed site of about 0.05 times the acceleration of gravity. This value is based on a 10 percent probability of exceedance in fifty years (or a 1 in 475 year return period).

3.5 Parking Areas and Slabs-on-Grade

It is recommended that grade supported floor slabs be founded on an underslab base course consisting of at least 100 mm of 19 mm minus crushed sand and gravel, which should in turn be underlain by at least 500 mm of 75 mm minus pitrun gravel. These materials should be compacted to 100 percent of Standard Proctor maximum dry density (ASTM D698). Slabs-on-grade should be structurally separate from all foundation elements and should include a cross joint system to control post construction cracking.

3.6 Site Drainage

The groundwater table is located at shallow depth below existing ground surface and accordingly ground disposal of storm water will not be feasible at the site. Surface water should be collected and disposed of in an approved manner. It is recommended that the asphalt pavement surface be constructed so as to produce a slope of not less than 0.5 percent grading away from the proposed structure. Where soft landscaping occurs adjacent to foundation walls, a minimum ground surface grade of 2 percent draining away from the structure is recommended.

It is suggested that the grade of the floor slab of proposed structure be located not closer than 0.3 m above the maximum groundwater levels for the site. Perimeter foundation drains are not expected to be necessary provided that the foundations are constructed on clean granular fill above the water table.

3.7 Inspection and Testing

It is recommended that a geotechnical engineer inspect the subgrade soil conditions prior to footing construction, utility construction, and/or granular placement for asphalt paving, footings, or floor slabs. Insitu density testing should be carried out to ensure that proper compaction of granular materials has been achieved. Settlement of preload fills should be monitored on a regular basis to permit confirmation of preload duration.

We trust the information presented in this letter meets your current requirements. Should you have any questions or concerns, please do not hesitate to contact one of the undersigned.

Yours very truly,
GOLDER ASSOCIATES LTD.

Tom Sabourin, P.Eng.

B. Carlsen, P. Eng.

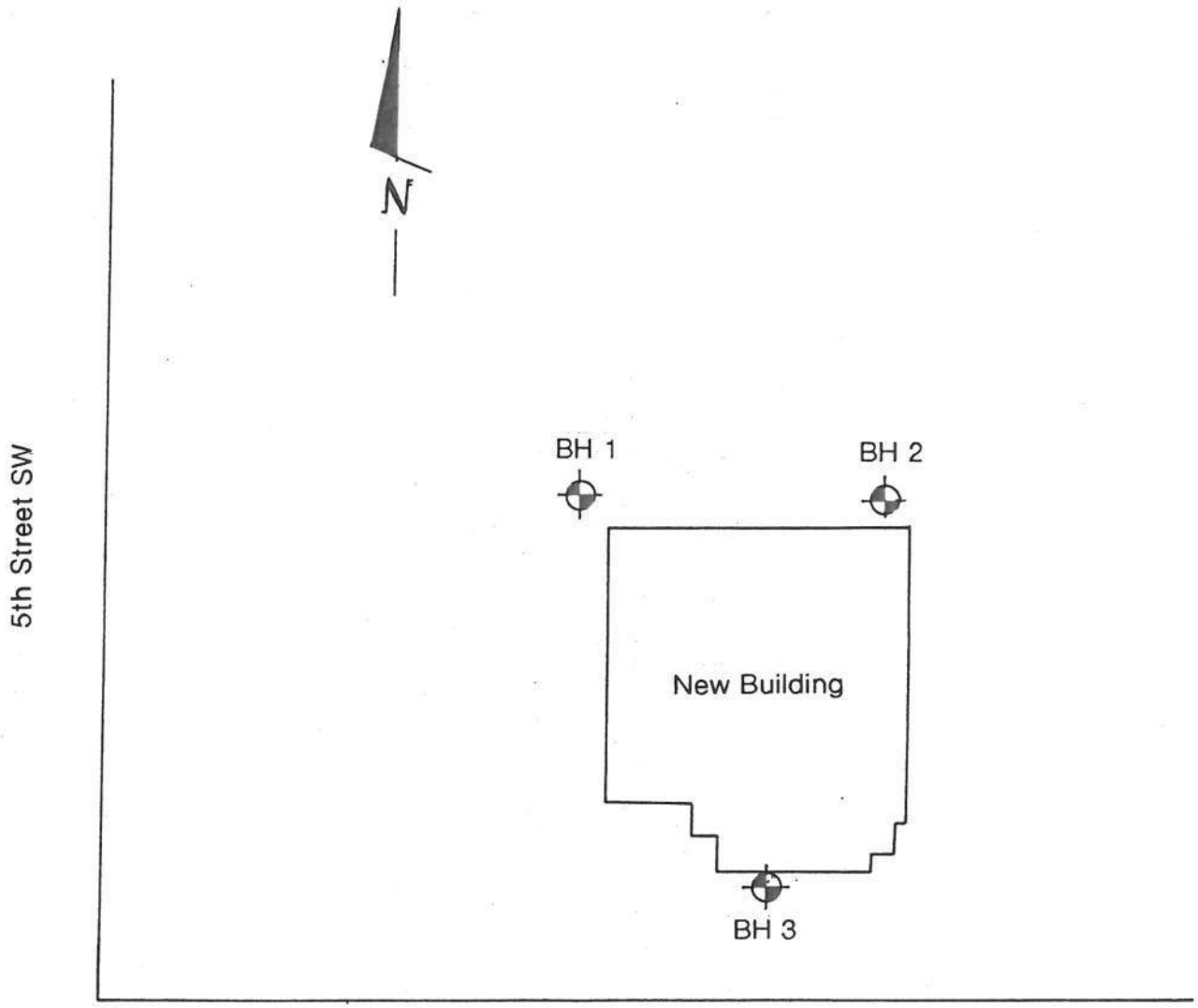
TJS/BC/rt
Encl.
d:\1996.100\962-4190\96190a.doc

APPENDIX A

Current Investigation

SITE PLAN

Figure 1



LEGEND

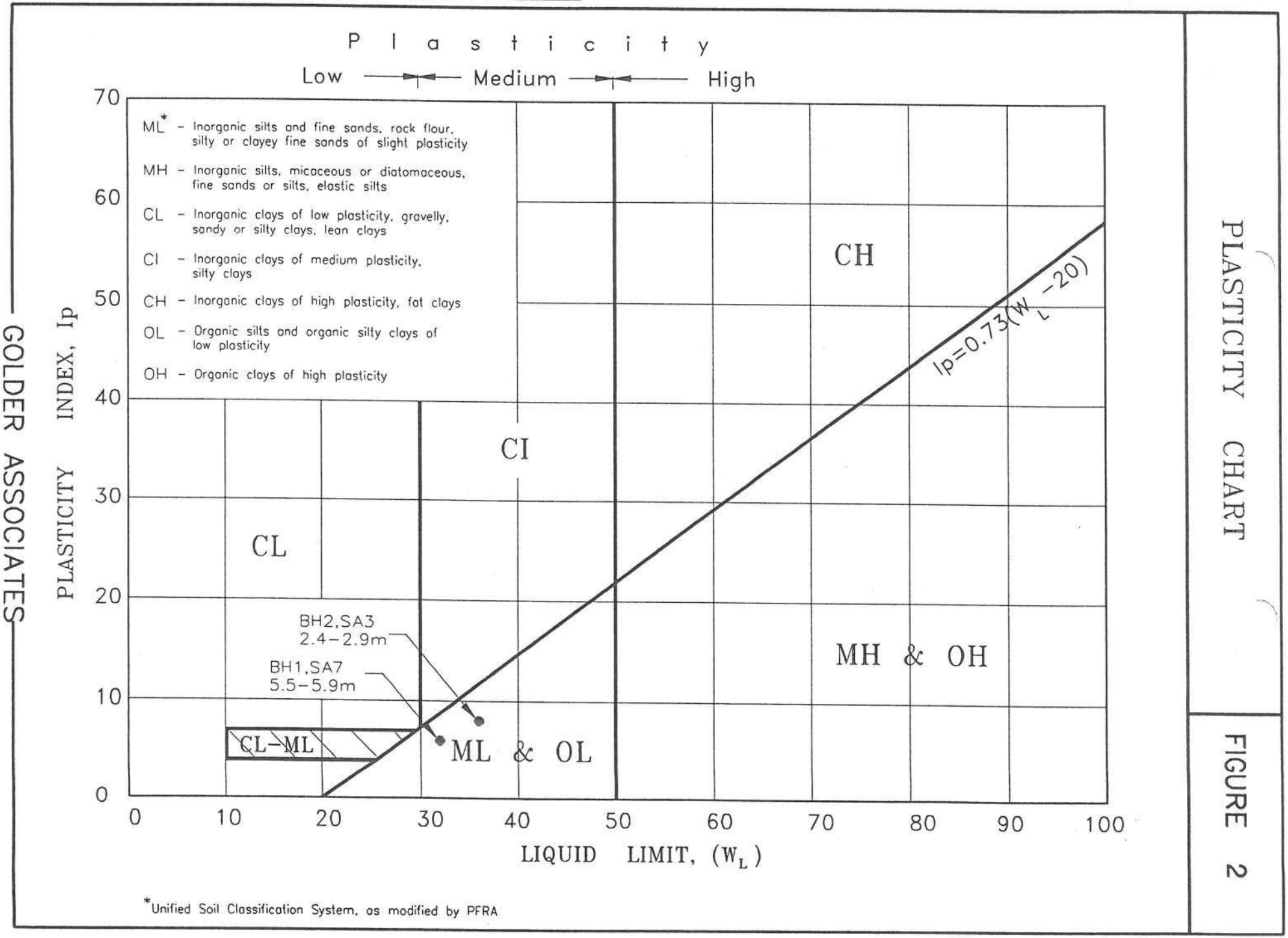
BH 1 — Approximate Borehole Location

Scale 1:750

PROJECT No. 962-4190 DRAWN JDF REVIEWED TS DATE Sept/96

Golder Associates

PROJECT No. 962-4190 DRAWN rt REVIEWED _____ DATE Sept 12/96



*Unified Soil Classification System, as modified by PFRA

PLASTICITY CHART

FIGURE 2

GOLDER ASSOCIATES

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 1

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: August 29, 1996

DATUM:

PROJECT NUMBER: 962-4190

BORING LOCATION: See Figure 1

BOREHOLE TYPE: Hollow Stem

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT (Wp 20, W 40, Wl 60, 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE									
	Firm brown desiccated clayey SILT with some root fibres throughout. (TOPSOIL)		0.00							
			0.60							
1	Soft ligth brown slightly desiccated clayey SILT with occasional layers of silt.			1	DO	1,1,2	3			Hole Cuttings
	Loose brown medium SAND with a trace of fine gravel.		1.70							
2			1.80	2	AS					
	Very soft to soft light brown silty CLAY grading to a clayey SILT at depth and occasional thin sand seams throughout with a 8 cm. thick sand layers encountered at 2.5 m depth.			3	DO	WH/WH/1	1			Sept. 3/96
3										
			3.30	4	AS					
4	Interlayered very loose light brown to grey SILT with some seams of grey clayer silt grading to a soft grey SILT with some clay at depth.			5	DO	1,1,2	3			25mm PVC
5				6	AS					Slotted PVC
				7	DO	1,1,2	3			
6	END OF AUGERHOLE		5.94							
7										
8										
9										
10										

DRILL RIG: MOBILE B61

DRILLING CONTRACTOR: Sandwell

DRILLER: DM

Golder Associates

LOGGED: RR

CHECKED: RT

DATE: August 29/96

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 2

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: August 29, 1996

DATUM:

PROJECT NUMBER: 962-4190

BORING LOCATION: See Figure 1

BOREHOLE TYPE: Hollow Stem

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT (Wp 20, W 40, Wl 60, 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE		0.00							
	Firm brown desiccated clayey SILT with some root fibres grading to a SILT with some clay at depth.									
1				1	DO	1,1,3	4			Hole Cuttings
	Loose orange-brown medium SAND with a trace of fine gravel.		1.20							
			1.32							
	Soft to very soft light brown slightly mottled SILT and CLAY with occasional thin sand seams grading to a clayey SILT at depth.			2	AS					
2										
			2.44	3	DO	1,1,2	3			
3	Interlayered very soft light brown to grey clayey SILT and very loose SILT with some clay.									
				4	AS					
										Sept. 3/96 25mm PVC
4				5	DO	1,1,2	3			
			4.70							
5	Very soft grey SILT and CLAY.			6	AS					Slotted PVC
				7	DO	1,1,1	2			
6	END OF AUGERHOLE		5.94							
7										
8										
9										
10										

DRILL RIG: MOBILE B61

DRILLING CONTRACTOR: Sandwell

DRILLER: DM

LOGGED: RR

CHECKED: RT

DATE: August 29/96

Golder Associates

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 3

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: August 29, 1996

DATUM:

PROJECT NUMBER: 962-4190

BORING LOCATION: See Figure 1

BOREHOLE TYPE: Hollow Stem

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT Wp 20 W 40 60 Wl 80	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE		0.00							
	Firm brown desiccated clayey SILT with some root fibres.									
1	Loose brown SILT with occasional thin sand seams throughout.		1.00	1	DO	3,2,2	4			Sept. 3/96
2	Soft light brown slightly mottled and slightly fissured silty CLAY with occasional thin sand seams.		1.83	2	AS					
				3	DO	1,1,2	3			
3			3.05							Hole Cuttings
4	Interlayered very soft light brown to grey SILT and CLAY, clayey SILT and very loose SILT with a trace to some clay.			4	AS					
				5	DO	1,1,1	2			25mm PVC
5				6	AS					Slotted PVC
				7	DO	1,1,1	2			
6	END OF AUGERHOLE		5.94							
7										
8										
9										
10										

DRILL RIG: MOBILE B61

DRILLING CONTRACTOR: Sandwell

DRILLER: DM

LOGGED: RR

CHECKED: RT

DATE: August 29/96

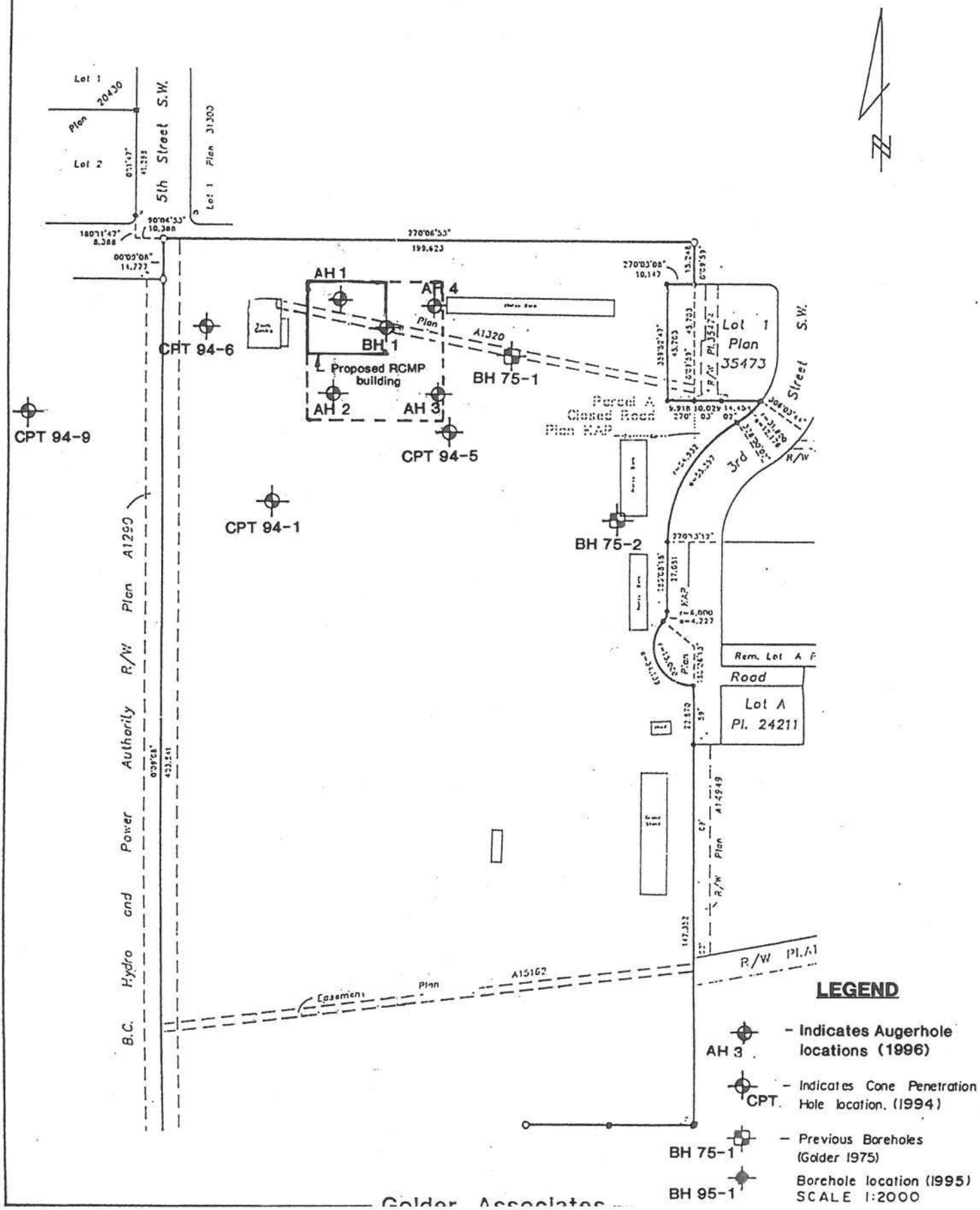
Golder Associates

APPENDIX B

Previous Investigation

SITE PLAN

Figure 3



PROJECT No. 962-4042 DRAWN RE REVIEWED TS DATE Mar./96

Golder Associates

PROJECT: RCMP BUILDING

PROJECT LOCATION: SALMON ARM

PROJECT NUMBER: 962-4042

Sampler Hammer: 63.5 kg., Drop 0.76m.

RECORD OF BOREHOLE - BH 1

BORING DATE: Feb.29-Mar.1/96

BORING LOCATION: See Figure 1

SHEET: 1 OF 2

DATUM:

BOREHOLE TYPE: MUD ROTARY

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS
0	GROUND SURFACE		0.00					
	Stiff dark brown SILT with a trace of sand and some clay. (TOPSOIL)		0.20					
	Firm brown clayey SILT with occasional seams to 1.3cm thick and fine sand and silt lenses throughout.			1	DO	2/0.15m,1	2	
2			1.95					
				2	DO	2,2,3	5	
4	Firm to soft grey layered silty CLAY with occasional layers of clayey silt and thin sand lenses.			3	DO	1,1,2	3	
6				4	TP	Ph		
				5	DO	1,2,2	4	
8			8.50					
	Soft grey clayey SILT grading to a SILT with a trace to some clay at depth with occasional sand lenses throughout.			6	DO	2,1,2	3	
10				7	TP	Ph		
			11.60					
12				8	DO	3,3,3	6	
				9	DO	2,2,3	5	
14				10	DO	3,3,3	6	
16	Loose grey SILT with a trace of clay grading to a loose SILT at depth.			11	DO	2,3,4	7	
18								
				12	DO	3,4,4	8	
20								

PENETRATION RESISTANCE BLOWS/0.3m

WATER CONTENT, PERCENT Wp 20 W 40 60 Wl 80

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole was advanced to a depth of 16.8m using hollow stem augers. From 16.8m down, mud rotary drilling was used.

CONTINUED ON NEXT PAGE

DRILL RIG: MOBILE B53

DRILLING CONTRACTOR: ENVIRO TECH

DRILLER: KM

Golder Associates

LOGGED: RT

CHECKED: T.S.

DATE: MAR 5/96

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - BH 1

SHEET: 2 OF 2

PROJECT LOCATION: SALMON ARM

BORING DATE: Feb.29-Mar.1/96

DATUM:

PROJECT NUMBER: 962-4042

BORING LOCATION: See Figure 1

BOREHOLE TYPE: MUD ROTARY

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT Wp 20 W 40 60 Wl 80	PIEZOMETER OR STANDPIPE INSTALLATION
20	CONTINUED FROM PREVIOUS PAGE									
	Loose grey SILT with a trace of clay grading to a loose SILT at depth.									
22			22.60							
24	Stiff grey clayey SILT grading to a very stiff grey SILT and CLAY.			13	DO	5,8,12	20		o	
				14	TP	Ph			o	
26	END OF BOREHOLE		25.90							
28										
30										
32										
34										
36										
38										
40										

DRILL RIG: MOBILE B53

DRILLING CONTRACTOR: ENVIRO TECH

DRILLER: KM

LOGGED: RT

CHECKED: T.S.

DATE: MAR 5/96

Golder Associates

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 1

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: Feb. 29/96

DATUM:

PROJECT NUMBER: 962-4042

BORING LOCATION: See Figure 1

BOREHOLE TYPE: SOLID STEM

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT Wp 20 W 40 60 Wl 80	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE									
	Compact brown SAND and GRAVEL with occasional cobbles. (FILL)		0.00							
	Very stiff brown clayey SILT with a trace of sand.		0.46	1	AS					
1			0.91							1050HRS FEB. 29/96
				2	AS					
2										
	Firm to stiff brown to grey silty CLAY with occaional fine sand lenses throughout. (A 7.5 cm. thick coarse to medium sand layer encountered at 2.44m depth.)									
3				3	AS					
4				4	AS					
	END OF AUGERHOLE		4.57							
5										
6										
7										
8										
9										
10										

DRILL RIG: MOBILE B53

DRILLING CONTRACTOR: ENVIRO TECH

DRILLER: KM

LOGGED: RT

CHECKED: T.S.

DATE: MAR 4/96

Golder Associates

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 2

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: Feb. 29/96

DATUM:

PROJECT NUMBER: 962-4042

BORING LOCATION: See Figure 1

BOREHOLE TYPE: SOLID STEM

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m; WATER CONTENT, PERCENT Wp 20 W 40 60 Wl 80	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE		0.00							
	Stiff dark brown clayey SILT with root fibres. (TOPSOIL)		0.18							
				1	AS				O	
1	Firm brown to grey slightly mottled layered silty CLAY grading to a clayey SILT with occasional sand lenses throughout. (A 5.0cm. thick white SAND and SILT layer encountered at 1.37m depth.)									1150hrs March 1/96
				2	AS					25mm PVC
2										
			2.13							Hole Cuttings
				3	AS				O	
3	Loose brown to grey layered SILT with a trace to some clay.									Slotted PVC
				4	AS					
4										
	END OF AUGERHOLE		4.57							
5										
6										
7										
8										
9										
10										

DRILL RIG: MOBILE B53

DRILLING CONTRACTOR: ENVIRO TECH

DRILLER: KM

LOGGED: RT

CHECKED: T.S.

DATE: MAR 4/96

Golder Associates

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH ?

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: Feb. 29/96

DATUM:

PROJECT NUMBER: 962-4042

BORING LOCATION: See Figure 1

BOREHOLE TYPE: SOLID STEM

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT (Wp 20, W 40, Wl 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE									
	Stiff dark brown clayey SILT with root fibres. (TOPSOIL)		0.00 / 0.20							
	Firm to stiff brown silty CLAY.			1	AS				o	▽ 1145hrs Feb. 29/96
1										
	Loose brown SILT with a trace of sand.		1.22							
2			1.68							
	Firm to stiff brown to grey layered silty CLAY with occasional sand seams to 1.3cm thick and fine sand lenses throughout.			2	AS				o	
3										
				3	AS					
4										
	END OF AUGERHOLE		4.57							
5										
6										
7										
8										
9										
10										

DRILL RIG: MOBILE B53

DRILLING CONTRACTOR: ENVIRO TECH

DRILLER: KM

LOGGED: RT

CHECKED: T.S.

DATE: MAR 4/96

Golder Associates

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 4

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: Feb. 29/96

DATUM:

PROJECT NUMBER: 962-4042

BORING LOCATION: See Figure 1

BOREHOLE TYPE: SOLID STEM

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT Wp 20 W 40 60 Wl 80	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE		0.00							
	Compact black SILT with root fibres throughout. (TOPSOIL)		0.10							
	Loose orange-brown sandy SILT with a trace of clay and gravel. (FILL)		0.61							1200hrs March 1/96
1	Firm brown to grey layered, slightly desiccated silty CLAY with thin sand lenses throughout.			1	AS				o	25mm PVC
2	Loose brown to grey SILT with a trace to some clay.		1.68	2	AS				o	Hole Cuttings
3	Firm brown to grey silty CLAY with occasional sand seams to 1.3cm thick and fine sand lenses throughout.		2.13							Slotted PVC
4				3	AS				o	
	END OF AUGERHOLE		4.57							
5										
6										
7										
8										
9										
10										

DRILL RIG: MOBILE B53

DRILLING CONTRACTOR: ENVIRO TECH

DRILLER: KM

Golder Associates

LOGGED: RT

CHECKED: T.S.

DATE: MAR 5/96

3

SALMON ARM MEMORIAL ARENA

BUILDING INFORMATION
DEC. 1999.

FOR: S.A. FALL FAIR USE
OR PURCHASE

Summary of Existing Areas

Main Level:	
Skate Change/Lobby	1,102
Concession Storage	192
Concession Area	360
Storage Roller Skates	160
Women's Washroom	216
Men's Washroom	156
Storage Room	210
Storage Room	210
Office	168
Ice Sheet	14,400
Players Boxes (2 @ 53)	106
Penalty Boxes (2 @ 21))	42
Official's Box	14
Seating (765)	2,813
Skate Sharpening	124
Hockey Storage	124
Change Room #1	874
Change Room #2	570
Change Room #3	432
Change Room #4	608
Change Room #5	912
Washroom	84
Washroom	132
Furnace/Repair Shop	210
Zamboni Room	420
Machine Room	464
Subtotal	25,103
Upper Level:	
Storage	464
Storage	210
Skating Club Storage	378
Office	160
Baseball Storage	124
Hockey Storage	124
Subtotal	1,250
Total Net Area	26,563
Total Gross Area	30,273

FACILITIES (EXISTING)

Construction of the Salmon Arm Memorial Centennial Arena began in 1955 and was completed in 1961 with the addition of the front section of the building. The facility was built almost entirely by volunteer labour.

The arena is approximately 30,300 gross square feet in size and has a seating capacity of 800 in the stands, and a potential for 1200 to 1400 on the floor. Unfortunately the facility is designed in such a way that the circulation aisles are between the ice and the spectators which causes distractions and restricts people's view during events.

At 180' X 80' the ice sheet is a sub-standard size which limits the type of activities that can take place. The shape of the ice is also a problem (more square than oval) making it difficult to clean with the ice resurfacer.

Until recently, exiting from the facility was a major concern, however, this has been partly remedied with the addition of new exit doors along the sides of the building.

Because of the age of the facility and the type of construction (primarily wood) maintenance is extremely difficult and requires a lot of extra work. There is very little seating in the skate change/lobby so skaters use the spectator bleachers placing extra wear and tear on them. The arena is poorly insulated and the flooring is uneven, all of which add unnecessary operating and maintenance costs. Efforts have been made to correct some of these shortfalls and to reduce costs. Recently reflective ceiling sheets were installed above the ice surface to help with insulation. This has had the added benefit of improving the acoustics. A new compressor was recently installed and a dehumidifier has been ordered to reduce humidity which will also help to reduce the cold. Heaters have also just been installed in the arena. All of the major components are being purchased and installed with a view to relocating them to a new facility.

The relationship of spaces is another concern. At present the zamboni room and the access route to the ice are between the dressing rooms which could result in a serious accident.

Architectural Assessment

SITE

Site context:

- Arena is located just ~~north~~ south of highway, and situated in an area of other public buildings: elementary and secondary schools, fairgrounds building and green area, armory, etc.
- A major commercial neighbour is the mall.
- Side street immediately adjacent.

Vehicular and pedestrian access:

- Good access for both vehicles and pedestrians.
- Limited parking area (about 30-40 spaces) immediately in front of main entrance. Additional parking on side street adjacent to building on north. Small parking/loading area to west with limited public access.

Landscaping:

- No extensive landscaping.
- Asphalted parking.
- Large grassed area adjacent to south as part of fairgrounds.

Site contours and drainage:

- Site relatively flat.
- Outside grade level relatively close to finish floor level insides, and there are no significant slopes away from building.
- Drainage away from building and water infiltration at base might be a problem in spring.

Handicap accessibility:

- Adequate to all public areas on ground level.
- No special elevated handicapped spectator area.

Site expansion capability:

- Virtually no expansion possible on existing site.
- A land swap or other arrangement with fairgrounds land may allow expansion of arena.
- Arena has recently made arrangements to acquire small area of land now owned by federal government and used as green space in front of the armory.
- Arena plans to use this as parking will allow approximately 20 additional spaces.

Parking:

. Asphalted parking area in front of building: approximately 30 spaces. Additional parking in newly acquired area: approximately 20 spaces. Parking at north side of building: approximately 10 spaces (but increasingly distant from main entrance).

Advantages and constraints:

. Adjacency to fairgrounds leads to some mutual advantage.
. City's use of fairgrounds building to west for parks and landscaping maintenance is convenient.
. Arena's limited land area limits expansion, unless adjacent fairgrounds land is considered.
. Expansion planning should take all public buildings in area into consideration.

BUILDING

Year built:

. 1955-56.

Expansion and remodelling:

. East front added 1961.
. West extension about 1966.
. Upstairs office about 1975.
. Additional exiting 1990.

Image and character:

. Large arch truss structure marks many large span buildings of the fifties.
. Flat roof additions to east and west are relatively characterless and add little to identity or character of building.

Impact on surrounding buildings:

. Surrounding buildings differ in age, type and use.
. Greatest impact may be bringing varied users to area.
. Arena is used by fall fair organization during fair. Use is for only a few weeks and brings in very little income.

ENVELOPE

Wall type:

. Wood vertical siding, paint finish.

Windows:

. Single glazed, wood frame.

Doors:
- Main entry doors: wood with glazing panels, wood frames. Showing some aging.
- Side exit doors: steel doors in steel frames.
- Interior doors: wood in wood frames.

Caulking, weatherstripping, waterproofing:
- Limited in arena area.
- Adequate in flat roof areas.

Insulation:
- None in arena area. Limited in flat roof areas. Further inspection required.

Roof type:
- Arch roof: wood sheathing on joists @ 16" o.c., membrane waterproofing.
- Flat roofs: built-up.

Roof drainage:
- Adequate. No problems indicated.

Roof age and condition:
- Arch roof: upper (central) area: redone 1984 or 85, lower areas to north and south: redone 1987.
- Flat roofs: westernmost section 1990, all others 1991 (still in progress October 1991). As exists, no leaking problems reported.

Roof venting:
- No problems reported, no signs of condensation.

STRUCTURE

Type:
- Wood columns on conc. footings.
- Wood arch trusses in arena area.
- Wood joists on columns and bearing walls in flat roofs.

Problems:
- Ongoing or previously occurring maintenance issues: repair of some wood column bases, strengthening of flat roof beams, water infiltration of foundations, floor areas. Truss bolts re-torqued 1985.

Expansion capability:

- Expansion of wood truss structure along its length would require demolition of flat roof areas, but site now limits this.
- A linking structure to south would be possible, but structurally tricky.

SUBSTRUCTURE:

Integrity:

- Column footings are reported to be sound.
- Freezing of ice surface causes frost expansion beneath ice surface slab.
- Arena is now considering new slab (including underslab insulation?) on ice area.

Subsurface water:

- Drainage has been a problem in this building.
- Site is a low point in area, and building is on grade.
- Some column bases have had to be replaced.

INTERIOR

Interior environment:

- Reflective foil ceiling may help condensation and lighting, but makes arena look somewhat makeshift.
- Spectator seating and interior wood painting is well maintained.
- Public services in front are functional, but haphazardly finished.

Plan suitability:

- Functional, but haphazard.
- Facilities for public well located at main entrance. Secondary exterior access to locker rooms at west end.
- Compressor room located at front beside public area not ideal.

Internal expansion capability:

- Limited.

Access and control:

- Functional.

Fire separations and code compliance:

- Fire separation of refrigeration room achieved with rated door and intumescent paint on wall surfaces. Open louver in this wall may be hazardous.

7

Furniture and finishings:

- Functional.

Code compliance:

- Additional exiting installed 1990 at recommendation of fire marshall.
- Fire alarm system upgraded 1991.

Mechanical Assessment

SITE SERVICES

Domestic Water Supply

- From municipal system; no problems reported.
- Hot water for the showers and zamboni is provided with a 768 MBH, gas-fired boiler, heat exchanger and two 120 US gal storage tanks; this system is reported to work well and has adequate capacity with the exception that the Zamboni cannot be filled when the showers are being used; this does not appear to be a major problem.

Sanitary Sewer

- Connected to municipal system; no problems reported.

Storm Drainage

- Eaves trough and rain water leaders drain roof to the perimeter of the building.

PLUMBING

Plumbing Fixtures

- All of the plumbing fixtures in the building are old, but functional.

HVAC

Heating System

- The spectator seating area is heated with new gas-fired infra-red radiant heaters: 8 units, 33' long each.
- The lobby area is heated with a relatively new gas-fired furnace; this unit is reported to work well and keep the entire lobby warm; the major problem with this unit is that it is not located in a fire-rated enclosure separating it from the remainder of the building; this is a code violation.
- Some of the small rooms (ie; office, minor hockey storage) at either end of the building are heated with electric baseboard.
- The store room under the figure skating room has a gas-fired wall heater vented through the wall, however it is reported that this unit is not used.
- The refrigeration equipment room contains an electric heater which staff say is not used. Nevertheless, having it located here is considered an unsafe practice as ammonia is explosive when exposed to hot surfaces. The heater should be removed to prevent accidental use.
- The propane-powered Zamboni is stored adjacent to the boiler room which is considered to have an open flame. Proper fire separation is required between these two areas.

Electrical Assessment

POWER SUPPLY

Electrical Service Entrance

- 120/240-volt, single-phase, 3-wire, overhead service has been divided into two, separately metered services (400-ampere service switch for the general building, 100-ampere service for "FALL FAIR" use).
- Switch and gutter arrangement.
- A separately metered, 480-volt, 3-phase, overhead service has been installed to accommodate the ice plant.
- Original service is approximately 30 years old.
- The original service equipment appears aged, and expansion capabilities are limited.
- Original grounding system not found.
- Overhead telephone service.

General Power Distribution

- Various sub-panels have been installed throughout the facility, at different times. Most panels have spaces for additional (future) circuits. Panel directories generally incomplete.
- Additional circuits have been added or re-worked over the years.
- General wiring installed in conduit or armoured (BX) cable.
- Generally, systems are intact and operational.

LIGHTING

General Lighting

- Lighting for the arena provided by surface-mounted, industrial fluorescent fixtures c/w curved reflectors. No guards installed for protection of lamps.
- Additional fluorescent light fixtures added approximately 20 years ago. Light levels generally low (15 f.c. at boards, 30 f.c. at centre ice).
- Bare lamp fluorescent light fixtures in lobby areas.
- Light fixtures are generally aged, and in need of repair or replacement.
- Bare lamp incandescent fixtures installed outside main entrance.

Emergency Lighting/EXIT signs

- Emergency lighting provided by local D.C. battery units, some with remote lamp heads.
- EXIT signs have been installed throughout the facility; some have D.C. standby power.
- Generally, emergency lighting and EXIT signs appear adequate and operational.

Ventilation System

- The spectator and ice sheet area is ventilated by several wall fans which move outdoor air through the building.
- A reflective ceiling was hung underneath the structure a number of years ago. The reflective ceiling is damaged in many areas. This ceiling has been partly successful in preventing condensation on the structure, however some condensation still occurs. This indicates the need for de-humidification. It is reported that a plan is in place to install two de-humidifiers in the building.
- The Zamboni room is not ventilated, thus allowing some build-up of fumes when the engine is running.
- The refrigeration equipment room is not ventilated in accordance with the mechanical refrigeration code, CSA B52.

OTHER

Fire Protection System

- The building contains some dry chemical type fire extinguishers.
- The building does not have a sprinkler system of any type.

Ice Refrigeration System

- The ammonia-based refrigeration system has two main compressors with a total nominal capacity of 180 tons; the system is reported to work well for the present operating season. The majority of the refrigeration equipment was installed in 1978, the compressors were replaced in 1988.
- The ice surface contains no under floor heating, therefore ice cannot be installed in summer.
- Refer to other parts of this report for structural movement problems caused by freezing and thawing of ice surface.
- The ice surface piping is constructed such that gaps between the boards and the ice sheet remain at perimeter of the ice sheet.
- The refrigeration room does have an ammonia alarm system installed.
- The cooling tower sump has developed a leak which should be repaired.
- The refrigeration room is not a proper fire separation as required by today's code.

COMMENTS

- The mechanical systems in the building are presently serving their purpose, with some exceptions. However, the equipment and systems are showing their age and will soon require major upgrading. An upgrading on life safety issues and fire protection measures is highly recommended. If the building is to be used for any significant length a major upgrading of all the building mechanical systems will have to be planned for.

FIRE SAFETY REVIEW
FOR FILE 351/3200 SA

GAGE-BABCOCK & ASSOCIATES LTD.

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January 26, 2000

Chief Building Official
Building Department
District of Salmon Arm
450-2 Avenue N.E.
Salmon Arm, BC
V1E 4N2

Project: **Salmon Arm Memorial Centennial Arena** **GBA FILE 000120**
Fire Safety Recommendations

Introduction

Gage-Babcock & Associates Ltd. has been retained by the Salmon Arm & Shuswap Lake Agricultural Association to review Building Code requirements and to provide recommendations for improving the level of fire and life safety at the Salmon Arm Memorial Centennial Arena (also referred to as the "Arena" in this report).

This report is based on information and sketches provided by Mr. Gary Schrik of the Salmon Arm and Shuswap Lake Agricultural Association (also referred to as the "Association" in this report).

Limitations

The analysis is limited to an evaluation of major building elements and systems for conformance to the fire and life safety requirements of Part 3 of the 1998 British Columbia Building Code (1998 BCBC). It does not attempt to assess all aspects of the building.

This report was prepared by Gage-Babcock & Associates Ltd. for the Salmon Arm and Shuswap Lake Agricultural Association. The material herein, reflects Gage-Babcock & Associates' best judgement in light of the information available to it at the time of preparation. Gage-Babcock & Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of use of the contents of this report without authorization from Gage-Babcock & Associates Ltd.

Building History

It is our understanding that construction of the Arena began in 1955 and was completed in 1956. There have been at least five renovations of the building since the time of original

construction: an east addition in 1961, a west addition in 1966, a mezzanine in 1975, additional exit facilities in 1990, and a fire alarm upgrade in 1991. An arena is classified as a Group A (Assembly), Division 3 major occupancy. There are offices, dressing rooms, a zamboni storage area, and a concession stand which are all subsidiary to the A3 major occupancy. During the summer months, the ice surface is dry. For about the last forty years, the Association has used the building as an exhibition hall during their annual fair.

The Arena is a single-storey, unsprinklered building with an area of 2330 m^2. The Arena is generally of wood-frame construction except that the east addition, containing dressing rooms, washrooms, and service room, is of concrete block construction with a combustible roof.

Future Use of the Arena

We are informed that the District of Salmon Arm has recently constructed a new ice arena and will decommission the Centennial Arena. The intention is to sell the Arena to the Association, who will leave the building available for sports such as indoor soccer, equine sports, tennis, etc. and will continue to use it for their annual fair. The building will therefore retain its Group A, Division 3 classification.

We understand that the Arena is used as an exhibition hall during the fair for only three days plus a week before and week afterwards to setup and take down the exhibits. The use of the Arena as an exhibition hall is specifically permitted by Sentence 3.1.2.3.(1) of the 1998 BC Building Code:

3.1.2.3. Arena Type Building

1) An arena type building intended for occasional use for trade shows and similar exhibition purposes shall be classified as Group A, Division 3 *occupancy*.

Sentence 1.1.2.1.(1) of the Building Code defines under what conditions the Code must be applied. Clause 1.1.2.1.(1)(c) requires the Code to apply when a building undergoes a change in occupancy. There will be no change in occupancy of the Arena, but because it is an existing non-conforming building, the Association has retained Gage-Babcock & Associates Ltd. to provide recommendations for improving the level of fire and life safety.

Major Building Elements

The building is classified under Article 3.2.2.32. Group A, Division 3, One Storey, Increased Area and if constructed today, it would be required to meet the requirements outlined in Table 1. of this report.

Table 1. Major Building Elements

	3.2.2.33. Group A, Division 3, One Storey, Sprinklered	**Captioned Project**
Sprinklered	Required	No
Building Height	1 Storey	1 Storey
Building Area	7200 m^2	2330 m^2
Construction	Combustible or Noncombustible	Combustible
Mezzanines	No Requirement	It is recommended that most of the existing mezzanines be removed.
Roof Assemblies	No Requirement	Rating is Unconfirmed
Loadbearing	No Requirement	Rating is Unconfirmed

Mezzanines

It is our recommendation that the mezzanines be removed with the exception of a small announcers' booth. The purpose of this recommendation is to prevent storage on the mezzanines.

Separation of Major Occupancies and Suites

The Arena is a single major occupancy and is occupied by a single tenant. No major occupancy or public corridor fire separations are required [3.1.3.1., 3.3.1.1., 3.3.1.4.]

Spatial Separation and Exposure Protection

The limiting distance from the north building face does not meet the minimum required by Code. The building does not conform to the requirements of Subsection 3.2.3. for spatial separation. It would be prohibitively expensive for the Association to upgrade the Arena to conform to current requirements, and it is therefore recommended that the fuel load and potential sources of ignition be reduced in order to lessen the exposure hazard. The following are our recommendations:

1. Storage shall be limited to sports equipment during the year. Exhibits for the annual fair are not considered storage but must be removed when the fair is over.
2. All mechanical or electrical equipment no longer in use shall be removed: ice making equipment, air refrigeration units, cooking equipment, etc. The natural gas boiler and hot water heater are permitted to remain.
3. Griddles, ranges, and deep-fryers shall be prohibited inside the building during all times of year including the time of the annual fair. Broilers, microwave ovens, and conventional ovens are permitted.
4. A fire safety plan, as outlined in **Summary of Recommendations** section at the end of this report shall be submitted to the Salmon Arm Fire Department and to the Salmon Arm Building Department.
5. Where a room in the Arena is no longer needed, the enclosure around it shall be removed to discourage storage.

Fire Alarm Requirements

The 1998 BCBC would require the building to be equipped with a fire alarm as an additional condition to sprinkler protection and due to the occupant load of the building [3.2.4.1.]. The building was retro-fitted with a new fire alarm system in 1991. The fire alarm shall be maintained in accordance with the 1998 BC Fire Code and the applicable CAN/ULC standard.

Provisions for Firefighting

The Association has provided GBA with a site plan which shows existing fire department access routes (see "Map 3" in Appendix A of this report). The plan shows access routes provided to all four sides of the building. During the winter, access to at least one side of the building and the main entrance shall be maintained. At no time during the year, especially when the annual fair is on, shall parking obstruct fire department access routes.

The Association shall demonstrate to the satisfaction of the Fire Department that the access routes conform to Articles 3.2.5.4. through 3.2.5.6 of the 1998 BCBC. An excerpt is

included in Appendix B of this report.

The Salmon Arm Fire Department shall be notified in advance of the dates at which the Arena will be used as an exhibition hall for the annual fair.

Fire Suppression Systems

An adequate water supply shall be provided for firefighting. The Salmon Arm Fire Department shall include a calculation of required water supply in their pre-fire plan for the Arena.

Sentence 3.1.2.3.(2) requires an arena type building intended for occasional use for trade shows and similar exhibition purposes to be sprinklered throughout if more than 1500 m^2 in area, but this requirement was not in force when the building was constructed. The lack of sprinkler protection is an existing condition and it would be prohibitively expensive for the Association to sprinkler the building. Therefore, alternative measures are identified in this report and summarized in the **Summary of Recommendations** section of this report.

Fire extinguishers are required to be provided and maintained in accordance with the 1998 BC Fire Code.

Lighting and Emergency Power

Sub-clause 3.2.7.3.(1)(h)(i) requires emergency lighting in floor areas or parts thereof where the public may congregate in Group A, Division 2 and 3 occupancies having an occupant load of 60 or more. Emergency lights shall be provided over all exterior exit doors and an emergency power supply for lighting shall be provided in conformance with 3.2.7.4.(1).

Separation of Service Rooms

A room containing a fuel-fired appliance and a janitors' room is required by Code to be separated from the remainder of the floor area by a fire separation with a 1 hour fire-resistance rating. The existing service rooms are located in the concrete block section of the building. We recommend that the fire separation around the service rooms be confirmed and that the openings to the service rooms be equipped with a door having a 45 minute fire protection rating. Service penetrations through a required fire separation must be sealed in accordance with Articles 3.1.9.1. and 3.1.9.4. See Appendix C for an excerpt from the 1998 BCBC.

Service rooms or spaces shall not facilitate storage [3.6.1.3.(1)].

Occupant Load

The occupant load for the building will be the greatest during those days in which the Association opens the facility to the public to view the exhibits. The occupant load is calculated in the Table 2. of this report.

Table 2. Occupant Load

17631.8²

Storey	Location	Area	Area per person	Design Occupant Load	Total
First Storey	Exhibition Area	1638 m^2	3.7 m^2	443	518
	Remainder	695 m^2	9.3 m^2	75	

An occupant load of 3.7 m^2 per person, equal to that of a ground floor retail store, is considered reasonable for the Arena. The remainder of the building will be only be accessible to staff, an occupant load of 9.3 m^2 per person is reasonable based on the occupant load for an office.

Exiting Capacity

The Association has proposed a plan (see "Map 2" in Appendix A of this report) to increase the exit capacity for the Arena. The plan includes removing bleachers on the north and south sides, removing the exterior exit stairs, and replacing the exit stairs with exit doors that discharge to grade. We have reviewed their plan and find it acceptable.

The exit capacity for the building is outlined in the following table:

Table 3. Exit Capacity

Storey	Exits Provided	Exit Width	Width Required	Exit Capacity
First Storey	8 Single Doors @ 900 mm	7200 mm	6.1 mm	1180
	3 Double Doors @1800 mm	5400 mm	6.1 mm	885
Total Exit Capacity Provided				**2065**

The exit capacity provided is more than sufficient to accommodate the occupant load of the Arena during the fair and at all times during the year.

Travel Distance to Exits

Upon implementation of the proposed exit plan (see Map "2" in Appendix A of this report), the travel distance will be within the 30 m indicated by the 1998 BCBC [3.4.2.5.(1)(f)] for an unsprinklered assembly building..

Exit Signs

It is our recommendation that an illuminated exit sign be located over or adjacent to every exterior exit door in conformance with Sentence 3.4.5.1.(1).

Fire Safety Plan

A fire safety plan shall be submitted to Salmon Arm for the acceptance of the Building Officials and the Fire Officials. The fire safety plan shall conform to Section 2.8. of the 1998 BC Fire Code (see an excerpt from the Fire Code in Appendix D of this report). The plan shall address operation of the building including the use of the building during the annual fair. During the fair, the following shall be provided:

1. Minimum staffing levels for security/safety personnel.
2. Security/safety personnel shall be aware of their duties.
3. Instructions for notifying the fire department.
4. The Fire Warden shall be responsible for directing security/safety personnel.
6. One member of the security/safety personnel shall be given responsibility for notifying the fire department in an emergency, and another member shall be given the responsibility of ensuring that this person successfully notifies the fire department. Both of these people will report to the Fire Warden after they notify the fire department.

Conformance to 1998 BC Fire Code

The Arena shall maintain conformance to the 1998 BC Fire Code.

Summary of Recommendations

We recommend the following measures be implemented:

1. Mezzanines shall be removed with the exception of the small announcers' booth..
2. Storage shall be limited to sports equipment during the year. Exhibits for the annual fair are not considered storage but must be removed when the fair is over.
3. All mechanical or electrical equipment no longer in use shall be removed: ice making equipment, air refrigeration units, cooking equipment, etc. The natural gas boiler and hot water heater are permitted to remain.
4. Where a room in the Arena is no longer needed, the enclosure around it shall be removed to discourage storage.
5. Bleachers along the north and south walls will be removed in order to implement the proposed exit plan. The east bleachers will be difficult to remove, but their presence does not affect exiting. Therefore, they may remain, but access and storage underneath them shall be prohibited.
6. Griddles, ranges, barbeques, deep-fryers, or other cooking appliances that utilize hot oil or open flames shall be prohibited inside the building during all times of year including the annual fair. Broilers, microwave ovens, and conventional ovens shall be permitted.
7. Fire department access routes shall be maintained for fire department use. At no time during the year, especially when the annual fair is on, shall parking obstruct fire department access routes.
8. The Salmon Arm Fire Department shall be notified in advance of the dates at which the Arena will be used as an exhibition hall for the annual fair.
9. Portable fire extinguishers shall be provided in conformance with the 1998 BC Fire Code.
10. Exits and fire department access routes must be kept clear of any vehicle or obstruction at all times during the year.
11. Fire separations around the service rooms shall be confirmed. Openings to the service rooms shall be equipped with a door having a 45 minute fire protection rating. Service penetrations through a required fire separation are to be sealed in accordance with Articles 3.1.9.1. and 3.1.9.4.
12. No storage is permitted in service rooms or spaces.
13. Exits shall be provided as shown on "Map 2" in Appendix A of this report.
14. Exit signs and emergency lighting shall be provided above every exit door.
15. A fire safety plan shall be submitted to Salmon Arm for the acceptance of the Building Officials and the Fire Officials.
16. The Arena shall maintain conformance to the 1998 BC Fire Code.

Conclusion

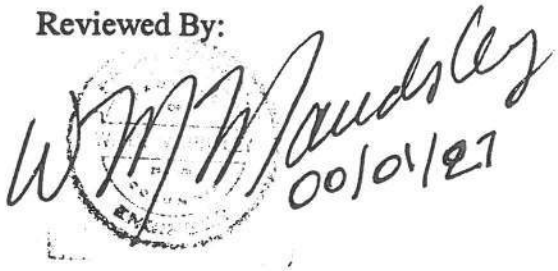
The recommendations outlined in this report will provide an increased level of fire and life safety for the Salmon Arm Memorial Centennial Arena.

Sincerely,
Gage-Babcock & Associates Ltd.

Prepared By:

Timothy Le Couteur, E.I.T.

Reviewed By:

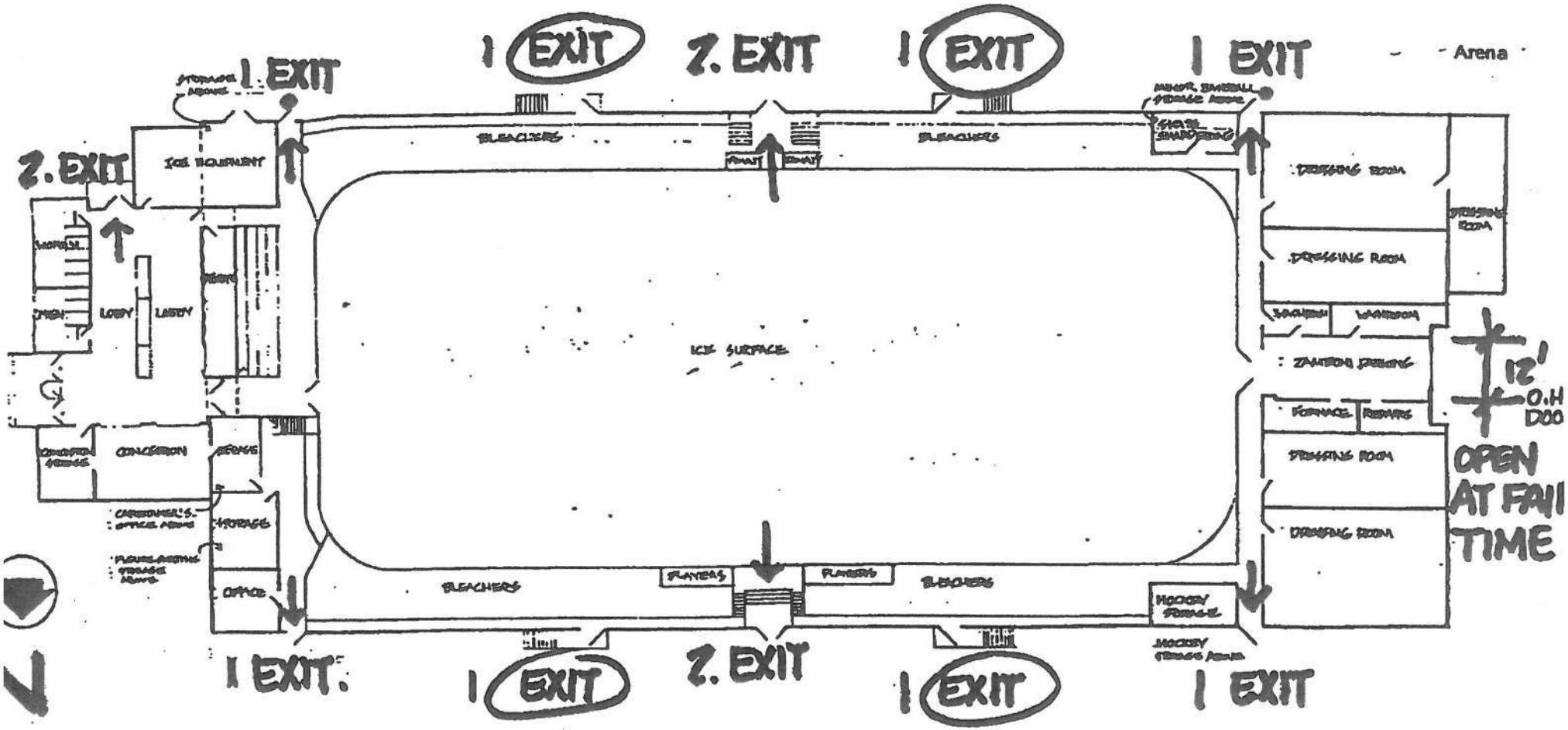


W.M. Maudsley, P.Eng.

Appendix A

1 EXIT = GROUNDLEVEL SINGLE 3' DOOR OR 4'

1 (EXIT) = 5' ABOVE GROUNDLEVEL

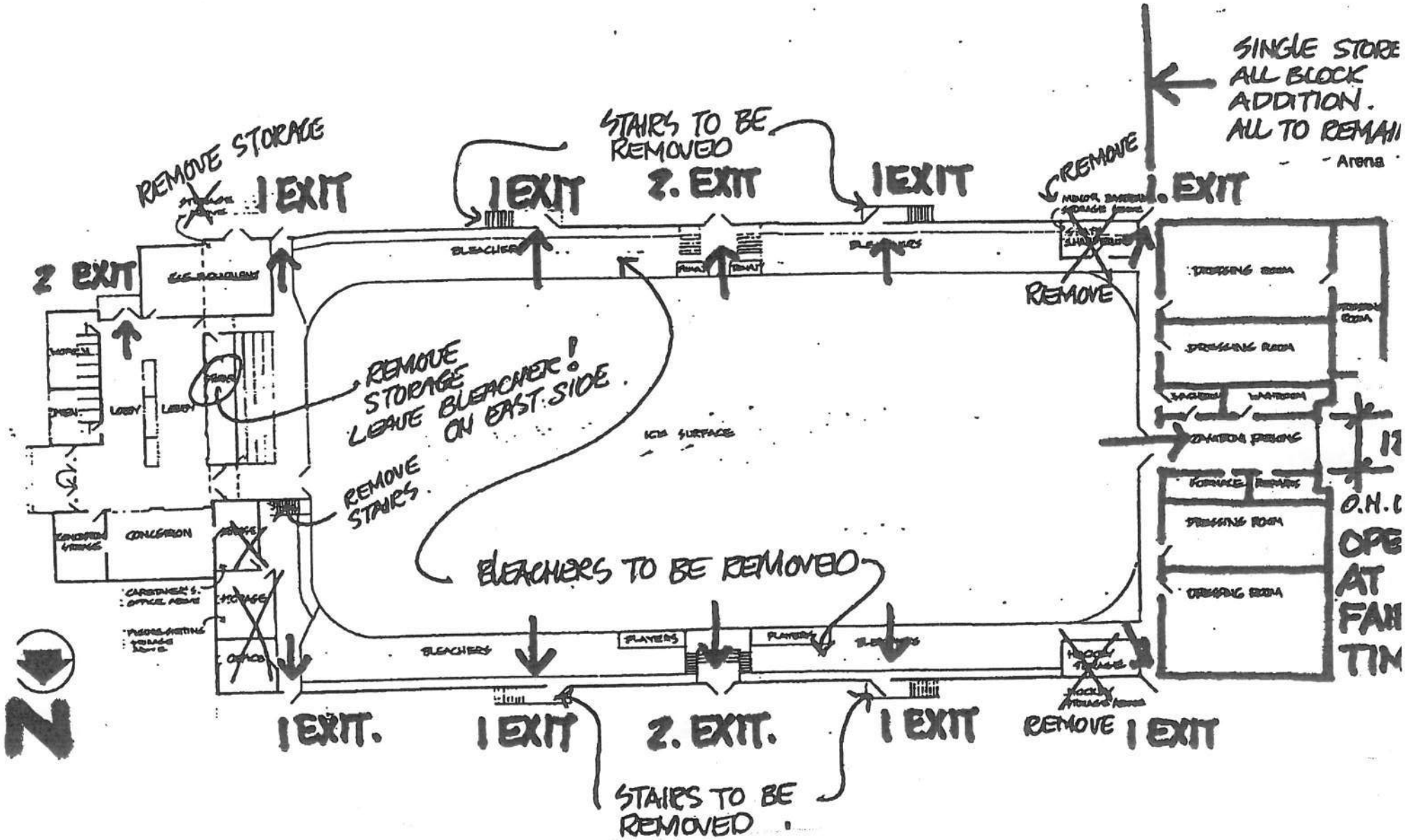


EXIT PLAN EXISTING

AT FAIR TIME

E-5

MAP. 1.



E-3

EXIT PLAN (PROPOSED)
AND OK'D BY ASS'N

MAP 2.

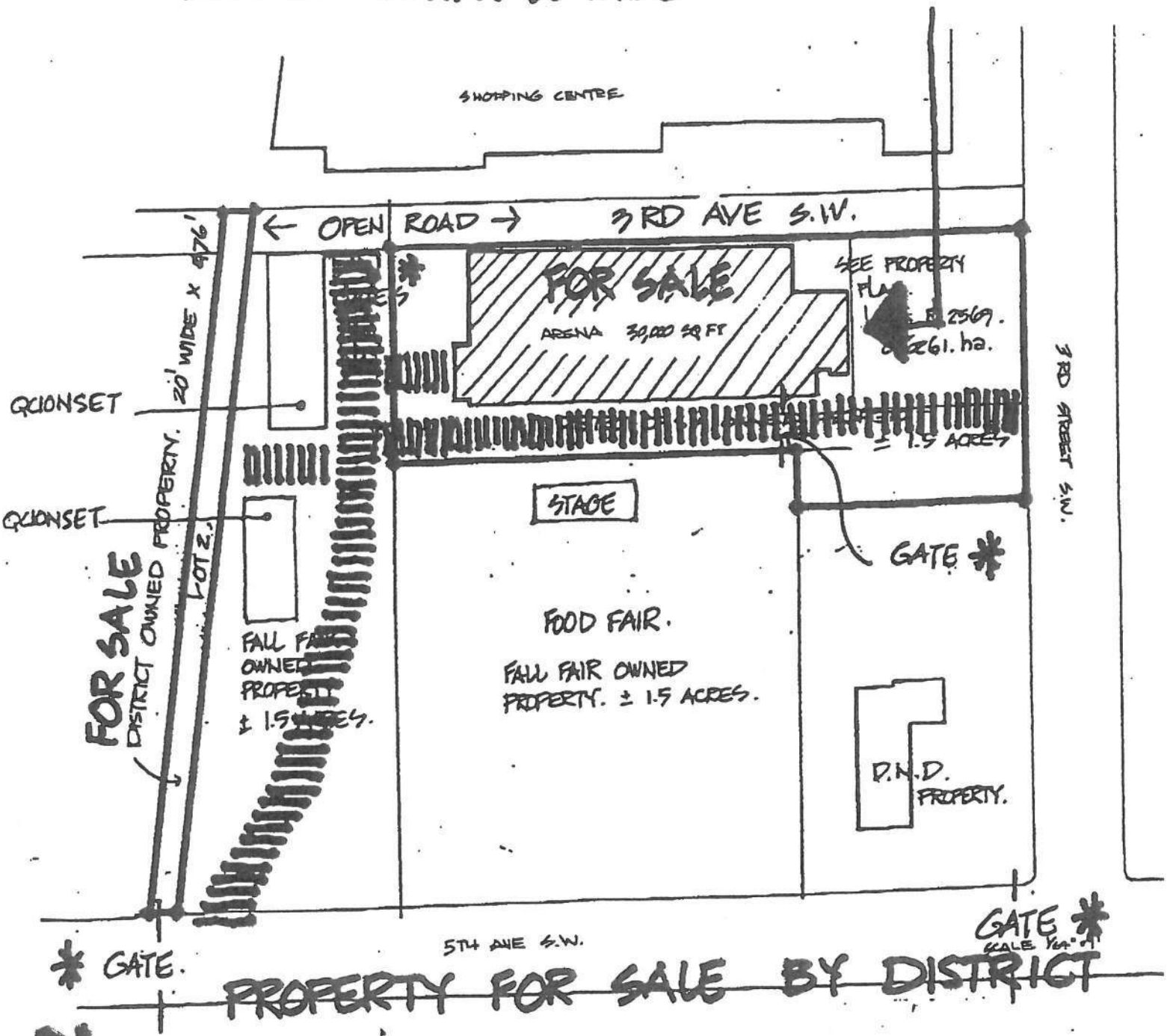
1. EXIT. SINGLE DOOR EXIT GROUNDLEVEL
2. EXIT. DOUBLE DOOR EXIT

MAP. 3.

* MANNED GATES AT FAIR TIME

FIRE ENGINE ACCESS. ON SITE (NO PARKING ON SITE) DURING FAIR. 30' WIDE

MAJOR ENTRANCE TO ARENA BLDG



PROPERTY FOR SALE BY DISTRICT

N

SOUTH OF 5th AVE IS FAIR LEASED PROPERTY. ± 18 ACRES.

MIDWAY & LIVESTOCK AREA
ALSO GRANDSTAND. (SEE AERIAL SKETCH.)

Appendix B

a) a stairway, or
b) a hatch not less than 550 mm by 900 mm with a fixed ladder.

3.2.5.4. Access Routes

1) A *building* which is more than 3 *storeys* in *building height* or more than 600 m² in *building area* shall be provided with access routes for fire department vehicles

a) to the *building* face having a principal entrance, and
b) to each *building* face having access openings for fire fighting as required by Articles 3.2.5.1. and 3.2.5.2.

(See Appendix A.)

3.2.5.5. Location of Access Routes

1) Access routes required by Article 3.2.5.4. shall be located so that the principal entrance and every access opening required by Articles 3.2.5.1. and 3.2.5.2. are located not less than 3 m and not more than 15 m from the closest portion of the access route required for fire department use, measured horizontally from the face of the *building*.

2) Access routes shall be provided to a *building* so that

a) for a *building* provided with a fire department connection, a fire department pumper vehicle can be located adjacent to the hydrants referred to in Article 3.2.5.16.,
b) for a *building* not provided with a fire department connection, a fire department pumper vehicle can be located so that the length of the access route from a hydrant to the vehicle plus the unobstructed path of travel for the fire fighter from the vehicle to the *building* is not more than 90 m, and
c) the unobstructed path of travel for the fire fighter from the vehicle to the *building* is not more than 45 m.

3) The unobstructed path of travel for the fire fighter required by Sentence (2) from the vehicle to the *building* shall be measured from the vehicle to the fire department connection provided for the *building*, except that if no fire department connection is provided, the path of travel shall be measured to the principal entrance of the *building*.

4) If a portion of a *building* is completely cut off from the remainder of the *building* so that there is no access to the remainder of the *building*, the access routes required by Sentence (2) shall be located so that the unobstructed path of travel from the vehicle to one entrance of each portion of the *building* is not more than 45 m.

3.2.5.6. Access Route Design

1) A portion of a roadway or yard provided as a required access route for fire department use shall

a) have a clear width not less than 6 m, unless it can be shown that lesser widths are satisfactory,
b) have a centreline radius not less than 12 m,
c) have an overhead clearance not less than 5 m,
d) have a change of gradient not more than 1 in 12.5 over a minimum distance of 15 m,
e) be designed to support the expected loads imposed by fire fighting equipment and be surfaced with concrete, asphalt or other material designed to permit accessibility under all climatic conditions,
f) have turnaround facilities for any dead-end portion of the access route more than 90 m long, and
g) be connected with a public thoroughfare.

(See Appendix A.)

3.2.5.7. Water Supply

1) An adequate water supply for fire fighting shall be provided for every *building*. (See A-3 in Appendix A.)

3.2.5.8. Standpipe Systems

1) Except as permitted by Sentence 3.2.5.9.(4), a standpipe system shall be installed in a *building* that is

a) more than 3 *storeys* in *building height*,
b) more than 14 m high measured between *grade* and the ceiling of the top *storey*, or
c) not more than 14 m high measured between *grade* and the ceiling of the top *storey* but has a *building area* exceeding the area shown in Table 3.2.5.8. for the applicable *building height* unless the *building* is *sprinklered* throughout.

Appendix C

Table 3.1.8.15.
Restrictions on Temperature Rise and Glazing for Closures
Forming Part of Articles 3.1.8.15. and 3.1.8.16.

Location	Minimum Required *Fire-Protection Rating* of Door	Maximum Temperature Rise on Opaque Portion of Unexposed Side of Door, °C	Maximum Area of Wired Glass in Door, m²	Maximum Aggregate Area of Glass Block and Wired Glass Panels not in a Door, m²
Between a dead-end corridor and an adjacent *occupancy* where the corridor provides the only *access to exit* and is required to have a *fire-resistance rating*	Less than 45 min	No limit	No limit	No limit
	45 min	250 after 30 min	0.0645	0.0645
Between an *exit* enclosure and the adjacent *floor area* in a *building* not more than 3 *storeys* in *building height*	All ratings	No limit	0.8	0.8
Between an *exit* enclosure and the adjacent *floor area* (except as permitted above)	45 min	250 after 30 min	0.0645	0.0645
	1.5 h	250 after 1 h	0.0645	0.0645
	2 h	250 after 1 h	0.0645	0.0645
In a *firewall*	1.5 h	250 after 30 min	0.0645	0
	3 h	250 after 1 h	0	0

a) the vestibule or corridor is separated from the remainder of the *floor area* by a *fire separation* having a *fire-resistance rating* not less than 45 min,
b) the *fire separation* required by Clause (a) contains no wired glass or glass block within 3 m of the *closure* into the *exit* enclosure, and
c) the vestibule or corridor contains no *occupancy*.

(See Appendix A.)

3.1.9. Building Services in Fire Separations and Fire Rated Assemblies

3.1.9.1. Fire Stopping of Service Penetrations

1) Piping, tubing, ducts, *chimneys*, optical fibre cables, electrical wires and cables, totally enclosed *noncombustible* raceways, electrical outlet boxes and other similar *building* services that penetrate a membrane forming part of an assembly required to have a *fire-resistance rating*, or a *fire separation*, shall be

a) tightly fitted, or
b) sealed by a fire stop system that, when subjected to the fire test method in CAN4-S115-M, "Standard Method of Fire Tests of Firestop Systems," has an F rating not less than the *fire-protection rating* required for *closures* in the *fire separation*.

(See A-9.10.9.6.(1) in Appendix A.) (See also Article 3.1.9.4. for penetrations involving *combustible* drain, waste and vent piping.)

2) Piping, tubing, ducts, *chimneys*, optical fibre cables, electrical wires and cables, totally enclosed *noncombustible* raceways, electrical outlet boxes and other similar *building* services that penetrate a *firewall* or a horizontal *fire separation*

that is required to have a *fire-resistance rating* in conformance with Article 3.2.1.2., shall be sealed at the penetration by a fire stop system that, when subjected to the fire test method in CAN4-S115-M, "Standard Method of Fire Tests of Firestop Systems," has an FT rating not less than the *fire-resistance rating* for the *fire separation*.

3.1.9.2. Combustibility of Service Penetrations

1) Except as permitted by Articles 3.1.9.3. and 3.1.9.4., pipes, ducts, electrical outlet boxes, totally enclosed raceways or other similar service equipment that penetrate an assembly required to have a *fire-resistance rating* shall be *noncombustible* unless the assembly has been tested incorporating that service equipment.

3.1.9.3. Penetration by Wires, Cables and Outlet Boxes

1) Optical fibre cables and electrical wires and cables in totally enclosed *noncombustible* raceways are permitted to penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2.

2) Except as permitted by Sentence (3), totally enclosed nonmetallic raceways conforming to Article 3.1.5.19., optical fibre cables, and electrical wires and cables, single or grouped, with *combustible* insulation, jackets or sheathes that conform to the requirements of Clause 3.1.5.17.(1)(a) and that are not installed in totally enclosed *noncombustible* raceways are permitted to penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the overall diameter of the single or grouped wires or cables, or the raceways is not more than 25 mm.

3) Single conductor metal sheathed cables with *combustible* jacketting that are more than 25 mm in overall diameter are permitted to penetrate a *fire separation* required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the cables are not grouped.

4) *Combustible* totally enclosed raceways which are embedded in a concrete floor slab are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the concrete cover between the raceway and the bottom of the slab is not less than 50 mm.

5) *Combustible* outlet boxes are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the opening through the membrane into the box is not more than 0.016 m².

6) Outlet boxes that penetrate opposite sides of a wall assembly shall be offset where necessary to maintain the integrity of the *fire separation*.

3.1.9.4. Combustible Piping Penetrations

1) *Combustible* sprinkler piping is permitted to penetrate a *fire separation* provided the *fire compartments* on each side of the *fire separation* are *sprinklered*.

2) *Combustible* water distribution piping that has an outside diameter not more than 30 mm is permitted to penetrate a vertical *fire separation* that is required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the piping is sealed in conformance with Clause 3.1.9.1.(1)(b).

3) Except as permitted by Sentences (4) to (6), *combustible* piping shall not be used in a drain, waste and vent piping system if any part of that system penetrates

a) a *fire separation* required to have a *fire-resistance rating*, or

b) a membrane that forms part of an assembly required to have a *fire-resistance rating*.

4) *Combustible* drain, waste and vent piping is permitted to penetrate a *fire separation* required to have a *fire-resistance rating* or a membrane that forms part of an assembly required to have a *fire-resistance rating*, provided

a) the piping is sealed at the penetration by a fire stop system that has an F rating not less than the *fire-resistance rating* required for the *fire separation* when subjected to the fire test method in CAN4-S115-M, "Standard Method of Fire Tests of Firestop Systems," with a pressure differential of 50 Pa between the exposed

and unexposed sides, with the higher pressure on the exposed side, and

b) the piping is not located in a vertical shaft.

5) *Combustible* drain piping is permitted to penetrate a horizontal *fire separation* provided it leads directly from a *noncombustible* water closet through a concrete floor slab.

6) *Combustible* drain, waste and vent piping is permitted on one side of a vertical *fire separation* provided it is not located in a vertical shaft.

3.1.9.5. Openings through a Membrane Ceiling

1) A membrane ceiling forming part of an assembly assigned a *fire-resistance rating* on the basis of Appendix D is permitted to be penetrated by openings leading into ducts within the ceiling space provided

a) the ducts are sheet steel, and

b) the amount of openings and their protection conform to the requirements of Appendix D.

3.1.9.6. Plenums

1) A ceiling assembly used as a *plenum* shall conform to Article 3.6.4.3.

3.1.10. Firewalls

3.1.10.1. Prevention of Firewall Collapse

1) Except as permitted by Sentence (2), the connections and supports for structural framing members that are connected to or supported on a *firewall* and have a *fire-resistance rating* less than that required for the *firewall*, shall be designed so that the collapse of the framing members during a fire will not cause the collapse of the *firewall*.

2) Sentence (1) does not apply to a *firewall* consisting of two separate wall assemblies each tied to its respective *building* frame but not to each other, provided each wall assembly is

a) a *fire separation* having one half of the *fire-resistance rating* required for the *firewall* by Sentences 3.1.10.2.(1) and (2), and

b) designed so that the collapse of one wall assembly will not cause collapse of the other.

3) A *firewall* is permitted to be supported on the structural frame of a *building* of *noncombustible construction* provided the supporting frame has a *fire-resistance rating* not less than that required for the *firewall*.

4) Piping, ducts and totally enclosed *noncombustible* raceways shall be installed so that their collapse will not cause collapse of the *firewall*.

3.1.10.2. Rating of Firewalls

1) A *firewall* which separates a *building* or *buildings* with *floor areas* containing a Group E or a Group F, Division 1 or 2 *major occupancy* shall be constructed as a *fire separation* of *noncombustible construction* having a *fire-resistance rating* not less than 4 h, except that where the upper portion of a *firewall* separates *floor areas* containing other than Group E or Group F, Division 1 or 2 *major occupancies*, the *fire-resistance rating* of the upper portion of the *firewall* is permitted to be not less than 2 h.

2) A *firewall* which separates a *building* or *buildings* with *floor areas* containing *major occupancies* other than Group E or Group F, Division 1 or 2 shall be constructed as a *fire separation* of *noncombustible construction* having a *fire-resistance rating* not less than 2 h.

3) Except for *closures*, the required *fire-resistance rating* of a *firewall* shall be provided by masonry or concrete.

3.1.10.3. Continuity of Firewalls

1) A *firewall* shall extend from the ground continuously through, or adjacent to, all *storeys* of a *building* or *buildings* so separated, except that a *firewall* located above a *basement storage garage* conforming to Article 3.2.1.2. is permitted to commence at the floor assembly immediately above the *storage garage*. (See also Sentence 3.1.10.1.(3).)

2) A *firewall* is permitted to terminate on the underside of a reinforced concrete roof slab provided

a) the roof slab on both sides of the *firewall* has a *fire-resistance rating* not less than

i) 1 h if the *firewall* is required to have a *fire-resistance rating* not less than 2 h, or

Appendix D

4) When doors are equipped with electromagnetic locks, these locks shall be tested at intervals not greater than 12 months.

2.7.2.2. Records

1) Records of tests required in Sentences 2.7.2.1.(2), (3) and (4) shall be retained in conformance with Article 1.1.1.6.

2.7.3. Exit Lighting, Exit Signs and Emergency Lighting

2.7.3.1. Installation and Maintenance

1) *Exit* lighting, *exit* signs and emergency lighting shall be provided in *buildings* in conformance with the British Columbia Building Code. (See Appendix A.)

2) *Exit* lighting and *exit* signs shall be illuminated during times the *building* is occupied.

3) Emergency lighting shall be maintained in operating condition, in conformance with Section 6.7.

Section 2.8. Emergency Planning

2.8.1. General

2.8.1.1. Application

1) Fire emergency procedures conforming to this Section shall be provided for

a) every *building* containing an *assembly* or a *care or detention occupancy*,

b) every *building* required by the British Columbia Building Code to have a fire alarm system,

c) demolition and construction sites regulated under Section 2.14. of this Code,

d) storage areas required to have a fire safety plan in conformance with Articles 3.2.2.6. and 3.3.2.9.,

e) areas where *flammable liquids* or *combustible liquids* are stored or handled, in conformance with Article 4.1.5.6., and

f) areas where hazardous processes or operations occur, in conformance with Article 5.1.5.1.

2.8.1.2. Training of Supervisory Staff

1) *Supervisory staff* shall be trained in the fire emergency procedures described in the fire safety plan before they are given any responsibility for fire safety. (See Appendix A.)

2.8.1.3. Keys and Special Devices

1) Any keys or special devices needed to operate the fire alarm system or provide access to any fire protection systems or equipment shall be readily available to on-duty *supervisory staff*.

2.8.2. Fire Safety Plan

2.8.2.1. Measures in a Fire Safety Plan

1) In *buildings* or areas described in Article 2.8.1.1., a fire safety plan conforming to this Section shall be prepared in cooperation with the fire department and other applicable regulatory authorities and shall include

a) the emergency procedures to be used in case of fire, including
   i) sounding the fire alarm (see Appendix A),
   ii) notifying the fire department,
   iii) instructing occupants on procedures to be followed when the fire alarm sounds,
   iv) evacuating occupants, including special provisions for persons requiring assistance (see Appendix A),
   v) confining, controlling and extinguishing the fire,

b) the appointment and organization of designated *supervisory staff* to carry out fire safety duties,

c) the training of *supervisory staff* and other occupants in their responsibilities for fire safety,

d) documents, including diagrams, showing the type, location and operation of the *building* fire emergency systems,

e) the holding of fire drills,

f) the control of fire hazards in the *building*,

g) the inspection and maintenance of *building* facilities provided for the safety of occupants, and

h) a copy of the records of inspections, maintenance procedures or tests as required by Article 1.1.1.6.

(See Appendix A.)

2) The fire safety plan shall be reviewed at intervals not greater than 12 months to ensure that it takes account of changes in the use and other characteristics of the *building*.

2.8.2.2. Care or Detention Occupancies

1) A sufficient number of *supervisory staff* shall be on duty in *care or detention occupancies* to perform the tasks outlined in the fire safety plan described in Clause 2.8.2.1.(1)(a).

2.8.2.3. Assembly Occupancies

1) In Group A, Division 1 *assembly occupancies* containing more than 60 occupants, there shall be at least one *supervisory staff* member on duty in the *building* to perform the tasks outlined in the fire safety plan in Clause 2.8.2.1.(1)(a) whenever the *building* is open to the public.

2.8.2.4. High Buildings

1) In *buildings* within the scope of Subsection 3.2.6. of the British Columbia Building Code, the fire safety plan shall, in addition to the requirements of Sentence 2.8.2.1.(1), include

a) the training of *supervisory staff* in the use of the voice communication system,
b) the procedures for the use of elevators,
c) the action to be taken by *supervisory staff* in initiating any smoke control or other fire emergency systems installed in a *building* in the event of fire until the fire department arrives,
d) instructions to the *supervisory staff* and fire department for the operation of the systems referred to in Clause (c), and
e) the procedures established to facilitate fire department access to the *building* and fire location within the *building*.

2.8.2.5. Retention of Fire Safety Plans

1) The fire safety plan shall be kept in a location, designated by the *authority having jurisdiction* within the *building*, for reference by the fire department, *supervisory staff* and other personnel.

2) The fire safety plan for a *building* within the scope of Subsection 3.2.6. of the British Columbia Building Code shall be kept at the central alarm and control facility.

2.8.2.6. Distribution

1) A copy of the fire emergency procedures and other duties for *supervisory staff*, as laid down in the fire safety plan, shall be given to all *supervisory staff*.

2.8.2.7. Posting of Fire Emergency Procedures

1) At least one copy of the fire emergency procedures shall be prominently posted on each *floor area*.

2) In every hotel and motel bedroom the fire safety rules for occupants shall be posted showing the locations of *exits* and the paths of travel to *exits*.

3) Where a fire alarm system has been installed with no provisions to transmit a signal to the fire department, a sign shall be posted at each manually actuated signalling box requesting that the fire department be notified, and including the telephone number of that department.

4) All *buildings* served by one or more elevators shall have a permanently mounted fire safety sign or symbol on each floor level at each elevator entrance, which indicates that the elevator is not to be used in case of fire. This symbol shall be at least 100 mm in height and width and shall be designed in accordance with NFPA 170.

2.8.3. Fire Drills

2.8.3.1. Fire Drill Procedures

1) The procedure for conducting fire drills shall be determined by the person in responsible charge of the *building*, taking into consideration

a) the *building occupancy* and its fire hazards,
b) the safety features provided in the *building*,
c) the desirable degree of participation of occupants other than *supervisory staff*,
d) the number and degree of experience of participating *supervisory staff*,
e) the features of fire emergency systems installed in *buildings* within the scope of Subsection 3.2.6. of the British Columbia Building Code, and
f) the requirements of the fire department. (See Appendix A.)

2.8.3.2. Fire Drill Frequency

1) Fire drills as described in Sentence 2.8.3.1.(1) shall be held at intervals not greater than 12 months for the *supervisory staff*, except that

a) in day-care centres and in Group B *major occupancies*, such drills shall be held at intervals not greater than one month,

b) in schools attended by children, total evacuation fire drills shall be held at least 3 times in each of the fall and spring school terms, and

c) in *buildings* within the scope of Subsection 3.2.6. of the British Columbia Building Code, such drills shall be held at intervals not greater than 2 months.

Section 2.9. Tents and Air-Supported Structures

2.9.1. General

2.9.1.1. Tents and Air-Supported Structures

1) Tents and *air-supported structures* shall be in conformance with the British Columbia Building Code.

2.9.2. Materials

2.9.2.1. Flame Retardant Treatments

1) Flame retardant treatments shall be renewed as often as required to ensure that the material will pass the match flame test in NFPA 701, "Fire Tests for Flame-Resistant Textiles and Films." (See A-2.3.2.2.(1) in Appendix A.)

2.9.3. Fire Hazards and Control

2.9.3.1. Electrical Systems

1) The electrical system in a tent or *air-supported structure* shall be maintained and operated in a safe manner.

2) Portable electrical systems shall be inspected for fire hazards and defects shall be corrected before the tent or *air-supported structure* is occupied by the public.

3) The electrical system and equipment in a tent or *air-supported structure*, including electrical fuses and switches, shall be inaccessible to the public.

4) Cables on the ground in areas used by the public in a tent or *air-supported structure* shall be placed in trenches or protected by covers to prevent damage from traffic.

2.9.3.2. Combustible Materials

1) Hay, straw, shavings or similar combustible materials other than necessary for the daily feeding and care of animals shall not be permitted within a tent or *air-supported structure* used for an *assembly occupancy*, except that sawdust and shavings are permitted to be used if kept damp.

2.9.3.3. Smoking and Open Flame Devices

1) Smoking and open flame devices shall not be permitted in a tent or *air-supported structure* while it is occupied by the public.

2.9.3.4. Fire Watch

1) A person shall be employed to watch for fires in tents and *air-supported structures* occupied by the public where the facilities are designed to accommodate more than 1 000 persons.

2) A person employed to watch for fires as described in Sentence (1) shall

a) be familiar with all fire safety features, including the fire safety plan as provided in conformance with Section 2.8. and the condition of *exits*, and

b) patrol the area to ensure that the *means of egress* are kept clear and that requirements of the *authority having jurisdiction* are enforced.

2.9.3.5. Fire Alarm System

1) Where tents and *air-supported structures* are designed to accommodate more than 1 000 persons, a fire alarm and emergency communication system shall be provided. (See Appendix A.)

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Asbestos Building Materials Management Survey

The Salmon Arm & Shuswap Lake Agricultural Association

351 3rd Street SW, Salmon Arm, BC – SASCU Indoor Sports Complex

April 4, 2016

Apex File Number: HOM16-022

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Appendices

1.0 INTRODUCTION

Apex EHS Services (Apex) was retained by The Salmon Arm & Shuswap Lake Agricultural Association to conduct an Asbestos Building Materials Management Survey (ABMMS) for the SASCU Indoor Sports Complex located at 351 3rd Street SW, Salmon Arm, BC. Apex understands that this survey was required for regulatory compliance purposes. See Appendix I for a complete description of the background and purpose for this survey.

The ABMMS for this site was conducted by Matt Summers and Stephanie Ott of Apex on March 28, 2016.

2.0 SCOPE OF WORK & LIMITATIONS

This assessment was performed with the objective of compiling an inventory of asbestos-containing materials (ACM). See Appendix II for bulk sample collection methodology utilized by Apex in this survey.

As per the requirements of WSBC OH&SR Section 6 (1) this survey determined the risk of worker exposure to asbestos by using a decision matrix. A risk/condition assessment was prepared for each asbestos-containing material identified in the inventory with due regard for the condition of the material, its' friability, accessibility and likelihood of damage, and the potential for fibre release and exposure of workers. See Appendix VII for a list of ACMs identified and the recommended Action/Management Priority.

A management survey only identifies the asbestos-containing building materials that could be encountered or disturbed by building workers or occupants during regular work activities. This is a non-destructive survey. As a result, hidden and below-ground materials are not addressed and any hidden materials which may contain asbestos should be assumed to be hazardous until sampling can demonstrate otherwise.

Energised or operational electronic and hydraulic equipment and systems, building contents, materials in concealed areas such as within solid wall and ceiling cavities, and materials within pipe chases were not assessed as part of this survey. These materials should not generally present a risk to workers if undisturbed, even if they are asbestos-containing. Nevertheless, in case of planned renovation work or accidental disturbance we recommend that suspect materials be sampled and analyzed.

Following the site assessments and receipt of laboratory analysis results, Apex has prepared this report which includes the findings of this investigation and, where applicable, provision of recommendations for further work.

Materials assumed not to contain asbestos during this ABMS included wood and wood composite materials, carpet, synthetic plastics, rubbers, metals and concrete.

The areas not included in the ABMMS are indicated in Table 1.

Table 1 - Areas Not Surveyed	
Location	**Reason**
Exterior Cladding	Not sampled to prevent damage to the integrity of the building envelope
Roof	Not sampled to prevent damage to the roof membrane.

3.0 SITE DESCRIPTION

A site drawing is attached in Appendix 4 and photographs taken during the site visit are presented in Appendix 5.

Table 2 - Site Description	
Building Information	**Description**
Construction Date	Prior to 1990
Refurbishment Date(s)	N/A
Number of Floors	Two
Exterior Finish	Stucco and Wood Siding
Heating System	Overhead Gas Heating
Roof Composition	Built Up Roll-on Asphalt
Flooring	Concrete, Vinyl Floor Tile, Rubber Tile and Vinyl Sheet Flooring
Interior Wall Finishes	Drywall, Plywood and Wood Siding
Ceiling Finishes	Drywall, Acoustic Ceiling Tile and Plywood

4.0 ASBESTOS BUILDING MATERIALS SURVEY RESULTS

Sample location drawings are included in Appendix 4. Photographs of asbestos-containing materials are included in Appendix 5.

Results for samples analyzed for asbestos are shown in Table 3. A risk assessment matrix of asbestos-containing materials is included in Appendix VII. Laboratory analytical results are included in Appendix 6. A

Table 3 - Asbestos Analysis Results

Sample #	Material	Description	Location	Asbestos Content / Type	Approximate Quantity (Square Feet)
S01(a-g)	Drywall Joint Compound	Applied to Drywall Walls and Ceilings	Throughout Building	Not Detected	-
S02	Acoustic Ceiling Tile	2'x4' Tile - Random Pinhole and Fissure	Front Office (Loc.1), Ribbon Storage Area (Loc.13), Lunch Room (Loc.20), N. Back Office (Loc.20), Office Washroom (Loc.23)	Not Detected	-
S03	**Vinyl Sheet Flooring**	**Yellow**	**Kitchen (Loc.7)**	**60%/ Chrysotile**	**15**
S04	Vinyl Sheet Flooring	Tan 4"x4" Square Pattern	Kitchen Storage Room (Loc.8)	Not Detected	-
S05	**Sink Mastic**	**Black**	**Kitchen (Loc.7)**	**1-5%/ Chrysotile**	**1**
S06(a-c)	Texture Coat	Applied to Drywall	Small Storage Room (Loc. 9)	Not Detected	-
S07	Mastic	Applied to Ducting – Black	2nd Floor Storage Room (Loc.11)	Not Detected	-
S08	Ceiling Tile	12"x12" Decretive Tile	S. Back Office (Loc.22)	Not Detected	-

Table 3 - Asbestos Analysis Results					
Sample #	**Material**	**Description**	**Location**	**Asbestos Content / Type**	**Approximate Quantity (Square Feet)**
S09	**Vermiculite**	**Present within Block Wall Cavities and as Debris**	**Back Hallway (Loc.15), Back Washroom (Loc.16), Back Storage Area (Loc.17), Workshop (Loc.18) and Tool Storage Area (Loc.19)**	**Detected/ Actinolite**	**1500**

Asbestos-containing materials are bolded.

*Quantities are an estimate and should not be used as an exact measurement.

According to WorkSafeBC, the definition of an asbestos-containing material is 0.5% by weight, with the exception of vermiculite, which is considered asbestos-containing if any amount of asbestos is present.

Visually identified suspect asbestos-containing materials that were unable to be sample are reported in Table 4:

Table 4 - Visually Identified Suspect Asbestos-Containing Materials				
Material	**Description**	**Location**	**Approximate Quantity (Square Feet)***	**Reason Not Sampled**
Stucco	Applied to Exterior Cladding	Exterior	5000	To Avoid Damage to Building Envelope
Roof	Built-Up Roll-On Asphalt	Exterior	20 000	To Avoid Damage to Roof Membrane

*Quantities are an estimate and should not be used as an exact measurement.

5.0 RECOMMENDATIONS

- Due to the presence of asbestos-containing vermiculite insulation present as debris, the back hallway (Loc.15), washroom (Loc.16), storage room (Loc.17), workshop (Loc.18) and tool storage area (Loc.19) should be treated as an asbestos-contaminated environment. These areas should be isolated from the remainder of the building and entry to these areas should be limited to workers following moderate risk asbestos work procedures (1/2 face respirator with p-100 filters, Tyvek suit, rubber boots, wash-up station).
- Asbestos-containing vermiculite insulation present as debris should be cleaned up immediately following WorkSafeBC asbestos safe work procedures.
- Retain a qualified professional to design an air tight wall system along the concrete block walls in the back hallway (Loc. 15), washroom (Loc. 16), storage room (Loc. 17), workshop (Loc. 18) and tool storage area (Loc. 19) and adjacent exterior side that will prevent future spillage of asbestos-containing vermiculite.
- Prior to removal or disposal of asbestos-containing materials, a risk assessment must be performed by a qualified person to determine the exposure risk to workers and other persons as per WorksafeBC OHS Guideline G20.112 Risk Assessment for Identified Asbestos.
- Prior to any renovation or demolition activity a detailed pre-demolition asbestos survey should be completed as required by Section 20.112 of the Occupational Health and Safety Regulations.
- As required by section 6.3 of the Occupational Health and Safety Regulations, if a worker is or may be exposed to potentially harmful levels of asbestos, an exposure control plan must be developed and implemented to meet the requirements of section 5.54.
- As required by section 6.5 of the Occupational Health and Safety Regulations, asbestos-containing materials present in the workplace should be identified by signs, labels or when not practicable, other effective means.
- Implement an Asbestos Management Program, including routine inspection of identified asbestos-containing materials. Materials should be reassessed to keep the inventory current.

6.0 CLOSURE

An asbestos building materials survey can not wholly eliminate uncertainty regarding the potential for recognized asbestos-containing materials conditions at the site. Performance of a standardized asbestos-containing material survey protocol is intended to reduce, but not eliminate uncertainty regarding the potential for recognized asbestos-containing materials at the site, given reasonable limits of time and cost.

This report has been prepared by Apex EHS Services exclusively for The Salmon Arm & Shuswap Lake Agricultural Association, and is intended to provide a survey of the potential for the presence of asbestos-containing materials on the site. No warranty, expressed or implied, is made. Any use which a third party makes of this report, or any reliance on or decisions to be made or actions based on it, are the responsibility of such third parties. Apex EHS Services accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report. The terms of reference for this report are specified in Appendix IX.

Authored By:

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Appendix I – Background & Purpose

The WorkSafeBC (WSBC) Occupational Health and Safety Regulation (OH&SR) Section 6.4 requires that an inventory of asbestos materials for buildings constructed prior to 1990 is completed in order to establish the presence/absence, location and type of asbestos materials utilized in the construction of the facility. Asbestos materials are inventoried by means of a room by room visual assessment, sample collection and subsequent laboratory analysis of suspected asbestos materials.

This Asbestos Building Materials Management Survey is a part of The Salmon Arm & Shuswap Lake Agricultural Association initiative to maintain compliance with WSBC requirements. The ABMMP is intended to help The Salmon Arm & Shuswap Lake Agricultural Association efficiently manage asbestos-containing materials at The Salmon Arm & Shuswap Lake Agricultural Association properties, protect the health and safety of The Salmon Arm & Shuswap Lake Agricultural Association staff, contractors and the general public when on The Salmon Arm & Shuswap Lake Agricultural Association property.

The findings from this survey should only be used for the purpose of building management and routine maintenance. The results of this survey are not intended to be used for construction, renovation, demolition or project tendering purposes.

Appendix II – Methodology

ASBESTOS-CONTAINING MATERIALS (ACMs)

An initial walk-through inspection was conducted throughout the structure and observations were made of the wall, ceiling, floor, and other materials including any machinery or equipment to make a preliminary determination if asbestos could be present

To confirm or discount the presence of asbestos, representative bulk samples were collected. The sample location in the building was identified with a unique sample number. The number of representative bulk samples collected was consistent with recognized industry standards and principles of good occupational hygiene practice. The approximate quantity, location and sample locations of suspect ACMs were recorded.

Bulk samples were submitted for analysis in accordance with PLM: Bulk Asbestos Building Materials EPA 600 R 93 / 116. 1993. The asbestos analysis was completed using a stop positive approach. Stop positive means samples in a homogenous material sample set were analyzed consecutively and when a sample was identified as asbestos-containing, further sample analysis within that sample set was not completed.

Samples containing >0.5% asbestos were identified as being asbestos containing. Vermiculite insulation was identified as being asbestos containing if any trace of asbestos was found.

The material descriptions and locations of suspect ACMs from this building are documented in Table 4.

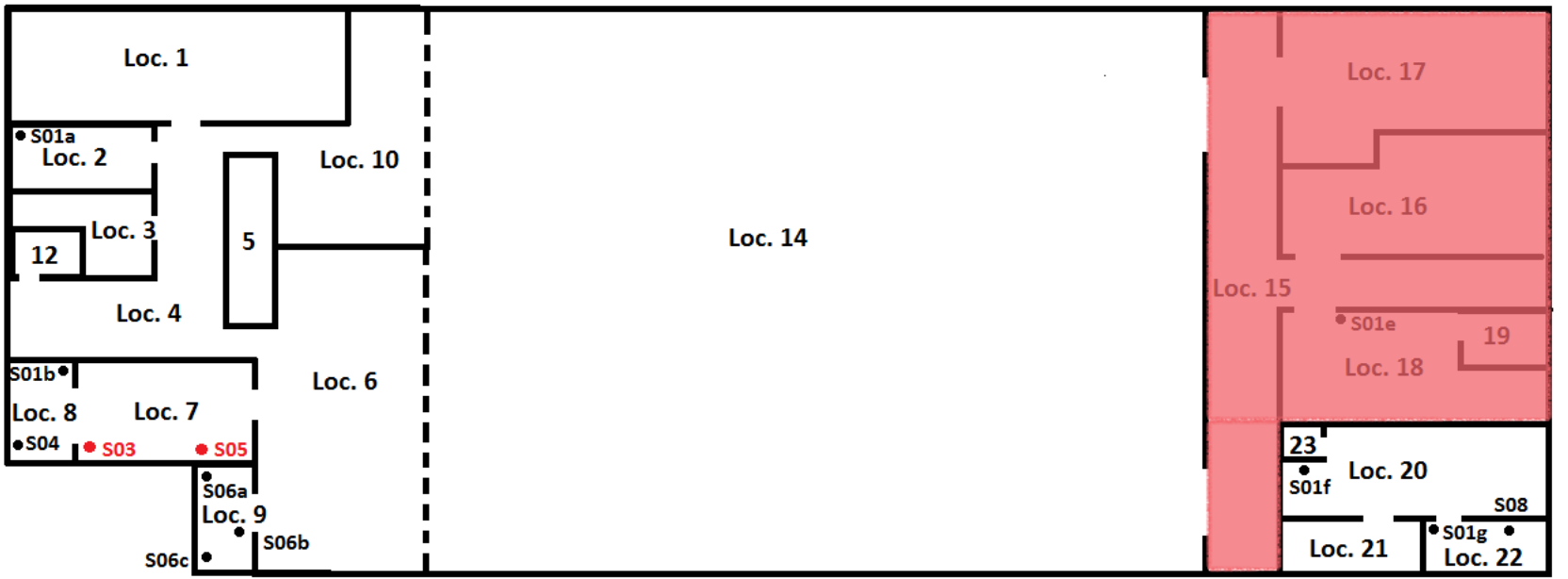
Materials assumed not to contain asbestos during this ABMS included wood and wood composite materials, carpet, synthetic plastics, rubbers, metals and concrete.

Appendix III – Regulatory Framework

1. BC Occupational Health and Safety Regulation
2. Safe Work Practices for Handling Asbestos, WorkSafeBC, 2013
3. Hazardous Waste Regulation, BC Ministry Of Environment
4. Transportation of Dangerous Goods Regulations SOR / 2008-34, Transportation of Dangerous Goods Act.

Appendix IV – Drawing

APEX EHS SERVICES



Legend

- Asbestos Sample Loction -Positive Results
- Asbestos Contaminated Area

Title: Sample Locations

Project: Asbestos Building Materials Management Survey - 351 3rd Street SW, Salmon Arm, BC

Client: The Salmon Arm & Shuswap Lake Agricultural Associatiopn

Date: April 4, 2016

Project #: HOM16-022

Scale: NTS

Drawn By: MS

Appendix V – Photographs

	Asbestos-containing vermiculite insulation present as debris in the Back Storage (Loc. 17)
	Asbestos-containing vermiculite insulation present as debris in the Back Hallway (Loc. 15)
	Asbestos-containing vermiculite insulation present as debris in the Workshop (Loc. 18)

	Damage to cinderblock walls allowing the accumulation of asbestos-containing vermiculite insulation debris in the Back Hallway (Loc. 15).
	Damage to cinderblock walls allowing the accumulation of asbestos-containing vermiculite insulation debris in the Back Storage (Loc. 17).
	Damage to cinderblock walls allowing the accumulation of asbestos-containing vermiculite insulation debris on the Exterior of the Building.

	The paper backing applied to the yellow vinyl sheet flooring within the kitchen (Loc.7) is asbestos-containing
	Black sink mastic in the kitchen (Loc.7) is asbestos-containing.

Appendix VI – Analytical Results

Apex EHS Services Inc.
1981 Bredin Road, Kelowna, BC, V1Y 8T2
Phone:250-868-0667 Email:apex@apexehs.ca

ASBESTOS ANALYSIS REPORT

Client: The Salmon Arm & Shuswap Lake Agricultural Association
Project Location: 351 3rd Street SW, Salmon Arm, BC
Number of Samples: 16
Reported: 31/3/2016

Report Number: HOM16-022
Project Number: -
Project: -

Sample No.	Lab No.	Phase	Sample Description	Results
S01a	3368	Single - White Compound	Drywall Joint Compound/ Location 2	Asbestos Fibres Not Detected 90-100% Non-fibrous
S01b	3369	Single - White Compound	Drywall Joint Compound/ Location 8	Asbestos Fibres Not Detected 90-100% Non-fibrous
S01c	3370	Single - White Compound	Drywall Joint Compound/ Location 11	Asbestos Fibres Not Detected 90-100% Non-fibrous
S01d	3371	Single - White Compound	Drywall Joint Compound/ Location 13	Asbestos Fibres Not Detected 90-100% Non-fibrous
S01e	3372	Single - White Compound	Drywall Joint Compound/ Location 18	Asbestos Fibres Not Detected 90-100% Non-fibrous
S01f	3373	Single - White Compound	Drywall Joint Compound/ Location 20	Asbestos Fibres Not Detected 90-100% Non-fibrous
S01g	3374	Single - White Compound	Drywall Joint Compound/ Location 22	Asbestos Fibres Not Detected 90-100% Non-fibrous
S02	3375	Single - Beige, Fibrous, Foam	Acoustic Ceiling Tile/ Location 13	Asbestos Fibres Not Detected 50% Cellulose 50% Non-fibrous
S03	3376	1st Layer - Yellow Vinyl	Vinyl Sheet Flooring(Yellow)/ Location 7	Asbestos Fibres Not Detected 90-100% Non-fibrous
S03	3376	2nd Layer - White Foam	Vinyl Sheet Flooring(Yellow)/ Location 7	Asbestos Fibres Not Detected 90-100% Non-fibrous
S03	3376	3rd Layer - Beige, Fibrous	Vinyl Sheet Flooring(Yellow)/ Location 7	60% Chrysotile Asbestos 10% Cellulose 30% Non-fibrous
S03	3376	4th Layer - Beige Compounf	Vinyl Sheet Flooring(Yellow)/ Location 7	Asbestos Fibres Not Detected 90-100% Non-fibrous

Method: US EPA 600/R-93/116 by Polarized Light Microscopy

Analyst: A. Copp

Apex EHS Services Inc.

1981 Bredin Road, Kelowna, BC, V1Y 8T2

Phone:250-868-0667 Email:apex@apexehs.ca

Sample No.	Lab No.	Phase	Sample Description	Results
S04	3377	1st Layer - Tan Vinyl	Vinyl Sheet Flooring(4x4 Tan)/ Location 8	Asbestos Fibres Not Detected 90-100% Non-fibrous
S04	3377	2nd Layer - White Foam	Vinyl Sheet Flooring(4x4 Tan)/ Location 8	Asbestos Fibres Not Detected 90-100% Non-fibrous
S04	3377	3rd Layer - Beige, Fibrous	Vinyl Sheet Flooring(4x4 Tan)/ Location 8	Asbestos Fibres Not Detected 70% Cellulose 30% Non-fibrous
S05	3378	Single -Black Compound, FIbrous	Sink Mastic/ Location 7	1-5% Chrysotile Asbestos 95-99% Non-fibrous
S06a	3379	Single - White Compound, Fibrous	Texture Coat/ Location 9	Asbestos Fibres Not Detected 0.5-5% Cellulose 95-99.5% Non-fibrous
S06b	3380	Single - White Compound, Fibrous	Texture Coat/ Location 9	Asbestos Fibres Not Detected 0.5-5% Cellulose 95-99.5% Non-fibrous
S06c	3381	Single - White Compound, Fibrous	Texture Coat/ Location 9	Asbestos Fibres Not Detected 0.5-5% Cellulose 95-99.5% Non-fibrous
S07	3382	Single - Black Mastic	Black Mastic/ Location 11	Asbestos Fibres Not Detected 90-100% Non-fibrous
S08	3383	Single - Beige, Fibrous, Foam	Decorative Ceiling Tile(12x12 Square Pattern)/ Location 22	Asbestos Fibres Not Detected 50% Cellulose 50% Non-fibrous

Samples analyzed in accordance with US EPA 600/R-93/116 by Polarized Light Microscopy
American Industrial Hygiene Association (AIHA) BAPAT Program Laboratory Number 224210
Quantification of <0.25% by volume is possible with this method.
Apex EHS Services will not accept any responsibility as to the manner of interpretation or application of these results.

Authorized By:

Kelly Konrad, B.Sc., EPt
Laboratory Manager

Method: US EPA 600/R-93/116 by Polarized Light Microscopy

Analyst: A. Copp

Apex EHS Services Inc.

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Phone:250-868-0667 Email:apex@apexehs.ca

ASBESTOS ANALYSIS REPORT

Client:	The Salmon Arm & Shuswap Lake Agricultural Association	**Report Number:**	HOM16-022
Project Location:	351 3rd Street SW, Salmon Arm, BC	**Project Number:**	-
Number of Samples:	1	**Project:**	-
Reported:	24/2/2016		

Sample No.	Lab No.	Phase	Sample Description	Results
S09	2729	Multiple - Beige/Grey Granular, Fibrous	Vermiculite	Actinolite Asbestos Detected

Samples analyzed in accordance with US EPA 600/R-93/116 by Polarized Light Microscopy
American Industrial Hygiene Association (AIHA) BAPAT Program Laboratory Number 224210
Quantification of <0.25% by volume is possible with this method.
Apex EHS Services will not accept any responsibility as to the manner of interpretation or application of these results.

Authorized By:

Kelly Konrad, B.Sc., EPt
Laboratory Manager

Method: US EPA 600/R-93/116 by Polarized Light Microscopy

Analyst: A. Copp

Appendix VII– Asbestos-Containing Materials Risk Matrix & Building Inventory

Asbestos-Containing Materials Risk Matrix & Building Inventory - 0

Address: 351 3rd Street SW, Salmon Arm, BC

Client: The Salmon Arm & Shuswap Lake Agricultural Association

Project No.: HOM16-022

Location No.	Location Description	Material Description			Sample Collection		Constraints		Condition	Action #	Lab Ref. #	Asbestos Content	
		Material or System Identifier Number (i.e., Same as S-1)	Description of Material (i.e., 9 x 9 FT - mottled black with beige, black mastic)	Friable or Non-Friable	Sample Number	Same as Sample Number	Debris (Y/N)	Accessibility of Material	Condition of Material (Integrity)			% Asbestos Content (Type)	ACM (Y/N)
7	Floor	Sheet Flooring	Yellow	Friable	S03		No	C	Good	7	3376	60% Chrysotile	Yes
7	Other	Mastic	Sink Mastic - Black	Non-Friable	S05		No	C	Good	7	367593	1.3% Chrysotile	Yes
15	Wall	Vermiculite	Present With in Block Wall Cavities	Friable		S09	No	A	Good	5	2729	Detected/ Actinolite	Yes
15	Debris	Vermiculite	Present as Debris	Friable		S09	Yes	A	Poor	1	2729	Detected/ Actinolite	Yes
16	Wall	Vermiculite	Present With in Block Wall Cavities	Friable		S09	No	C	Good	7	2729	Detected/ Actinolite	Yes
16	Debris	Vermiculite	Present as Debris	Friable		S09	Yes	C	Poor	2	2729	Detected/ Actinolite	Yes
17	Wall	Vermiculite	Present With in Block Wall Cavities	Friable		S09	No	C	Good	7	2729	Detected/ Actinolite	Yes
17	Debris	Vermiculite	Present as Debris	Friable		S09	Yes	C	Poor	2	2729	Detected/ Actinolite	Yes
18	Wall	Vermiculite	Present With in Block Wall Cavities	Friable		S09	No	C	Good	7	2729	Detected/ Actinolite	Yes
18	Debris	Vermiculite	Present as Debris	Friable		S09	Yes	C	Poor	2	2729	Detected/ Actinolite	Yes
19	Wall	Vermiculite	Present With in Block Wall Cavities	Friable		S09	No	C	Good	7	2729	Detected/ Actinolite	Yes
19	Debris	Vermiculite	Present as Debris	Friable		S09	Yes	C	Poor	2	2729	Detected/ Actinolite	Yes

ACTION	EXPLANATION
1	**HIGH Priority - Clean up of ACM Debris** Clean up ACM debris immediately. Restrict any access that may disturb the debris.
2	**MEDIUM Priority - Clean up of ACM Debris** Clean up ACM debris. Restrict any access that may disturb the debris.
3	**HIGH Priority - Removal of ACMs** Remove ACMs as soon as possible. Restrict any access that may disturb the debris until it is removed.
4	**MEDIUM Priority - Removal of ACMs** Remove ACMs. Restrict any access that may disturb the debris until it is removed.
5	**LOW Priority - ACM Control** In conjunction with other building activities, remove, enclose or encapsulate ACMs.
6	**ACM Repair**
7	**Asbestos Management Program** Implement an Asbestos Management Program, including routine surveillance. Materials should be reassessed (at least once per year).

Appendix VIII – Building Materials Room by Room Inventory

Building Materials Room by Room Inventory

Room Name	Room Number	Visible Flooring	North Wall	East Wall	South Wall	West Wall	Ceiling	Above Ceiling	Mechanical	Other	Comments
Front Office	Loc.1	Concrete	S01	S01	S01	S01	S02	-	-	-	
Women' Washroom	Loc.2	Concrete	S01	S01	S01	S01	S01	-	-	-	
Men's Washroom	Loc.3	Concrete	S01	S01	S01	S01	S01	-	-	-	
Foyer	Loc.4	Rubber	S01	S01	Brick	Wood	Wood	-	-	-	
Sign Storage Room	Loc.5	Rubber	Wood	Wood	Wood	Wood	Wood	-	-	-	
Waiting Area	Loc.6	Concrete	S01	-	-	S01	Wood	-	-	-	-
Kitchen	Loc.7	Rubber/ S03	Wood	Wood	Wood	Wood	Wood	-	-	S05	S03(VSF) S05(Sink Mastic)
Kitchen Storage	Loc.8	S04	S01	S01	Wood	Wood	Wood	-	-	-	
Archery Storage	Loc.9	Concrete	Wood	Wood	Wood	Wood	S01 & S06	-	-	-	
Bleachers	Loc.10	Rubber	Wood	-	-	-	Wood	-	-	-	
2nd Floor Storage	Loc.11	Carpet	S01	S01	S01	S01	S01	-	-	-	
Hot Water Tank	Loc.12	Concrete	S01	S01	S01	S01	Wood	-	-	-	
Ribbon Storage	Loc.13	Wood	S01	S01	S01	S01	S02	Wood	-	-	
Field	Loc.14	Turf	Wood	Wood	Wood	Wood	Wood	-	-	-	
Back Hallway	Loc.15	Rubber	Wood	Wood	Wood	S09	Wood	-	-	-	S09 (Vermiculite)
Back Washroom/ Storage Room	Loc.16	Rubber	S09	S09	S09	S09	Wood	-	-	-	S09 (Vermiculite)
Back Storage	Loc.17	Rubber	S09	S09	S09	S09	Wood	-	-	-	S09 (Vermiculite)
Work Shop	Loc.18	Rubber	S09	S09	S09	S09	Wood	-	-	-	S09 (Vermiculite)
Tool Storage	Loc.19	Concrete	S09	S09	S09	S09	Wood	-	-	-	S09 (Vermiculite)
Lunch Room	Loc.20	Concrete	S01	S01	S01	S01	S02	Wood	-	-	
N. Back Office	Loc.21	Concrete	S01	S01	S01	S01	S02	Wood	-	-	
S. Back Office	Loc.22	Concrete	S01	S01	S01	S01	S08	Wood	-	-	
Office Washroom	Loc.23	Concrete	S01	S01	S01	S01	S02	Wood	-	-	

Site Location: 351 3rd Street SW, Salmon Arm, BC
Building Name: SASCU Indoor Spports Complex
Apex Project No.: HOM16-022

Yellow Indicates Asbestos-Containing

APEX EHS SERVICES

Appendix IX – Terms of Reference

- This report has been prepared in accordance with generally-accepted consulting practices and the level of care for hazardous materials and occupational health and safety consulting services. No other warranty, expressed or implied, is made.
- This report should be read in conjunction with all other communication between Apex EHS Services and the client with respect to the subject site.
- This report has been prepared in response to the specific objectives of the client as stated when Apex EHS Services was retained to carry out this project.
- This report has been prepared for the sole use of the client and no other party may rely on this report or any component of this report.
- This report remains the copyright of Apex EHS Services.
- Apex EHS Services accepts no responsibility for and damages to a third party resulting from the use of this report.
- This report is based on the conditions observed at the date of the assessment and is limited specifically to the areas defined in the report.
- Apex EHS Services has relied on any information provided by the client regarding the subject site and has assumed this information is accurate and truthful.
- This report in written or digital format must not be altered in any way by the client.

Apex EHS Services Inc.
1981 Bredin Road, Kelowna, BC V1Y 8T2
Phone: 250-868-0667 Email: apex@apexehs.ca

April 18, 2016
APEX File No.: HOM16-022

The Salmon Arm & Shuswap Agricultural Association
351 3rd Street SW,
Salmon Arm, BC

Attention: Phil Wright

CC: Les Brandt

Lead Paint Bulk Sampling Results Letter

Project Address: 351 3rd Street SW, Salmon Arm, BC
Project Name: SASCU Indoor Sports Complex

Introduction

Apex EHS Services (Apex) was retained by Okanagan Restoration on behalf of The Salmon Arm & Shuswap Agricultural Association to undertake sampling for suspect lead paints at the SASCU Indoor Sports Complex located at 351 3rd Street SW, Salmon Arm, BC.

Sampling was carried out on Stephanie Ott, *Hazardous Materials Technician* in accordance with Apex's standard sampling methodology.

Sampling was limited to the areas and materials potentially impacted by the proposed restoration work as indicated by Okanagan Restoration Services which comprised:

- Paint applied to interior and exterior concrete block walls

Results

Lead analytical results are summarised in Table 1, site photographs and full results are attached to this report.

Table 3- Lead Paint[1]				
Sample #	**Substrate / Colour**	**Location**	**Lead Content (%)**	**Approximate Quantity (Square Feet)***
L01	Concrete Block / Red	Back Washroom, Back Storage, Work Shop, Tool Storage	<0.0084	-
L02	Concrete Block / White	Back Washroom, Back Storage, Work Shop, Tool Storage	0.0061	-
L03	**Concrete Block / Beige**	**Back Washroom, Back Storage, Work Shop, Tool Storage**	**0.030**	**1000**
L04	**Concrete Block / Dark Red**	**Exterior**	**1.8**	**25**
L05	Concrete Block / Red	Exterior	<0.0091	-

Paints with a lead content greater than 0.009% lead are identified as lead containing and are bolded
*Quantities are an estimate and should not be used as an exact measurement.

[1] Paints with a lead content greater than 0.009% w/w are identified as lead containing

Recommendations

- Proper procedures and documentation such as safe work practices, an exposure control plan, risk assessments and/or other controls must be developed if paints containing greater than 0.06% lead are to be removed or disturbed.
- Paints containing greater than 0.01% lead should be submitted for lead leachate analysis to determine method of disposal subject to the requirements of the landfill selected for disposal.

Prepared by:

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Reviewed by:

Kelly Konrad, B.Sc., EP(OH&S)
Laboratory Manager
for Apex EHS Services
Tel: 250-868-0667
Email: kkonrad@apexehs.ca

Attached:
Sampling Methodology
Terms of Reference
Analytical Results
Photograph Table

Lead Sampling Methodology

During the walk-through inspection a visual review of the painted surfaces was conducted for paints and coatings. Apex personnel collected representative bulk samples from the building structure. The number of representative bulk samples collected was consistent with recognized industry standards and principles of good occupational hygiene practice.

Bulk samples were submitted for lead analyses in accordance with ASTM D3335-85A "Standard Method to Test for Low Concentrations of Lead in Paint by Atomic Absorption Spectrophotometry". Chain-of-custody protocol was observed during handling and transportation of the bulk samples.

Samples containing >0.009% (90 mg/kg) lead were identified as lead paints.

TERMS OF REFERENCE

- This report has been prepared in accordance with generally-accepted consulting practices and the level of care for hazardous materials and occupational health and safety consulting services. No other warranty, expressed or implied, is made.
- This report should be read in conjunction with all other communication between Apex EHS Services and the client with respect to the subject site.
- This report has been prepared in response to the specific objectives of the client as stated when Apex EHS Services was retained to carry out this project.
- This report has been prepared for the sole use of the client and no other party may rely on this report or any component of this report.
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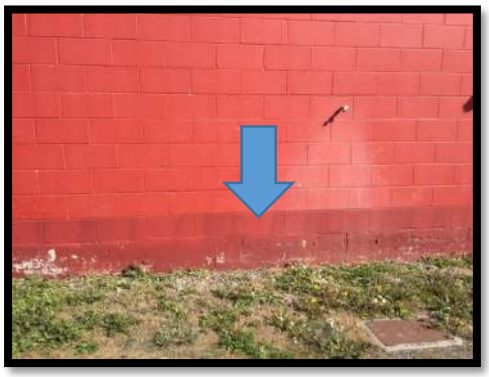
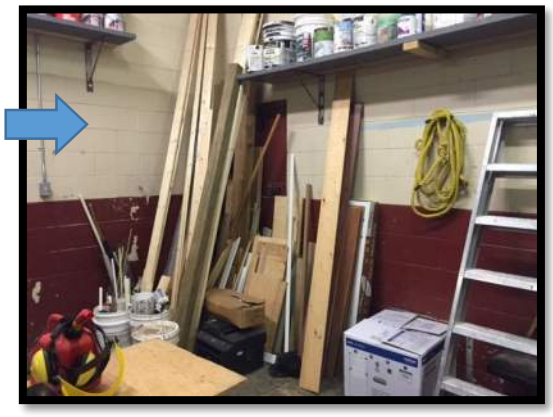
- Apex EHS Services accepts no responsibility for and damages to a third party resulting from the use of this report.
- This report is based on the conditions observed at the date of the assessment and is limited specifically to the areas defined in the report.
- Apex EHS Services has relied on any information provided by the client regarding the subject site and has assumed this information is accurate and truthful.
- This report in written or digital format must not be altered in any way by the client.

	Dark red paint applied to exterior block wall contains 1.8% lead.
	Beige paint applied to the interior side of the concrete black walls contained 0.03% lead.

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

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Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: Apex EHS Services
1981 Bredin Rd.
Kelowna BC V1Y 8T2

Client: APE864

Report Date: 4/18/2016
Report No.: 507665 - Lead Paint
Project: 351 3rd St. SW, Salmon Arm.
Project No.: HOM16-022

LEAD PAINT SAMPLE ANALYSIS SUMMARY

Lab No.:5905962 **Description:**Red **Result (% by Weight):**<0.0084
Client No.:L01 **Location:**Interior, 4-15-16 **Result (ppm):**<84
Comments:

Lab No.:5905963 **Description:**White **Result (% by Weight):**0.0061
Client No.:L02 **Location:**Interior, 4-15-16 **Result (ppm):**61
Comments:

Lab No.:5905964 **Description:**Beige **Result (% by Weight):**0.030
Client No.:L03 **Location:**Interior, 4-15-16 **Result (ppm):**300
Comments:

Lab No.:5905965 **Description:**Dk.Red **Result (% by Weight):**1.8
Client No.:L04 **Location:**Exterior, 4-15-16 **Result (ppm):**18000
Comments:***

Lab No.:5905966 **Description:**Red **Result (% by Weight):**<0.0091
Client No.:L05 **Location:**Exterior, 4-15-16 **Result (ppm):**<91
Comments:

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/18/2016
Date Analyzed: 4/18/2016 11:30:13 AM
Signature:
Analyst: Chad Shaffer

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: Apex EHS Services
1981 Bredin Rd.
Kelowna BC V1Y 8T2

Client: APE864

Report Date: 4/18/2016
Report No.: 507665 - Lead Paint
Project: 351 3rd St. SW, Salmon Arm.
Project No.: HOM16-022

Appendix to Analytical Report:

Customer No.: APE864
Customer: Apex EHS Services
Address: 1981 Bredin Rd.
Customer Contact: J Widmer
Analysis: ASTM D3335--85a

This appendix seeks to promote greater understanding of any observations, exceptions, special instructions, or circumstances that the laboratory needs to communicate to the client concerning the above samples. The information below is used to help promote your ability to make the most informed decisions for you and your customers. Please note the following points of contact for any questions you may have.

iATL Customer Service: customerservice@iatl.com
iATL Office Manager: cdavis@iatl.com
iATL Account Representative: Shirley Clark
Sample Login Notes: See Batch Sheet Attached
Sample Matrix: Paint
Exceptions Noted: See Following Pages

General Terms, Warrants, Limits, Qualifiers:

General information about iATL capabilities and client/laboratory relationships and responsibilities are spelled out in iATL policies that are listed at www.iATL.com and in our Quality Assurance Manual per ISO 17025 standard requirements. The information therein is a representation of iATL definitions and policies for turnaround times, sample submittal, collection media, blank definitions, quantification issues and limit of detection, analytical methods and procedures, sub-contracting policies, results reporting options, fees, terms, and discounts, confidentiality, sample archival and disposal, and data interpretation.

iATL warrants the test results to be of a precision normal for the type and methodology employed for each sample submitted. iATL disclaims any other warrants, expressed or implied, including warranty of fitness for a particular purpose and warranty of merchantability. iATL accepts no legal responsibility for the purpose for which the client uses test results. Any analytical work performed must be governed by our Standard Terms and Conditions. Prices, methods and detection limits may be changed without notification. Please contact your Customer Service Representative for the most current information.

This confidential report relates only to those item(s) tested and does not represent an endorsement by NIST-NVLAP, AIHA LAP LLC, or any agency of local, state or province governments nor of any agency of the U.S. government.

Information Pertinent to this Report:

Analysis by ASTM D3335--85a by AAS

Certification:
- National Lead Laboratory Program (NLLAP): AIHA-LAP, LLC No. 100188&
- NYSDOH-ELAP No. 11021

Regulatory limit is 0.5% lead by weight (EPA/HUD guidelines). Recommend multiple sampling for all samples less than regulatory limit for confirmation.

All results are based on the samples as received at the lab. iATL assumes that appropriate sampling methods have been used and that the data upon which these results are based have been accurately supplied by the client.

Method Detection Limit (MDL) per EPA Method 40CFR Part 136 Apendix B.

Reporting Limit (RL) based upon Lowest Standard Determined (LSD) in accordance with AIHA-ELLAP policies.

LSD=0.2 ppm MDL=0.0044% by weight. RL= 0.010% by weight (based upon 100 mg sampled).

* Insufficient sample provided to perform QC reanalysis (<200 mg)

** Not enough sample provided to analyze (<50 mg)

*** Matrix / substrate interference possible.

9000 Commerce Parkway Suite B
Mt. Laurel, New Jersey 08054
Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: Apex EHS Services
1981 Bredin Rd.
Kelowna BC V1Y 8T2

Client: APE864

Report Date: 4/18/2016
Report No.: 507665 - Lead Paint
Project: 351 3rd St. SW, Salmon Arm.
Project No.: HOM16-022

Disclaimers / Qualifiers:

There may be some samples in this project that have a "NOTE:" associated with a sample result. We use added disclaimers or qualifiers to inform the client about something that requires further explanation. Here is a complete list with highlighted disclaimers pertinent to this project. For a full explanation of these and other disclaimers, please inquire at **customerservice@iatl.com.**

* NOTE: Multiple samples received in container. Composite analysis requested per EPA/HUD guidelines not covered by NLLAP/AIHA accreditation.

Apex EHS Services Inc.
1981 Bredin Road, Kelowna, BC V1Y 8T2
Phone: 250-868-0667 Email: apex@apexehs.ca

April 22, 2016

APEX Project Number: ORS16-057

Okanagan Restoration Services
6236 Pleasant Valley Road
Vernon, BC

Client Project Manager: Les Brandt

Asbestos Clearance Letter

Project Address: 351 3rd Street NW, Salmon Arm, BC

Introduction

Apex EHS Services Inc. (Apex) was retained by Okangan Restoration Services to provide asbestos consulting services in connection with a project carried out at 351 3rd Street, Salmon Arm, BC.

Scope of Work

Apex's scope of work included the following:

- Collection and analysis of clearance air samples.

Air Sampling Results

Table 1 present's asbestos air sampling results; table 2 presents sample interpretation criteria.

Table 1 - Asbestos Air Sampling Results

Sample No.	Date Collected	Sampling Location	Sample Type	Fibre Level (f/cc)	Within Criteria (Y/N)
1	April 22, 2016	Field Blank	Blank	<7 f/mm^2	Y
2	April 22, 2016	Field Blank	Blank	<7 f/mm^2	Y
3	April 22, 2016	Turf Field	Clearance	<0.01	Y
4	April 22, 2016	Turf Field	Clearance	<0.01	Y

< below the limit of detection

Table 2 – Interpretation Criteria

Location / Type	Criteria (f/cc)
Clearance	0.02
Blank**	N/A

*50% of permissible exposure limit (0.1 f/cc) for unprotected worker over an 8 hour shift, **blank sample(s) collected for quality control purposes, criteria is <7 f/mm^2

Air samples were collected during the abatement by Stephanie Ott, of Apex on April 22, 2016. All samples were collected and analyzed following NIOSH Method 7400 using Phase Contrast Microscope (PCM) analysis.

Air clearance sample results were below WorkSafeBC criteria (0.02 f/cc).

Closure

The scope of this project was limited to the collection of asbestos air samples and the comparison of sample results to regulatory criteria. Apex did not design or supervise asbestos abatement work for this project and cannot comment on whether the work was carried out fully in accordance with Provincial/Federal Occupational fully in accordance with Provincial/Federal Occupational Health and Safety Regulations.

Prepared By:

Stephanie Ott, B.Sc.,
Hazardous Material Technician
for Apex EHS Services
Tel: 250-868-0667
Email: sott@apexehs.ca

Reviewed by:

Kelly Konrad, B.Sc., EP(OH&S)
Laboratory Manager
for Apex EHS Services
Tel: 250-868-0667
Email: kkonrad@apexehs.ca

Attached:
Terms of Reference
Site Photo

TERMS OF REFERENCE

- This report has been prepared in accordance with generally-accepted consulting practices and the level of care for hazardous materials and occupational health and safety consulting services. No other warranty, expressed or implied, is made.
- This report should be read in conjunction with all other communication between Apex EHS Services and the client with respect to the subject site.
- This report has been prepared in response to the specific objectives of the client as stated when Apex EHS Services was retained to carry out this project.
- This report has been prepared for the sole use of the client and no other party may rely on this report or any component of this report.
- This report remains the copyright of Apex EHS Services.
- Apex EHS Services accepts no responsibility for and damages to a third party resulting from the use of this report.
- This report is based on the conditions observed at the date of the assessment and is limited specifically to the areas defined in the report.
- Apex EHS Services has relied on any information provided by the client regarding the subject site and has assumed this information is accurate and truthful.
- This report in written or digital format must not be altered in any way by the client.

	The air sample clearance results that were taken from the field were below WorkSafeBC criteria (0.02 f/cc).

ASBESTOS AIR SAMPLING REPORT

22-Apr-16
351 3rd Street Salmon Arm, BC
HOM16-022

Sample #	Date Collected	Flow Rate (L/Min)	Time On	Time Off	Sample Type	Sample Location	Fibre Level (f/cc)
1	22-Apr-16				BLK	Field Blank	N/A x
2	22-Apr-16				BLK	Field Blank	N/A x
3	22-Apr-16	16.00	11:06	13:11	CLR	Turf Field	<0.01 x
4	22-Apr-16	16.00	11:06	13:11	CLR	Turf Field	<0.01 x

Sample Type	Description
AMB	Ambient sample collect outside of enclosure or designated work area
BLK	Field blank collected for quality control purposes.
CLR	Air clearance sample collected post abatement
CLN	Clean room sample collected in the clean room
OCC	Occupational sample collected from the workers breathing zone during abatement.

As noted in NIOSH Method 7400, the default coefficient of variation for this method is 0.45

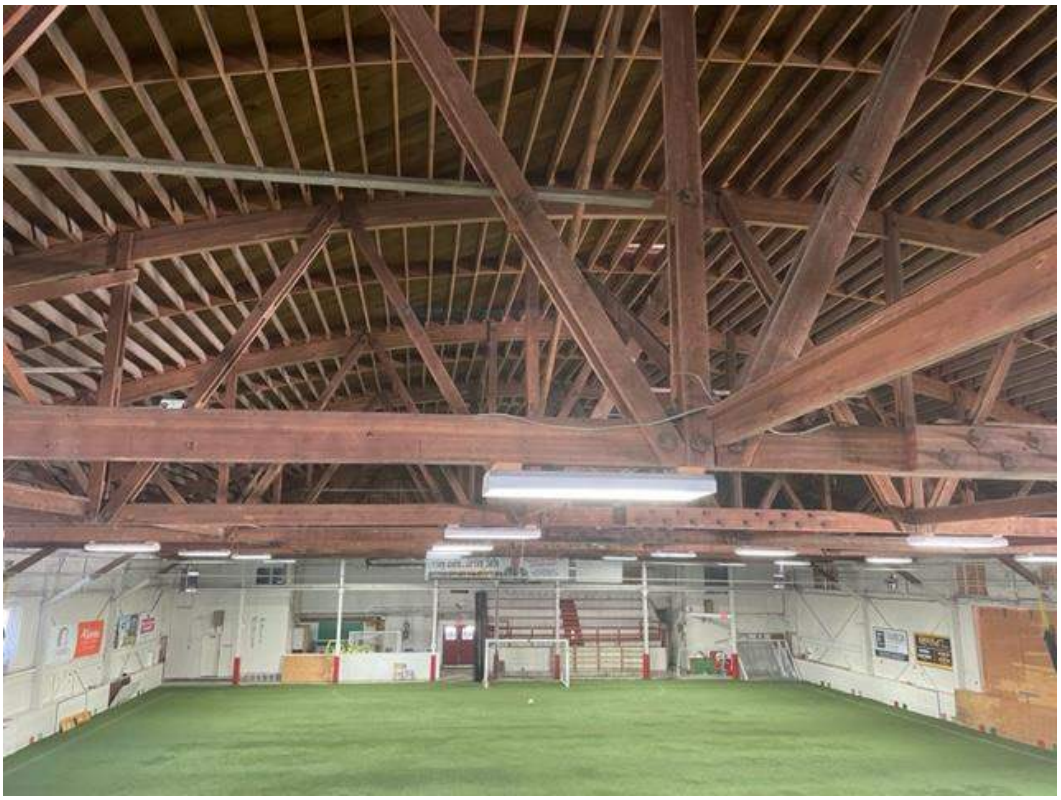
x - below the detection limit of 7 f/mm^2

Overloaded - non-fibrous material (as defined by NIOSH 7400) covered the counting field so no value could be determined

Defect - Pump malfunction or loss of power or cassette invalid (wet, damaged, no filter, etc.), therefore no sample available

R&A ENGINEERING (1997) LTD.
Structural Consultants

PRELIMINARY STRUCURAL CONDITION ASSESSMENT



Salmon Arm Memorial Arena
351 3rd Street SW, Salmon Arm

Prepared for:

Salmon Arm Recreation
2600-10th Avenue NE
Salmon Arm, BC
V1E2S

Prepared by:

R&A Engineering (1997) Ltd.
#202-3401 33rd Street
Vernon, BC, V1T 7X7

Project No.: 123006

Issue Date: May 10th, 2023

1.0 Introduction

R&A Engineering (1997) Ltd. was retained by Salmon Arm Recreation to perform a preliminary structural condition assessment of the building´s main roof support structure located at 351 3rd Street, SW, Salmon Arm, BC. R&A Engineering also reviewed the original structural drawings that were available by the City of Salmon Arm. On January 23, 2023 Matthew Derkach, P.Eng of R&A Engineering completed an initial walk-through of the structure. Subsequently, Greg Wylie, P.Eng and Emilio Gonzalez, EIT of R&A Engineering visited the site to complete a site assessment March 8th, 2023. R&A Engineering also completed preliminary calculations for the main components of the existing building related to the existing BCBC code in conformance to the requirements of BCBC Part 4 Commentary L. The following report outlines the results of our review and provides recommendations for future reviews.

2.0 Building Description

As indicated in the building structural drawings, the Salmon Arm Memorial Arena was constructed around 1956. Since this time, minor renovations have occurred at the east and west end of the original arena structure. Recently, the ice surface was decommissioned, and the building was repurposed as an indoor soccer field with synthetic turf above the original slab-on-grade. It does not appear that any significant upgrades or updates to the existing building from the original construction have been completed.

2.1 Main Roof Structure

The main roof system is comprised of plywood decking supported on a wood joist system, spanning between the large bowstring type wood trusses spaced at approximately 20’-0” on center. The trusses span about 103 feet and are supported by heavy timber columns on each end. The trusses are made up of a curving glulam top chord and a horizontal glulam bottom chord. Double heavy timber members are used for truss vertical and diagonal members, which sandwich the top and bottom glulam chords. All members appear to be connected with exposed through-bolts, with some members connected with hidden steel shear rings which are not visible but are noted in the original structural drawings, combined with other miscellaneous steel. Photographs of the existing truss and connections have been provided in Appendix A, Photographs 1 and 2. The north and south exterior walls are constructed from a plywood sheathed 2”x8” stud wall with diagonal wood bracing in some of its bays.

2.2 East and West Low Roof Structure

To the east and west sides of the main building, the structure is comprised of a lower flat roof which appears to align with the bottom chord of the main roof trusses. Although these structures were not reviewed in detail, the structures appear to be heavy timber post and beams supporting roof joists of unknown depth and spacing. See Photograph 3 for the typical framing of the structure. The exterior walls of this portion of the building appear to be of wood frame construction.

3.0 Field Evaluation and Document Review

A visual walk-through assessment of the existing building was carried out by Greg Wylie, P.Eng. and Emilio Gonzalez, E.I.T. of R&A Engineering on March 8th, 2023 with the assistance of a provided boom lift. The review involved a visual inspection of the current condition of the roof framing system, a review of the exterior and interior stud walls, as well as a review of the exterior heavy timber columns. Photographs were taken of the structure for future review and coordination. A steel tool was also used to inspect a select number of wood members, looking for soft sections of wood which could indicate rot or other issues.

A subsequent review of available record drawings was conducted to identify areas of concern and clarify structural items that ere not available for the review due to interior and exterior finishes. The scope of this report does not include a detailed review of the lateral load resisting system of the building or detailed design review of structural members for gravity loading, as outline in Appendix B – Scope of Work and Limitations. Photograph of item identified during the evaluation are provided in Appendix A – Site Photographs.

3.1 Preliminary Site Assessment of Existing Main Roof Trusses

To verify the current condition of the wood trusses, a visual inspection of the members as well as their connections was conducted during the site visit completed by Emilio Gonzalez. Visual signs of significant distress or deterioration in the glulam top and bottom chords or the heavy timber truss web members was identified. With the exception of one select connection, the connections did not appear to show visible signs of distress around the bolted connections. One connection location showed sign of distress, in which a visible split parallel to grain was a identified in a through-bolt connection of a vertical member with the top glulam member, as shown in Photograph 4. A detailed review should be done on this connection in order provide a structural repair of this location as soon as possible, regardless if potential remediation or upgrades of the structure occurs.

During the review areas of moisture was identified in the diagonal and vertical members of the truss, in close proximity to the side walls. From a visual review of the beams no visible signs of rot or deterioration was identified, although long term exposure to moisture can result in potential deterioration of the wood members. In numerous locations, rusting of the bolted connections was identified which appears to be as a result of moisture exposure. It is recommended that the roof of the existing building be reviewed in further detail, such that moisture exposure of the interior wood members can be eliminated. .

3.2 Preliminary Site Assessment of Main Roof Support Columns and Wall

The exterior stud walls and heavy timber columns are supported at grade on a foundation with unknown configuration. In review of the perimeter of the building, it appears that the exterior grading of the finishes around the building are flush with the interior of the building which has resulted in moisture entrance into the building. In the northeast corner of the building, there is one column location which shows significant signs of rot and deterioration, which is show in photograph 5. This rot resulted in the column to deform vertically and out of plane, which has also caused the structure to deform globally in this location. Due to the extent of the deformation of the structure, this column should be reviewed by a structural engineer as soon as possible such that a repair can be provided.

As all sides of the building have been exposed to moisture throughout the life of the building, it would be anticipated that more location of potential deterioration of the wood frame structure would be identified in the remaining exterior walls. It is recommended that further review of the primary wood structural be

completed in a detailed structural assessment of the building, which would require the interior finishes of the building to be removed to allow visual observation of the base of the columns.

3.3 Preliminary Assessment of East and West Structure

Although structural drawings could not be provided for the west and west additions, the visible structure for these roof systems was reviewed on site. From a review of the structure, no visible signs of deterioration or distress were identified. Similar to the notes in section 3.2, the structure appears to have some signs of moisture entrance into the building, which may result in deterioration of the wood framing system. As such further review of the structure is recommended, which may require selective demolition of the interior finishes to allow access to the structure.

As with the main arena roof, although the roof systems appears have performed adequately for the life of the buildings it would not be anticipated that these roof systems are not believed to be suitable to support current snow loading requirements. It would also be anticipated that these low roofs would not have been designed for current snow loading requirements. Although this analysis is outside of the scope of this report, we would anticipate that structural upgrades would be required to bring this portion of the building up to current standards.

4.0 Preliminary Structural Analysis of Main Roof Structure

With the use of structural analysis software, the profile of the wood trusses was modeled to verify the existing capacity of the roof system. Through the analysis of this model, we completed preliminary analysis of the structure to verify the approximate capacity of the glulam chord members and web members when subject to current loading values as per the 2018 version of the British Columbia Building Code (BCBC 2018). It is noted that the analysis was only completed to determine the approximate capacity of the roof system, it is recommended that future analysis be conducted to get an accurate evaluation of the capacity of the structure.

It is noted that a review of the existing foundation system, the east and west structures, as well as the interior slab on grade were not completed as part of the preliminary analysis. It is recommended that a review of these elements be completed as part of a detailed structural assessment of the building.

4.1 Design Loading

R&A Engineering reviewed the current capacity of the existing structural in general conformance with the recommendations of BCBC 2018 Commentary L for significant renovation of an existing building with the assumption that the potential structural upgrade of this building would be classified as a major renovation. These load combinations include self-weight of the building, as well as wind and snow loading for the City of Salmon Arm. The buildings lateral design was also checked with preliminary values for seismic and wind loading, although no formal evaluation of the lateral system was completed. It is noted that the Building Code design values have increased the design requirements for both design snow and earthquake loading since the date of the original design of the arena in the 1950's.

4.1.1 Unbalanced Snow Loading

It is anticipated that during the time of design and construction of the arena, design for unbalanced snow loading was not required and not readily considered during design. Unbalanced snow loading occurs when one side of the building is fully loading with snow and the other side has considerably less or is free of snow. This can occur after a large snow fall, when the weather warms and begins to melt the snow on

only one side of the roof due to the path of the sun. This melting can result in snow sliding off only one side of the roof, leaving the other side of the roof with full or partial snow loading. For this type of wood trusses, this unbalanced loading can result in load reversal of the diagonal and vertical stress.

4.1.2 Current BCBC 2018 Snow Loading

As a result of continued revisions to the Building Code, the Design Snow Load requirements for various locations across British Columbia have increased. When the arena was originally designed, during the 1950's, the roof load in the city of Salmon Arm is estimated to have been approximately 40 pounds per square foot (psf), which was indicated on the existing structural drawings as a live load value. The current Building Code requires that the roof snow load be designed for 60.6 psf, which is an approximate increase of 52% from the load considered for the original design.

4.1.3 Lateral Wind and Seismic Design Loading

The lateral wind and seismic design requirement for this type of building have significantly increased during recent revisions of the Building Code. For the purpose of this preliminary analysis, preliminary lateral loads were used for the City of Salmon arm in order to complete a preliminary review of the current capacity of the existing roof structure. The current building has a lateral resisting system comprised of horizontal T-strut braces connected to the bottom chord members as well as plywood exterior walls with diagonal and strut wood members, which would be considered unconventional with current design requirements.

In addition to the structural requirements for the building, the current Building Code recommends a comprehensive geotechnical investigation to be completed to verify the soils of the building for analysis. Although the geotechnical assessment was not completed for this building, for this analysis Site Class D, represented by stiff soil, was assumed as per BCBC 2018.

4.2 Results of Preliminary Analysis

Through the modeling of a typical wood truss and the aforementioned design loading values within RISA-3D Software, the approximate capacity of the truss members was determined. As anticipated from the initial loading review, the results of the structural analysis indicate that the existing glulam and web members did not have sufficient capacity to support the design loading for the existing structure. The following sections will provide an overview of the results of the analysis that was completed as well as the approximate capacity of the structure.

4.2.1 Roof Design for Unbalanced Snow Loading

Using the specified load combinations within BCBC 2018, the current structural condition of the wood trusses for increased snow load could be assessed. The results of the structural analysis concluded that the current glulam and truss web members did not have sufficient capacity to support the current snow loading values as well as unbalanced snow loading conditions. As unbalanced snow loading imposes a reverse loading on the vertical and diagonal stud members, the absence of snow on one side of the roof system imposes significant stresses on these members. In the case of the top and bottom glulam members, the loading condition with increased snow load in the whole span is most critical.

The results of the structural analysis of total snow loading concluded that the current capacity of the glulam bottom chord members is approximately 60% of the required capacity considering the increased Building Code snow loading. Comparatively, the capacity of the glulam bottom chord members is approximately 60% of the required capacity when subjected to unbalanced snow loading. It is noted that further detailed review of the truss should be completed in order to verify the capacity of the structure

including individual truss wood members, connection capacity requirements, as well as splice connections.

As the difference between the load carrying capacity of the main roof truss and the current code requirements is significant, it would be that the structural upgrade of the main roof trusses would require significant remediation and detailing. It is also noted that the existing roof system does not appear to have sufficient capacity to support the design snow loading for the region which could result in potential overloading of the truss during large snowfall events. Although the analysis and detailing of the structural truss upgrade is outside the scope of this report, it is believed that the upgrades could include the installation of additional arched members and the strengthening of the existing glulam members, stiffening of the existing diagonal web members, as well increased connection requirements.

4.2.2 Current Lateral Load Analysis

From preliminary review of the lateral load resisting system of the building, relative to the required lateral wind and seismic loading for the building, it was identified that the building did not appear to have sufficient capacity to support the design loading. Should a major renovation be completed for the building, it would be anticipated that that lateral load resisting system for the building would be required to be upgraded including the introduction of plywood sheathing shear walls with defined hold-down systems. The shear walls would also potentially require upgrades of the foundation system, which would need to be reviewed in detail. Further detailed design and analysis of the lateral capacity and potential upgrades of the structure should be completed in order to understand the extent of the upgrade that would be required.

5.0 Recommendations

Even though the main roof structure appears to have performed to an acceptable level of quality over the years, it is anticipated that significant retrofits and ongoing financial obligations would be required to maintain quality and safety within the facility. As the extent of remediation required to ensure the existing facility meets current Building Code requirements is far beyond the contents of this report, it is recommended that a building life cycle analysis be conducted to verify the validity of completing any future structural detailed condition assessments or remediation. The age of the facility and expected remaining lifespan should be considered when verifying if structural remediation of the facility is to be completed or if replacement options should be considered. The following items are recommended for further review and evaluation, as previously identified in the report.

1. A detailed structural assessment of the deteriorated wood column and settlement at the northeast end of the main roof should be conducted to provide a structural repair. The repair should include a geotechnical engineer to comment on the suitability of the current foundation system. As the deterioration has resulted in settlement and out-of-plumbness of the roof system, this repair should be completed as soon as possible in coordination with the items listed below.

2. A structural repair is recommended to be completed as soon as possible for truss web members which showed signs of distress and cracking at the bolted location, as identified in the report.

3. It is recommended that further detailed structural assessment of the existing structure be conducted to verify the feasibility of repairing or replacing the existing main roof structure. The findings of the structural analysis concluded that the roof structure would not have sufficient capacity to meet the current design loading. It would be anticipated that significant structural upgrades of all components of the roof truss structure would be required.

4. The building envelope should be repaired to prevent future moisture and deterioration issues, including a review to ensure adequate roof drainage is provided. Although no significant signs of deterioration were identified, signs of excessive moisture within the building were which could lead to future rot and deterioration of the wood structure. It is recommended that if a detailed structural analysis of the existing structure proceed, that a qualified architect be retained to comment on issues related to the envelope of the building and provide recommendations for future upgrades. The review should be completed to also identify the current condition of all of the wood column based to determine if additional repairs of these member will be required.

5. A significant number of the bolts of the main truss connection were found to be rusted. A sample of these bolts should be removed and assessed to determine the extent of the rust and to confirm their integrity. The wood surrounding these bolts would also need to be reviewed further for rot and deterioration.

6. Further review of the existing foundation system for the building should be conducted, as a visual review could not be completed at the time of the review.

7. The lateral load resisting system for the building appears to be deficient from the initial analysis, which should be reviewed in further detail prior to proceeding with any potential upgrade. It would be anticipated that significant upgrades to the existing lateral design resisting system would be required.

After the structural review and repairs have been completed for the portion of the structure identified as requiring immediate review are completed, including resolving issues regarding moisture entrance into the building, it is recommended that a full detailed structural analysis of the building be completed in conjunction with a potential life cycle analysis of the facility.

As the existing roof does not currently have sufficient capacity to support the current design snow loading, it is recommended that the overall snow loading on the building should be limited while it remains in use until a complete structural analysis of the building can be completed. It is recommended that the roof snow depth be limited to 10” when in use for public, which would require snow removal during and after snowfall events. As the removal of snow from existing roofs can be a difficult and costly process to complete, the requirement to do so should be considered as part of the life cycle analysis for the main building. Potential procedures for removal of snow from the roof, including safe access to workers, should be reviewed by owner. When snow is removed, it should be removed equally from each side of the roof such that unbalanced snow loading does not occur. Care should also be taken to remove any built-up snow at the base of the curved roof.

6.0 Closure

R&A Engineering has competed the preliminary structural assessment report at the request of Salmon Arm Recreation, based on the scope of work agreed upon. This report discusses the current physical structural condition of the existing buildings and includes recommendations for further detailed structural, geotechnical, and architectural evaluations. Detailed review of structural lateral load and gravity systems were not included within the scope of this report, although areas of potential structural concern were identified and recommended for further evaluation.

As noted in the building description, due to the age of the building it is anticipated that the design and detailing for the majority of the building would not conform to the general intent of the current building code which would result in significant structural upgrades to the building in order to maintain functionality. It is recommended that a complete life cycle analysis of the facility be completed taking into account not

only potential structural upgrades to the facility, but also upgrades related to all other building elements including building envelope, mechanical systems, electrical systems, as well as architectural.

Should further clarifications be required regarding the content of this report, please do not hesitate to contact the undersigned below.

Best Regards,

R & A Engineering (1997) Ltd.
Permit to Practice No.: 1002538

Prepared by:

Emilio Gonzalez, E.I.T.
Project Engineer

Reviewed by:

Matthew Derkach, P. Eng.
Partner, Structural Engineer
E: matt@raengineering.ca
P: 250-542-1357 (Ext. 102)

Appendix A – Photographs and Observations

Table A1: Observations	
Photo 1 Typical through-bolt connection for main roof structure.	
Photo 2 Example of existing roof trusses	
Photo 3 Typical framing at the North lower roof entrance structure.	

Photo 4 A split in a vertical truss member was identified which should be reviewed for repairs as soon as possible.	
Photo 5 Exterior of building at location in which a column shows signs of significant deterioration. The exterior finish of the building also shows indications of excessive moisture and deterioration.	

Appendix B - SCOPE OF WORK AND LIMITATIONS

B.1 Scope of Work

The Scope of Work for the proposed structural review and report at the Salmon Arm Memorial Arena was summarized as part of the proposal issued to the client on February 3rd, 2023 by R&A Engineering (1997) Ltd. The scope of work included a visual review of the existing framing and existing drawings. The structural assessment protocol was based on the recommendations of the Structural Conditional Assessment of Existing Buildings professional practice guidelines published by the Engineers & Geoscientists of British Columbia on December 3, 2020.

The structural condition assessment for the existing building was based on a visual walk-through, which included components of the structure which were accessible without modifying the interior or exterior finishes. As such, the preliminary structural assessment does not confirm the adequacy of the structural system nor confirm that the building was constructed to applicable codes and standards at the time of construction.

B.2 Limitations

Exclusive use and Reliance

This report has been prepared for the exclusive use of Salmon Arm Recration and shall not be relied upon for any other purpose than those identified in the Scope of Work agreed upon by R&A Engineering and Salmon Arm Recreation. The report shall not be used for any other purpose without the express prior written consent of R&A Engineering.

Third Party Reliance

This report shall not be relied upon by any other person or entity other than those described in the Scope of Work without the express written consent of R&A Engineering (1997) Ltd. Any reliance of this report by a third party, without express written consent by R&A Engineering (1997) Ltd., is the sole responsibility of the third party.

Limitations of Structural Assessments

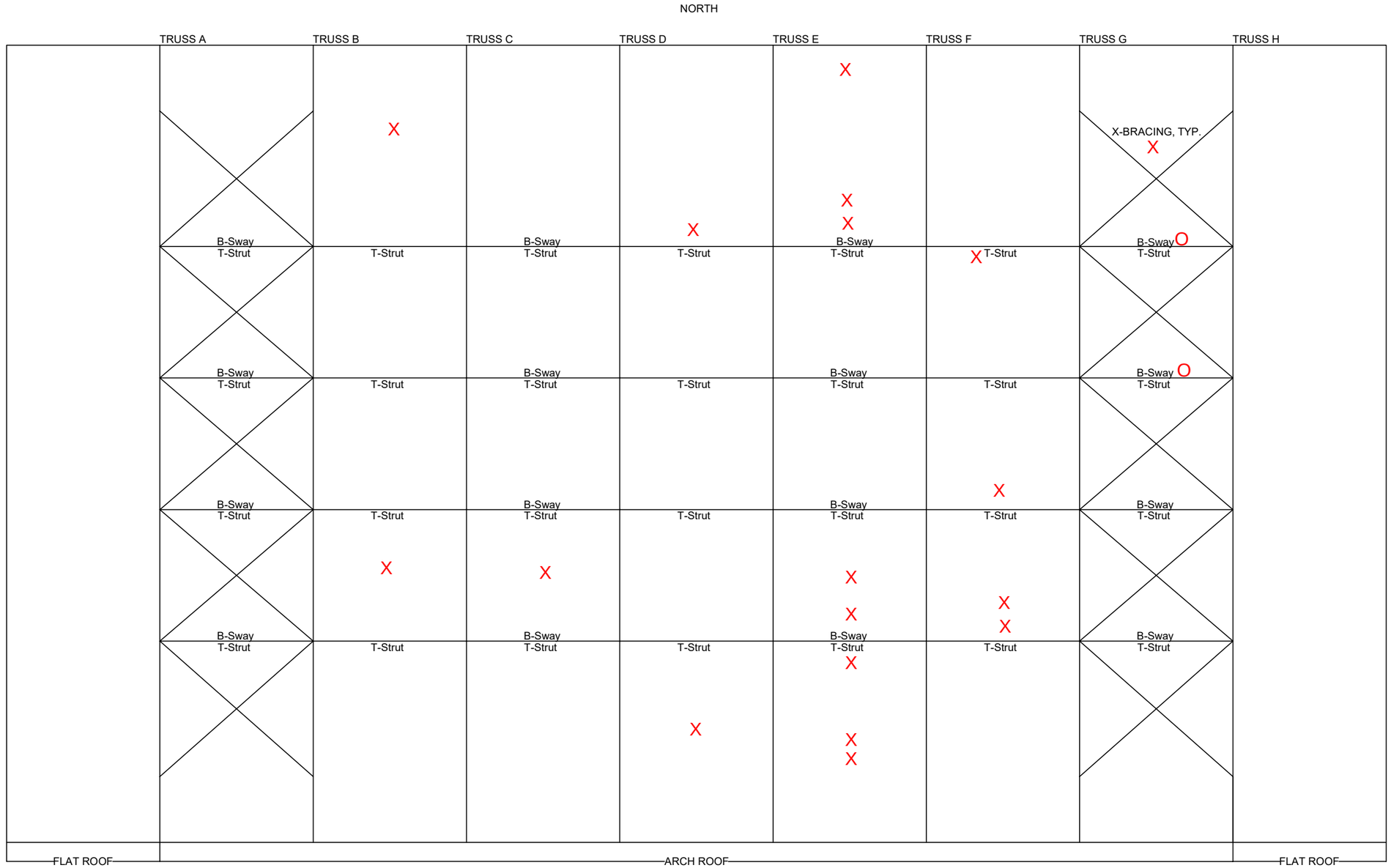
The structural assessment conducted did not include geotechnical assessments, seismic assessments, detailed engineering calculations, architectural and building envelope assessment, or electrical and mechanical assessments. R&A Engineering does not verify the accuracy of any documents reviewed or verify the buildings conformance with applicable codes and standards. R&A Engineering's Scope of Work did not include the verification of the structural adequacy of individual members or structural systems. As such, any recommendations presented in this report are based on a visual review of the existing structure and preliminary review of the existing record drawings only.

APPENDIX D

Arena Rafter Field Data

Truss Assessment Field Data

Truss Survey



ARENA RAFTER DEFECTS

LEGEND

B-SWAY: VERTICAL SWAY BRACING
T-STRUT: TEE STRUT BRACING BETWEEN BOTTOM CHORDS
X-BRACING: CROSS BRACING BETWEEN BOTTOM CHORDS
X: SPLIT RAFTERS
O: BRACING BUCKLED 2" SOUTH

BAR ENGINEERING
#201, 2540 - 53 Avenue Vernon, B.C. V1T 9W8

CLIENT:

CITY OF SALMON ARM

SEAL:

PERMIT:

No.	BY	ENG	APR	DESCRIPTION	DATE
01	JLF	JLF	WS	ISSUED FOR INFORMATION	2024-03-25

PROJECT:

STRUCTURAL ASSESSMENT & LIFE CYCLE ANALYSIS
MEMORIAL ARENA

LOCATION:

351 3RD STREET SOUTHWEST
SALMON ARM, BC

DRAWING NAME:

ARENA RAFTER DEFECTS

PROJECT NO.:

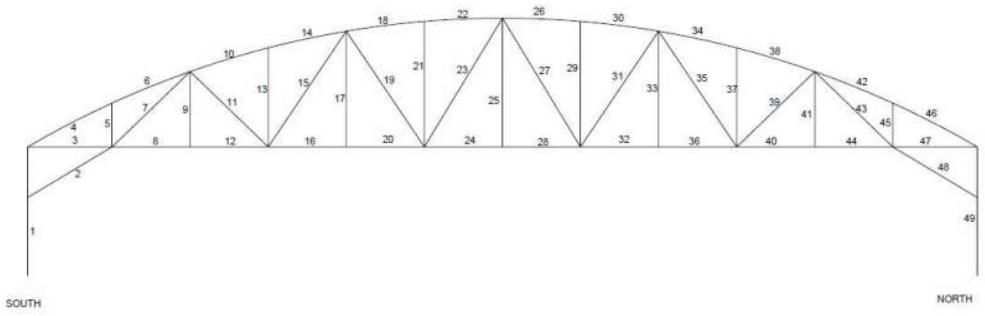
24VR-600400

DRAWING NO.:

SHT-03

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	

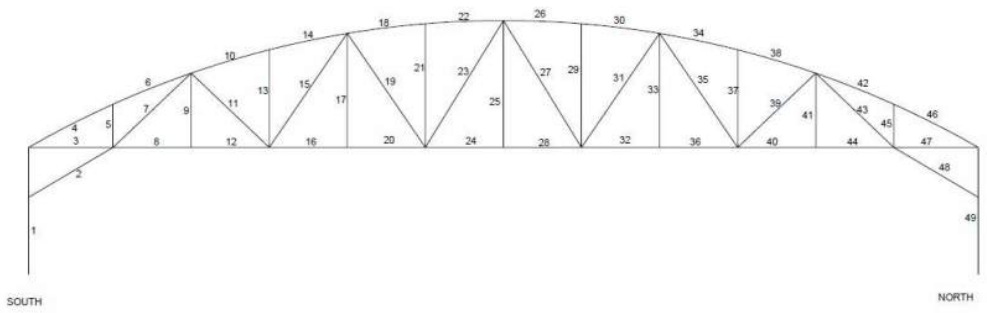


Truss:	A	Date: Feb 26	Inspector: CT / JF			
Member	**Face (E/W)**	**Size (w"xd")**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16	Fail @ Bottom			
1	West	10 x 16	Fail @ Bottom	Checking (15mmx100mm)		
2	East	2 x 6				
2	West	2 x 6				
3	East	6-ply glulam, 5" x 9.75"		Lamination 6		
3	West	6-ply glulam, 5" x 9.75"		Lamination 6		
4	East	9-ply glulam, 5" x 14.625"				
4	West	9-ply glulam, 5" x 14.625"				
5	East	2 x 8	Fail @ bottom			
5	West	2 x 8		Checking		
6	East	9-ply glulam, 5" x 14.625"				
6	West	9-ply glulam, 5" x 14.625"				
7	East	2 x 6				
7	West	2 x 6				
8	East	6-ply glulam, 5" x 9.75"		Lamination 6		
8	West	6-ply glulam, 5" x 9.75"		Lamination 6		
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				
10	East	9-ply glulam, 5" x 14.625"				
10	West	9-ply glulam, 5" x 14.625"				
11	East	2 x 6				water staining, no rot
11	West	2 x 6	Fail @ bottom			
12	East	6-ply glulam, 5" x 9.75"		Lamination 6		
12	West	6-ply glulam, 5" x 9.75"				
13	East	2 x 6	Fail @ bottom			
13	West	2 x 6	Fail @ bottom			
14	East	9-ply glulam, 5" x 14.625"				
14	West	9-ply glulam, 5" x 14.625"				
15	East	2 x 6	Fail @ bottom			
15	West	2 x 6				
16	East	6-ply glulam, 5" x 9.75"		Lamination 6		
16	West	6-ply glulam, 5" x 9.75"		Lamination 5		
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9-ply glulam, 5" x 14.625"				
18	West	9-ply glulam, 5" x 14.625"				
19	East	2 x 6				
19	West	2 x 6				
20	East	6-ply glulam, 5" x 9.75"				
20	West	6-ply glulam, 5" x 9.75"				
21	East	2 x 6				
21	West	2 x 6				
22	East	9-ply glulam, 5" x 14.625"				
22	West	9-ply glulam, 5" x 14.625"				
23	East	2 x 8	Fail @ bottom, Fail @ top			
23	West	2 x 8				
24	East	6-ply glulam, 5" x 9.75"				
24	West	6-ply glulam, 5" x 9.75"				
25	East	Tension tie (gable) Null (non gable)				
25	West	Tension tie (gable) Null (non gable)				
26	East	9-ply glulam, 5" x 14.625"				
26	West	9-ply glulam, 5" x 14.625"				
27	East	2 x8	Fail @ bottom, Fail @ top			
27	West	2 x8		Checking		
28	East	6-ply glulam, 5" x 9.75"				
28	West	6-ply glulam, 5" x 9.75"				
29	East	2 x 6	Fail @ bottom			
29	West	2 x 6				
30	East	9-ply glulam, 5" x 14.625"				
30	West	9-ply glulam, 5" x 14.625"				
31	East	2 x 6				
31	West	2 x 6	Fail @ bottom			
32	East	6-ply glulam, 5" x 9.75"				
32	West	6-ply glulam, 5" x 9.75"		Lamination 6		
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9-ply glulam, 5" x 14.625"				
34	West	9-ply glulam, 5" x 14.625"				
35	East	2 x 6				
35	West	2 x 6				
36	East	6-ply glulam, 5" x 9.75"				
36	West	6-ply glulam, 5" x 9.75"				
37	East	2 x 6				
37	West	2 x 6	Fail @ bottom			
38	East	9-ply glulam, 5" x 14.625"				
38	West	9-ply glulam, 5" x 14.625"				
39	East	2 x 6				
39	West	2 x 6				
40	East	6-ply glulam, 5" x 9.75"				
40	West	6-ply glulam, 5" x 9.75"				
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9-ply glulam, 5" x 14.625"				
42	West	9-ply glulam, 5" x 14.625"				
43	East	2 x 6				
43	West	2 x 6				
44	East	6-ply glulam, 5" x 9.75"				
44	West	6-ply glulam, 5" x 9.75"		Lamination 6		
45	East	2 x 8				
45	West	2 x 8				
46	East	9-ply glulam, 5" x 14.625"				
46	West	9-ply glulam, 5" x 14.625"				
47	East	6-ply glulam, 5" x 9.75"				
47	West	6-ply glulam, 5" x 9.75"				
48	East	2 x 6				
48	West	2 x 6				
49	East	10 x 16		Checking (9mmx70mm)		Top of post is 1/2" north of bottom
49	West	10 x 16				Top of post is 1/2" north of bottom

General Truss notes:
- Crossbracing 2 x 6
- Gable wall 2x4 @ 24" o/c
-Roof joist 2x12 @ 16" o/c w/ midpsan blocking
- Sag observed on bracing
- eave beam at south west corner has a severee twist. Bottom edge rotated north 30 Degree aprox
- 1 x8 roof planking toungue and groove'

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	

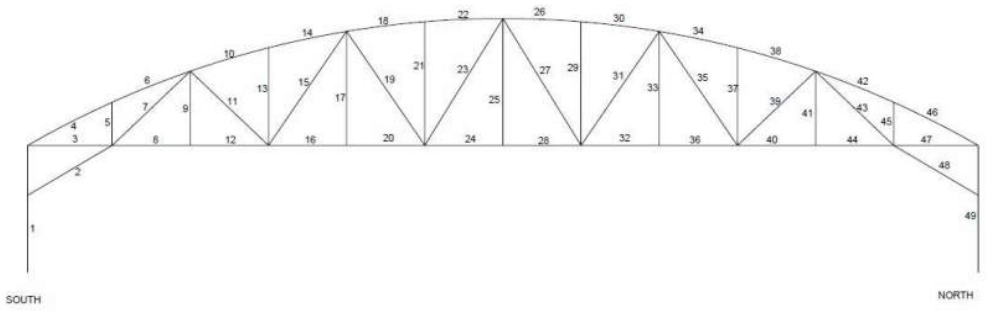


Truss:	B	Date: Feb 26	Inspector: CT / JF			
Member	**East/West**	**Size (wxd)**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16 post	Fail @ bottom	Checking (8mmx75mm)		Top of post is 1" north of bottom
1	West	10 x 16 post	Fail @ bottom	Checking (8mmx75mm)		Top of post is 1" north of bottom
2	East	2 x 6				
2	West	2 x 6				
3	East	6ply 5x 10 glulam				
3	West	6ply 5x 10 glulam				
4	East	9ply 5 x 15 glulam				
4	West	9ply 5 x 15 glulam				
5	East	2 x 8				
5	West	2 x 8	Fail @ bottom			
6	East	9ply 5 x 15 glulam				
6	West	9ply 5 x 15 glulam				
7	East	2 x 6				
7	West	2 x 6				
8	East	6ply 5x 10 glulam				
8	West	6ply 5x 10 glulam				
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				
10	East	9ply 5 x 15 glulam				
10	West	9ply 5 x 15 glulam				
11	East	2 x 6	Fail @ bottom			
11	West	2 x 6	Fail @ bottom			
12	East	6ply 5x 10 glulam				
12	West	6ply 5x 10 glulam				
13	East	2 x 6	Fail @ bottom			
13	West	2 x 6	Fail @ bottom			
14	East	9ply 5 x 15 glulam		Lamination 9		
14	West	9ply 5 x 15 glulam				
15	East	2 x 6				
15	West	2 x 6				
16	East	6ply 5x 10 glulam				
16	West	6ply 5x 10 glulam				
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9ply 5 x 15 glulam				
18	West	9ply 5 x 15 glulam				
19	East	2 x 6				
19	West	2 x 6				
20	East	6ply 5x 10 glulam				
20	West	6ply 5x 10 glulam				
21	East	2 x 6	Fail @ bottom	Checking		
21	West	2 x 6	Fail @ bottom	Checking		
22	East	9ply 5 x 15 glulam				
22	West	9ply 5 x 15 glulam				
23	East	2 x 8	Fail @ top, Fail @ bottom			
23	West	2 x 8	Fail @ top	Checking		
24	East	6ply 5x 10 glulam (Splice)				
24	West	6ply 5x 10 glulam (Splice)				
25	East	Tension tie (gable) Null (non gable)				
25	West	Tension tie (gable) Null (non gable)				
26	East	9ply 5 x 15 glulam				
26	West	9ply 5 x 15 glulam				
27	East	2 x8	Fail @ bottom			
27	West	2 x8				
28	East	6ply 5x 10 glulam (Splice)				
28	West	6ply 5x 10 glulam (Splice)				
29	East	2 x 6				
29	West	2 x 6				
30	East	9ply 5 x 15 glulam			Lamination 9	
30	West	9ply 5 x 15 glulam				
31	East	2 x 6				
31	West	2 x 6		Checking		
32	East	6ply 5x 10 glulam			Lamination 6	
32	West	6ply 5x 10 glulam				
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9ply 5 x 15 glulam				
34	West	9ply 5 x 15 glulam				
35	East	2 x 6	Fail @ bottom			
35	West	2 x 6	Fail @ bottom			
36	East	6ply 5x 10 glulam		Lamination 4		
36	West	6ply 5x 10 glulam		Checking		
37	East	2 x 6	Fail @ bottom			
37	West	2 x 6				
38	East	9ply 5 x 15 glulam				
38	West	9ply 5 x 15 glulam				
39	East	2 x 6	Fail @ top			
39	West	2 x 6				
40	East	6ply 5x 10 glulam				
40	West	6ply 5x 10 glulam				
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9ply 5 x 15 glulam				
42	West	9ply 5 x 15 glulam				
43	East	2 x 6	Fail @ bottom, Fail @ top			
43	West	2 x 6				
44	East	6ply 5x 10 glulam		Lamination 6, Lamination 5		
44	West	6ply 5x 10 glulam				
45	East	2 x 8	Fail @ bottom			
45	West	2 x 8				
46	East	9ply 5 x 15 glulam		Checking		
46	West	9ply 5 x 15 glulam				
47	East	6ply 5x 10 glulam				
47	West	6ply 5x 10 glulam				
48	East	2 x 6				
48	West	2 x 6				
49	East	10 x 16 Post	Checking			Top of post is 1" north of bottom
49	West	10 x 16 Post				Top of post is 1" north of bottom

General Truss notes:
- bottom south bolt on truss B bottom chord splice examined

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	

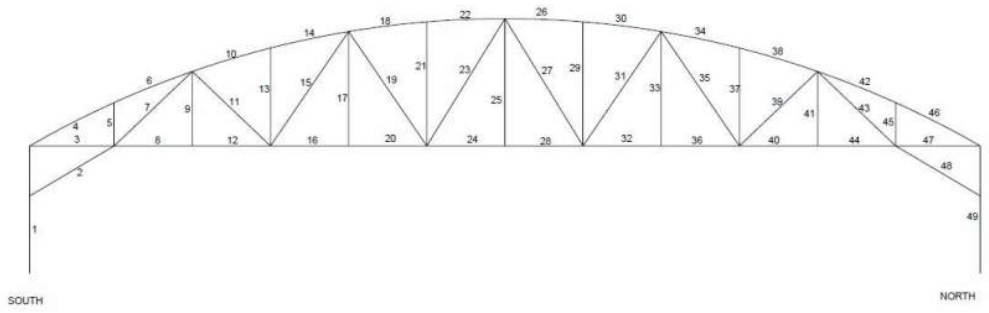


Truss:	C	Date: Feb 27	Inspector: CT / JF			
Member	**East/West**	**Size (wxd)**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16 post	Fail @ bottom	Checking		Top of post is 1" north of bottom
1	West	10 x 16 post	Fail @ bottom			Top of post is 1" north of bottom
2	East	2 x 6				
2	West	2 x 6				
3	East	6ply 5x 10 glulam				
3	West	6ply 5x 10 glulam				
4	East	9ply 5 x 15 glulam				
4	West	9ply 5 x 15 glulam				
5	East	2 x 8	Fail @ bottom			
5	West	2 x 8	Fail @ bottom			
6	East	9ply 5 x 15 glulam				
6	West	9ply 5 x 15 glulam				
7	East	2 x 6	Fail @ bottom , Fail @ top			
7	West	2 x 6				
8	East	6ply 5x 10 glulam				
8	West	6ply 5x 10 glulam				
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				
10	East	9ply 5 x 15 glulam				
10	West	9ply 5 x 15 glulam				
11	East	2 x 6	Fail @ top			
11	West	2 x 6	Fail @ bottom	Checking		
12	East	6ply 5x 10 glulam				
12	West	6ply 5x 10 glulam				
13	East	2 x 6				
13	West	2 x 6	Fail @ bottom			
14	East	9ply 5 x 15 glulam				
14	West	9ply 5 x 15 glulam		Checking		
15	East	2 x 6	Fail @ top, Fail @ bottom	Checking		
15	West	2 x 6	Fail @ bottom			
16	East	6ply 5x 10 glulam		Lamination 6 (0.7mm wide 12mm deep)		
16	West	6ply 5x 10 glulam		Lamination 4		
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9ply 5 x 15 glulam				
18	West	9ply 5 x 15 glulam		Lamination 9 (12.5mm deep 0.8mm wide)		
19	East	2 x 6	Fail @ bottom	Checking		
19	West	2 x 6	Fail @ bottom			
20	East	6ply 5x 10 glulam				
20	West	6ply 5x 10 glulam		Lamination 4		
21	East	2 x 6				
21	West	2 x 6	Fail @ top			
22	East	9ply 5 x 15 glulam				
22	West	9ply 5 x 15 glulam				
23	East	2 x 8				
23	West	2 x 8	Fail @ bottom	Checking		
24	East	6ply 5x 10 glulam (Splice)		Lamination 3		
24	West	6ply 5x 10 glulam (Splice)		Lamination 5		
25	East	Tension tie (gable) Null (non gable)				
25	West	Tension tie (gable) Null (non gable)				
26	East	9ply 5 x 15 glulam				
26	West	9ply 5 x 15 glulam				
27	East	2 x8				
27	West	2 x8	Fail @ bottom			
28	East	6ply 5x 10 glulam (Splice)				
28	West	6ply 5x 10 glulam (Splice)		Lamination 4, Lamination 5		
29	East	2 x 6				
29	West	2 x 6	Fail @ bottom			
30	East	9ply 5 x 15 glulam				
30	West	9ply 5 x 15 glulam				
31	East	2 x 6	Fail @ bottom	Checking		
31	West	2 x 6				
32	East	6ply 5x 10 glulam				
32	West	6ply 5x 10 glulam			Lamination 4 (0.7mm wide x 18mm deep)	
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9ply 5 x 15 glulam				
34	West	9ply 5 x 15 glulam				
35	East	2 x 6				
35	West	2 x 6	Fail @ bottom	Checking		
36	East	6ply 5x 10 glulam				
36	West	6ply 5x 10 glulam				
37	East	2 x 6	Fail @ top			
37	West	2 x 6	Fail @ bottom	Checking		
38	East	9ply 5 x 15 glulam				
38	West	9ply 5 x 15 glulam				
39	East	2 x 6	Fail @ top			
39	West	2 x 6				
40	East	6ply 5x 10 glulam				
40	West	6ply 5x 10 glulam				
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9ply 5 x 15 glulam				
42	West	9ply 5 x 15 glulam				
43	East	2 x 6	Fail @ top			
43	West	2 x 6				split joist above member 50% span
44	East	6ply 5x 10 glulam				
44	West	6ply 5x 10 glulam		Lamination 5 (1.5mm wide 25mm deep)		
45	East	2 x 8	Fail @ top, Fail @ bottom			
45	West	2 x 8	Fail @ bottom	Checking		
46	East	9ply 5 x 15 glulam				
46	West	9ply 5 x 15 glulam				
47	East	6ply 5x 10 glulam				
47	West	6ply 5x 10 glulam				
48	East	2 x 6				
48	West	2 x 6				
49	East	10 x 16 Post				
49	West	10 x 16 Post				

General Truss notes:
-2nd top bolt @ north end of bottom chord splice examined'

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	

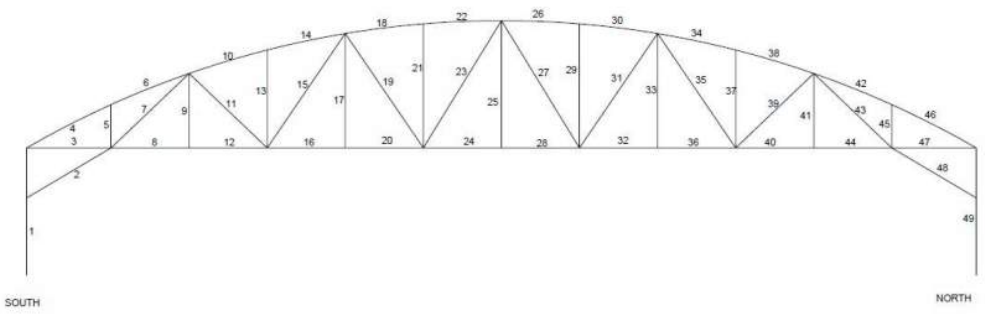


Truss:	D	Date: Feb 27	Inspector: CT / JF			
Member	**East/West**	**Size (wxd)**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16 post				Top of post is 1" north of bottom
1	West	10 x 16 post		Checking (12mmx59mm)		
2	East	2 x 6				
2	West	2 x 6				
3	East	6ply 5x 10 glulam				
3	West	6ply 5x 10 glulam				
4	East	9ply 5 x 15 glulam	Fail @ top, Fail @ bottom			
4	West	9ply 5 x 15 glulam				
5	East	2 x 8				
5	West	2 x 8	Fail @ bottom			
6	East	9ply 5 x 15 glulam				
6	West	9ply 5 x 15 glulam				
7	East	2 x 6	Fail @ bottom			
7	West	2 x 6	Fail @ bottom			
8	East	6ply 5x 10 glulam				
8	West	6ply 5x 10 glulam				
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				
10	East	9ply 5 x 15 glulam				
10	West	9ply 5 x 15 glulam		Lamination 8		
11	East	2 x 6	Fail @ bottom			
11	West	2 x 6	Fail @ bottom			
12	East	6ply 5x 10 glulam				
12	West	6ply 5x 10 glulam				
13	East	2 x 6	Fail @ bottom			
13	West	2 x 6	Fail @ bottom			
14	East	9ply 5 x 15 glulam				
14	West	9ply 5 x 15 glulam				
15	East	2 x 6	Fail @ bottom			
15	West	2 x 6				
16	East	6ply 5x 10 glulam				
16	West	6ply 5x 10 glulam				
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9ply 5 x 15 glulam				
18	West	9ply 5 x 15 glulam		Lamination 9, Lamination 8		Joist split above
19	East	2 x 6				
19	West	2 x 6				
20	East	6ply 5x 10 glulam				
20	West	6ply 5x 10 glulam				
21	East	2 x 6				
21	West	2 x 6	Fail @ top, Fail @ bottom			
22	East	9ply 5 x 15 glulam				
22	West	9ply 5 x 15 glulam		Checking (12.5mm wide 12mm deep)		
23	East	2 x 8	Fail @ bottom, Fail @ top			
23	West	2 x 8	Fail @ bottom			
24	East	6ply 5x 10 glulam (Splice)		Lamiantion 5		
24	West	6ply 5x 10 glulam (Splice)		Lamination 6, Lamination 5		
25	East	Tension tie (gable) Null (non gable)				
25	West	Tension tie (gable) Null (non gable)				
26	East	9ply 5 x 15 glulam		Checking		
26	West	9ply 5 x 15 glulam				
27	East	2 x8	Fail @ bottom			
27	West	2 x8	Fail @ bottom			
28	East	6ply 5x 10 glulam (Splice)				
28	West	6ply 5x 10 glulam (Splice)				
29	East	2 x 6				
29	West	2 x 6	Fail @ bottom			
30	East	9ply 5 x 15 glulam		Checking		
30	West	9ply 5 x 15 glulam				
31	East	2 x 6	Fail @ bottom, Fail @ top			
31	West	2 x 6	Fail @ bottom			
32	East	6ply 5x 10 glulam		Lamination 6		
32	West	6ply 5x 10 glulam		Lamination 6		
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9ply 5 x 15 glulam		Lamination 5		
34	West	9ply 5 x 15 glulam		Lamination 9 (1mm wide 25mm deep)		
35	East	2 x 6	Fail @ bottom, Fail @ top			
35	West	2 x 6	Fail @ bottom			
36	East	6ply 5x 10 glulam		Lamination 6		
36	West	6ply 5x 10 glulam		Lamination 6		
37	East	2 x 6	fail @ bottom			
37	West	2 x 6	Fail @ bottom			
38	East	9ply 5 x 15 glulam				
38	West	9ply 5 x 15 glulam				
39	East	2 x 6	Fail @ top			
39	West	2 x 6				
40	East	6ply 5x 10 glulam				
40	West	6ply 5x 10 glulam				
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9ply 5 x 15 glulam				
42	West	9ply 5 x 15 glulam				
43	East	2 x 6				
43	West	2 x 6				
44	East	6ply 5x 10 glulam		Lamination 6 (2mm wide 25mm deep)		
44	West	6ply 5x 10 glulam				
45	East	2 x 8	Fail @ bottom			
45	West	2 x 8	Fail @ bottom			
46	East	9ply 5 x 15 glulam				
46	West	9ply 5 x 15 glulam				
47	East	6ply 5x 10 glulam				
47	West	6ply 5x 10 glulam				
48	East	2 x 6				
48	West	2 x 6				
49	East	10 x 16 Post				top of post 1/2" north of bottom
49	West	10 x 16 Post		Checking (10mmx80mm)		top of post 1/2" north of bottom

General Truss notes:
- 4th bolt from the north, bottom row of bottom chord splice examined

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	

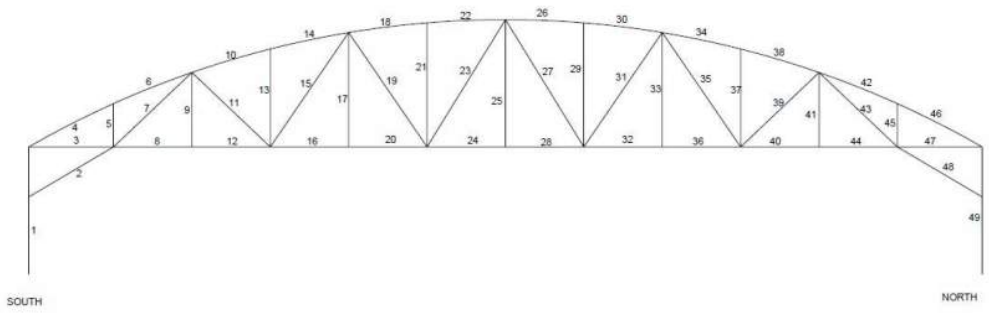


Truss:	E	Date: Feb 27	Inspector: CT / JF			
Member	**East/West**	**Size (wxd)**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16 post				
1	West	10 x 16 post		Checking		
2	East	2 x 6				
2	West	2 x 6				
3	East	6ply 5x 10 glulam				
3	West	6ply 5x 10 glulam				
4	East	9ply 5 x 15 glulam				
4	West	9ply 5 x 15 glulam				
5	East	2 x 8	Fail @ bottom			
5	West	2 x 8	Fail @ bottom, Fail @ top	Checking		split ring exposed
6	East	9ply 5 x 15 glulam				split joist above
6	West	9ply 5 x 15 glulam				
7	East	2 x 6	Fail @ top			
7	West	2 x 6				
8	East	6ply 5x 10 glulam				
8	West	6ply 5x 10 glulam				
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				split joist above
10	East	9ply 5 x 15 glulam				
10	West	9ply 5 x 15 glulam				
11	East	2 x 6				
11	West	2 x 6	Fail @ top, Fail @ bottom	Checking		
12	East	6ply 5x 10 glulam				
12	West	6ply 5x 10 glulam				
13	East	2 x 6	Fail @ bottom			
13	West	2 x 6	Fail @ bottom			
14	East	9ply 5 x 15 glulam				
14	West	9ply 5 x 15 glulam				
15	East	2 x 6				split joist above node
15	West	2 x 6				
16	East	6ply 5x 10 glulam		Lamination 4		
16	West	6ply 5x 10 glulam				
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9ply 5 x 15 glulam				
18	West	9ply 5 x 15 glulam				
19	East	2 x 6				
19	West	2 x 6	Fail @ bottom	Checking		
20	East	6ply 5x 10 glulam				
20	West	6ply 5x 10 glulam				
21	East	2 x 6				
21	West	2 x 6	Fail @ bottom			
22	East	9ply 5 x 15 glulam		Lamination 3		
22	West	9ply 5 x 15 glulam				
23	East	2 x 8	Fail @ bottom			
23	West	2 x 8	Fail @ bottom, Fail @ top			
24	East	6ply 5x 10 glulam (Splice)				
24	West	6ply 5x 10 glulam (Splice)				
25	East	Tension tie (gable) Null (non gable)				
25	West	Tension tie (gable) Null (non gable)				
26	East	9ply 5 x 15 glulam		Lamination 7		
26	West	9ply 5 x 15 glulam				
27	East	2 x8				
27	West	2 x8	Fail @ top			
28	East	6ply 5x 10 glulam (Splice)		Lamination 5 , Lamination 3		
28	West	6ply 5x 10 glulam (Splice)				
29	East	2 x 6	Fail @ top, Fail @ bottom			
29	West	2 x 6	Fail @ bottom	Checking		
30	East	9ply 5 x 15 glulam			Lamination 1	
30	West	9ply 5 x 15 glulam				
31	East	2 x 6				
31	West	2 x 6				
32	East	6ply 5x 10 glulam		Lamination 4		
32	West	6ply 5x 10 glulam				
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9ply 5 x 15 glulam				
34	West	9ply 5 x 15 glulam				
35	East	2 x 6	Fail @ bottom			
35	West	2 x 6	Fail @ bottom			
36	East	6ply 5x 10 glulam				
36	West	6ply 5x 10 glulam				
37	East	2 x 6	Fail @ top, Fail @ bottom (5mm wid	Checking		cracked joist above node
37	West	2 x 6				
38	East	9ply 5 x 15 glulam		Lamination 3		
38	West	9ply 5 x 15 glulam				Joist split above 38 midspan
39	East	2 x 6	Fail @ top			cracked joist above node
39	West	2 x 6				
40	East	6ply 5x 10 glulam				
40	West	6ply 5x 10 glulam				
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9ply 5 x 15 glulam				
42	West	9ply 5 x 15 glulam				
43	East	2 x 6				
43	West	2 x 6				
44	East	6ply 5x 10 glulam				
44	West	6ply 5x 10 glulam				
45	East	2 x 8	Fail @ top, Fail @ bottom			
45	West	2 x 8	Fail @ top, Fail @ bottom			
46	East	9ply 5 x 15 glulam				
46	West	9ply 5 x 15 glulam				
47	East	6ply 5x 10 glulam				
47	West	6ply 5x 10 glulam				
48	East	2 x 6				
48	West	2 x 6	Fail @ top			
49	East	10 x 16 Post	Fail @ nottom	Checking (6mmx82mm)		Top of post 1/2" north of bottom.
49	West	10 x 16 Post	Fail @ bottom			Top of post 1/2" north of bottom.

General Truss notes:
- post checked
- bolt removed from bottom of bottom chord splice @ north end
- bolt removed from bottom of bottom chord splice @ south end

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	

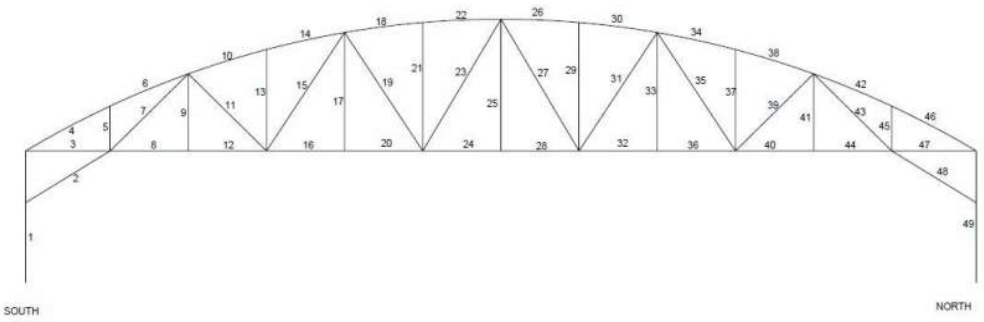


Truss:	F	Date: Feb 28	Inspector: CT / JF			
Member	**East/West**	**Size (wxd)**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16 post		Checking		
1	West	10 x 16 post		Chekcing (10mmx85mm)		
2	East	2 x 6	Fail @ bottom			
2	West	2 x 6				
3	East	6ply 5x 10 glulam				
3	West	6ply 5x 10 glulam				
4	East	9ply 5 x 15 glulam				
4	West	9ply 5 x 15 glulam				
5	East	2 x 8	Fail @ bottom, Fail @ top			
5	West	2 x 8	Fail @ bottom, Fail @ top			
6	East	9ply 5 x 15 glulam				
6	West	9ply 5 x 15 glulam		Checking near joint w/ 5		split joist near joint w/ 7
7	East	2 x 6				
7	West	2 x 6				
8	East	6ply 5x 10 glulam				
8	West	6ply 5x 10 glulam				
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				
10	East	9ply 5 x 15 glulam				
10	West	9ply 5 x 15 glulam				split joist above
11	East	2 x 6	Fail @ bottom, Fail @ top			
11	West	2 x 6				
12	East	6ply 5x 10 glulam		Lamination 6, Lamination 3		
12	West	6ply 5x 10 glulam		Lamination 6, Lamination 3		
13	East	2 x 6	Fail @ bottom			
13	West	2 x 6	Fail @ bottom			
14	East	9ply 5 x 15 glulam		check 1mm wide 25mm deep		
14	West	9ply 5 x 15 glulam				split joist above
15	East	2 x 6				
15	West	2 x 6				
16	East	6ply 5x 10 glulam		checking near joint w/ 13		
16	West	6ply 5x 10 glulam		checking thourghout contiunes into 20		
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9ply 5 x 15 glulam				
18	West	9ply 5 x 15 glulam			Lamination 9	
19	East	2 x 6				
19	West	2 x 6		Checking		
20	East	6ply 5x 10 glulam			Lamination 2	
20	West	6ply 5x 10 glulam				
21	East	2 x 6	Fail @ bottom			
21	West	2 x 6				
22	East	9ply 5 x 15 glulam				
22	West	9ply 5 x 15 glulam				
23	East	2 x 8				
23	West	2 x 8	Fail @ bottom	Checking		
24	East	6ply 5x 10 glulam (Splice)			Lamination 6, Lamination 3	
24	West	6ply 5x 10 glulam (Splice)		checking near joint w/ 27		
25	East	Tension tie (gable) Null (non gable)				
25	West	Tension tie (gable) Null (non gable)				
26	East	9ply 5 x 15 glulam				
26	West	9ply 5 x 15 glulam				
27	East	2 x8	Fail @ bottom	Checking		
27	West	2 x8	Fail @ bottom	Checking		
28	East	6ply 5x 10 glulam (Splice)				
28	West	6ply 5x 10 glulam (Splice)				
29	East	2 x 6				
29	West	2 x 6	Fail @ bottom	Checking		
30	East	9ply 5 x 15 glulam				
30	West	9ply 5 x 15 glulam				
31	East	2 x 6	Fail @ top	Checking		
31	West	2 x 6	Fail @ bottom			
32	East	6ply 5x 10 glulam		Lamination 6, Lamination 2		
32	West	6ply 5x 10 glulam				
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9ply 5 x 15 glulam				
34	West	9ply 5 x 15 glulam				
35	East	2 x 6				
35	West	2 x 6	Fail @ bottom			
36	East	6ply 5x 10 glulam		Lamination 6, Lamination 2		
36	West	6ply 5x 10 glulam		checking near joint w/ 35		
37	East	2 x 6				split joist above
37	West	2 x 6	fail @ bottom			
38	East	9ply 5 x 15 glulam				
38	West	9ply 5 x 15 glulam				
39	East	2 x 6				
39	West	2 x 6				
40	East	6ply 5x 10 glulam				
40	West	6ply 5x 10 glulam				
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9ply 5 x 15 glulam				
42	West	9ply 5 x 15 glulam				2 split joists above
43	East	2 x 6				
43	West	2 x 6				
44	East	6ply 5x 10 glulam		Lamination 3		
44	West	6ply 5x 10 glulam				
45	East	2 x 8	Fail @ bottom, Fail @ top			
45	West	2 x 8	Fail @ bottom			
46	East	9ply 5 x 15 glulam				
46	West	9ply 5 x 15 glulam				Split joist above
47	East	6ply 5x 10 glulam				
47	West	6ply 5x 10 glulam		checking near joint w/ 45		
48	East	2 x 6				
48	West	2 x 6				
49	East	10 x 16 Post		Checking		
49	West	10 x 16 Post		Checking		

General Truss notes:
- Bolt examined @ 2nd from the north top row
- bolt examined @ 1st from the south top row

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	

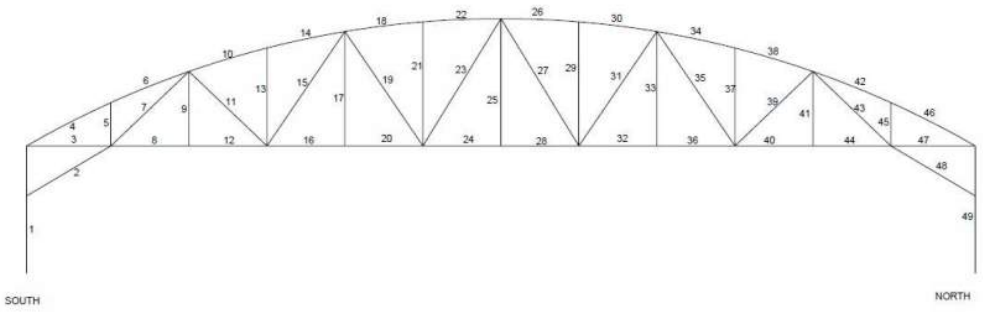


Truss:	G	Date: Feb 28	Inspector: CT / JF			
Member	**East/West**	**Size (wxd)**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16 post	Fail @ bottom	Checking (10mmx75mm)		Top of post is 2" north of bottom
1	West	10 x 16 post	Fail @ bottom			Top od post is 2" north of bottom
2	East	2 x 6	Fail @ bottom			
2	West	2 x 6				
3	East	6ply 5x 10 glulam		Lamination 5, Lamination 2		
3	West	6ply 5x 10 glulam				
4	East	9ply 5 x 15 glulam				
4	West	9ply 5 x 15 glulam				
5	East	2 x 8	Fail @ bottom			
5	West	2 x 8	Fail @ bottom			
6	East	9ply 5 x 15 glulam				
6	West	9ply 5 x 15 glulam				
7	East	2 x 6				
7	West	2 x 6				
8	East	6ply 5x 10 glulam				
8	West	6ply 5x 10 glulam				
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				
10	East	9ply 5 x 15 glulam				
10	West	9ply 5 x 15 glulam				
11	East	2 x 6	Fail @ bottom			
11	West	2 x 6	Fail @ top, Fail @ bottom			
12	East	6ply 5x 10 glulam				
12	West	6ply 5x 10 glulam				
13	East	2 x 6				
13	West	2 x 6	Fail @ bottom			
14	East	9ply 5 x 15 glulam				
14	West	9ply 5 x 15 glulam				
15	East	2 x 6	Fail @ bottom			
15	West	2 x 6	Fail @ bottom			2 joists split above
16	East	6ply 5x 10 glulam		Lamination 8		
16	West	6ply 5x 10 glulam		Lamination 6		
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9ply 5 x 15 glulam				
18	West	9ply 5 x 15 glulam		Lamination 4		
19	East	2 x 6				
19	West	2 x 6	Fail @ bottom			
20	East	6ply 5x 10 glulam		Lamination 8		
20	West	6ply 5x 10 glulam				
21	East	2 x 6				
21	West	2 x 6	Fail @ bottom	Checking		
22	East	9ply 5 x 15 glulam				
22	West	9ply 5 x 15 glulam		Lamination 4		
23	East	2 x 8	Fail @ top			
23	West	2 x 8	Fail @ bottom			
24	East	6ply 5x 10 glulam (Splice)				
24	West	6ply 5x 10 glulam (Splice)				Split joist above
25	East	Tension tie (gable) Null (non gable)				
25	West	Tension tie (gable) Null (non gable)				
26	East	9ply 5 x 15 glulam				
26	West	9ply 5 x 15 glulam				
27	East	2 x8	Fail @ bottom, Fail @ top			Whole member split
27	West	2 x8	Fail @ bottom	Checking		
28	East	6ply 5x 10 glulam (Splice)		Lamination 6		
28	West	6ply 5x 10 glulam (Splice)				
29	East	2 x 6				
29	West	2 x 6	Fail @ bottom			1" buckle towards east on 29
30	East	9ply 5 x 15 glulam				
30	West	9ply 5 x 15 glulam				
31	East	2 x 6	Fail @ bottom			
31	West	2 x 6				
32	East	6ply 5x 10 glulam				
32	West	6ply 5x 10 glulam		Lamination 2		
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9ply 5 x 15 glulam				
34	West	9ply 5 x 15 glulam				
35	East	2 x 6				
35	West	2 x 6				
36	East	6ply 5x 10 glulam				
36	West	6ply 5x 10 glulam		Lamination 2		
37	East	2 x 6	Fail @ bottom			
37	West	2 x 6				
38	East	9ply 5 x 15 glulam				
38	West	9ply 5 x 15 glulam				
39	East	2 x 6	Fail @ top, Fail @ bottom			
39	West	2 x 6		Checking		
40	East	6ply 5x 10 glulam				
40	West	6ply 5x 10 glulam		Lamination 5		
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9ply 5 x 15 glulam				
42	West	9ply 5 x 15 glulam		Lamination 7		
43	East	2 x 6				
43	West	2 x 6				
44	East	6ply 5x 10 glulam		Lamination 3		
44	West	6ply 5x 10 glulam		Lamination 3		
45	East	2 x 8				
45	West	2 x 8	Fail @ bottom			
46	East	9ply 5 x 15 glulam				
46	West	9ply 5 x 15 glulam				
47	East	6ply 5x 10 glulam				
47	West	6ply 5x 10 glulam				
48	East	2 x 6				
48	West	2 x 6	Fail @ bottom	Checking		
49	East	10 x 16 Post				Top of post is 1.5" north of bottom
49	West	10 x 16 Post		Checking (10mmx 65mm)		Top of post is 1.5" north of bottom

General Truss notes:
- 2nd from the south top row bolt examined.
- 2nd from the north top row bolt examined
- @ 37 cross bracing causing seperation of web from chord
- Bolt examined @ south end
- Split edge distance 20mm perp to grain

FIELD DATA - TRUSS ASSESSMENT

Truss Chord Lamination Legend	
Top Chord	Bottom Chord
Top 1	Top 1
2	2
3	3
4	4
5	5
6	Bottom 6
7	
8	
Bottom 9	



Truss:	H	Date: Feb 28	Inspector: CT / JF			
Member	**East/West**	**Size (wxd)**	**Splits**	**Checks**	**Delamination**	**Notes**
1	East	10 x 16 post	Fail @ bottom	Checking (15mmx100mm)		Top of post is 1" north of bottom
1	West	10 x 16 post	Fail @ bottom	Checking (12mmx50mm)		Top of post is 1" north of bottom
2	East	2 x 6				
2	West	2 x 6	Fail @ top			
3	East	6ply 5x 10 glulam				
3	West	6ply 5x 10 glulam				
4	East	9ply 5 x 15 glulam				
4	West	9ply 5 x 15 glulam				
5	East	2 x 8				
5	West	2 x 8	Fail @ top, Fail @ bottom			
6	East	9ply 5 x 15 glulam				
6	West	9ply 5 x 15 glulam				
7	East	2 x 6				
7	West	2 x 6				
8	East	6ply 5x 10 glulam				
8	West	6ply 5x 10 glulam		Lamination 5 (3mm wide x 40mm deep)		
9	East	Tension tie (gable) Null (non gable)				
9	West	Tension tie (gable) Null (non gable)				
10	East	9ply 5 x 15 glulam				
10	West	9ply 5 x 15 glulam				
11	East	2 x 6				
11	West	2 x 6				
12	East	6ply 5x 10 glulam		Lamination 5		
12	West	6ply 5x 10 glulam				
13	East	2 x 6	Fail @ bottom			
13	West	2 x 6	Fail @ bottom			
14	East	9ply 5 x 15 glulam				
14	West	9ply 5 x 15 glulam				
15	East	2 x 6	Fail @ bottom			
15	West	2 x 6	Fail @ bottom			
16	East	6ply 5x 10 glulam		Lamination 5		
16	West	6ply 5x 10 glulam				
17	East	Tension tie (gable) Null (non gable)				
17	West	Tension tie (gable) Null (non gable)				
18	East	9ply 5 x 15 glulam				
18	West	9ply 5 x 15 glulam	Fail @ bottom			
19	East	2 x 6				
19	West	2 x 6				
20	East	6ply 5x 10 glulam				
20	West	6ply 5x 10 glulam		Lamination 5		
21	East	2 x 6	Fail @ bottom			
21	West	2 x 6	Fail @ bottom			
22	East	9ply 5 x 15 glulam				
22	West	9ply 5 x 15 glulam				
23	East	2 x 8	Fail @ bottom			
23	West	2 x 8				
24	East	6ply 5x 10 glulam (Splice)				
24	West	6ply 5x 10 glulam (Splice)				
25	East	Tension tie (gable) Null (non gable)				crushing failure in all vertical bolts
25	West	Tension tie (gable) Null (non gable)				
26	East	9ply 5 x 15 glulam				
26	West	9ply 5 x 15 glulam				
27	East	2 x8				
27	West	2 x8				
28	East	6ply 5x 10 glulam (Splice)				
28	West	6ply 5x 10 glulam (Splice)		Lamination 5		
29	East	2 x 6				
29	West	2 x 6				
30	East	9ply 5 x 15 glulam				
30	West	9ply 5 x 15 glulam				
31	East	2 x 6	Fail @ bottom			
31	West	2 x 6	Fail @ bottom			
32	East	6ply 5x 10 glulam		Lamination 3		
32	West	6ply 5x 10 glulam				
33	East	Tension tie (gable) Null (non gable)				
33	West	Tension tie (gable) Null (non gable)				
34	East	9ply 5 x 15 glulam				
34	West	9ply 5 x 15 glulam				
35	East	2 x 6				
35	West	2 x 6				
35	East	2 x 6				
35	West	2 x 6				
36	East	6ply 5x 10 glulam				
36	West	6ply 5x 10 glulam				
37	East	2 x 6				
37	West	2 x 6				
38	East	9ply 5 x 15 glulam				
38	West	9ply 5 x 15 glulam				
39	East	2 x 6				
39	West	2 x 6	Fail @ top			
40	East	6ply 5x 10 glulam				
40	West	6ply 5x 10 glulam				
41	East	Tension tie (gable) Null (non gable)				
41	West	Tension tie (gable) Null (non gable)				
42	East	9ply 5 x 15 glulam				
42	West	9ply 5 x 15 glulam				Joist split above
43	East	2 x 6				
43	West	2 x 6				
44	East	6ply 5x 10 glulam				
44	West	6ply 5x 10 glulam				
45	East	2 x 8	Fail @ bottom			
45	West	2 x 8				
46	East	9ply 5 x 15 glulam				
46	West	9ply 5 x 15 glulam				
47	East	6ply 5x 10 glulam				
47	West	6ply 5x 10 glulam				
48	East	2 x 6				
48	West	2 x 6				Buckling to the west by 1/2"
49	East	10 x 16 Post	Fail @ bottom	Checking (10x70)		Top of post is 2" south of bottom
49	West	10 x 16 Post	Fail @ bottom	Checking		Top of post is 2" south of bottom

General Truss notes:
- 2nd from south bottom row bolt examined
-2nd from north bottom row bolt examined
- Joists are 2x12 @ 16" o/c w/ 1/3 span bridging
- @ gable end 2x6 ledger fastened w/ 2 runs of nails at 12" o/c staggered

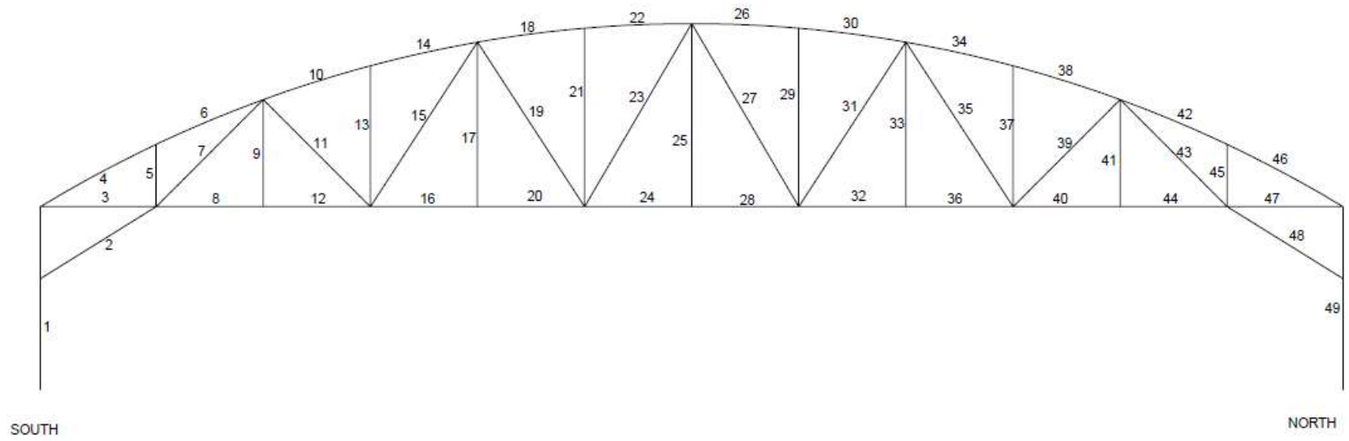
TRUSS SURVEY

Truss	South Bearing Elev. (inch)	Center Elev. (inch)	North Bearing Elev. (inch)	Truss Camber (inch)	Truss Bearing Elevation (South) in relation to Average (inch)	Truss Bearing Elevation (North) in relation to Average (inch)
A	7.5	5	6.75	**2.125**	-0.3125	-0.8125
B	7	4.125	6.75	**2.75**	-0.8125	-0.8125
C	6.75	4.625	7	**2.25**	-1.0625	-0.5625
D	7	4.5	7	**2.5**	-0.8125	-0.5625
E	8.75	5	7.25	**3**	0.9375	-0.3125
F	6.75	4.5	7.25	**2.5**	-1.0625	-0.3125
G	9.25	5.5	7	**2.625**	1.4375	-0.5625
H	9.5	8	11.5	**2.5**	1.6875	3.9375

APPENDIX E

Structural Evaluation

TRUSS ANALYSIS RESULTS



Member Force Analysis														Connection Analysis			
	Tension	Compression	Tension	Compression	Moment	Tension	Compression	Moment	Axial Unity Check			Axial+Bending Unity Check		Compression	Tension	Compression	Tension
Member	Tf Original (kN)	Cf Original (kN)	BCBC2024 Max Tf (kN)	BCBC2024 Max Cf (kN)	BCBC2024 Mf (kN-m)	Tr (kN)	Cr (kN)	Mr (kN-m)	Cf/Cr	Tf/Tr	Mf/Mr	Unity_Tens	Unity_Comp	Vr (kN)	Vr (kN)	Unity Check	Unity Check
1, 49		376	67	513	28.8	520.4	734.0	88.2	0.70	0.13	0.33	**0.34**	**0.85**				
2, 48		67	24	89	0.0	105.7	27.8	5.3	3.20	0.23	0.00	**0.05**	**>2.0**	58	29.2	**1.53**	**0.82**
3, 47	574		753	101	3.1	444.0	99.6	10.4	1.01	1.70	0.30	**>2.0**	**1.34**				
4, 46		630	114	846	6.8	666.0	556.5	23.5	1.52	0.17	0.29	**0.32**	**>2.0**				
5, 45	2		14	73	0.0	113.9	129.0	9.4	0.57	0.12	0.00	**0.02**	**0.32**	43.54	39.6	**1.68**	**0.35**
6, 42		596	113	834	4.0	666.0	556.5	23.5	1.50	0.17	0.17	**0.20**	**>2.0**				
7, 43		60	68	78	0.0	105.7	23.9	5.3	3.27	0.64	0.00	**0.41**	**>2.0**	58	41.6	**1.34**	**1.63**
8, 44	562		737	101	3.1	444.0	99.6	10.4	1.01	1.66	0.30	**>2.0**	**1.38**				
9, 41	Tension Rod																
10, 38		636	121	834	4.0	666.0	556.5	23.5	1.50	0.18	0.17	**0.20**	**>2.0**				
11, 39	25		46	93	0.0	105.7	22.1	5.3	4.21	0.44	0.00	**0.19**	**>2.0**	58	41.6	**1.60**	**1.11**
12, 40	562		737	101	1.8	444.0	99.6	10.4	1.01	1.66	0.17	**>2.0**	**1.23**				
13, 37		2	17	35	0.0	105.7	22.9	5.3	1.53	0.16	0.00	**0.03**	**>2.0**	58	41.6	**0.60**	**0.41**
14, 34		617	122	810	1.9	666.0	556.5	23.5	1.46	0.18	0.08	**0.11**	**>2.0**				
15, 35		16	123	56	0.0	105.7	12.7	5.3	4.42	1.16	0.00	**1.35**	**>2.0**	58	41.6	**0.97**	**>2.0**
16, 36	588		772	104	0.6	444.0	99.6	10.4	1.04	1.74	0.06	**>2.0**	**1.16**				
17, 33	Tension Rod																
18, 30		612	123	812	1.5	666.0	556.5	23.5	1.46	0.18	0.06	**0.10**	**>2.0**				
19, 31	9		65	117	0.0	105.7	11.8	5.3	9.90	0.61	0.00	**0.38**	**>2.0**	58	41.6	**2.00**	**1.56**
20, 32	588		772	104	0.6	444.0	99.6	10.4	1.04	1.74	0.06	**>2.0**	**1.16**				
21, 29		4	22	10	0.0	105.7	13.7	5.3	0.73	0.21	0.00	**0.04**	**0.53**	58	41.6	**0.17**	**0.53**
22, 26		612	123	802	1.6	666.0	556.5	23.5	1.44	0.18	0.07	**0.10**	**>2.0**				
23, 27		3	110	86	0.0	113.9	10.3	9.4	8.38	0.97	0.00	**0.93**	**>2.0**	58	49.5	**1.48**	**>2.0**
24, 28	595		780	101	0.5	444.0	99.6	10.4	1.01	1.76	0.05	**>2.0**	**1.08**				
25	Tension Rod																

Notes:

1. Highlighted cells represents slenderness failure.
2. Large Unity values, ie. Greater than 2.0, have been discussed in Section 7.4 of the Interim Report
3. This table represents the analysis for trusses B through G. Note that members 9, 17, 25, 33, and 41 only exist on trusses A and H and therefore not included in the above analysis.
4. Tr, Cr, Mr - Factored member resistance
5. Tf, Cf, Mf -Factored member force

APPENDIX F

Geotechnical Report

25 March 2024

Evertek Project No.: 100954

BAR Engineering
Mr. Joey Funk
Email: joey.funk@bareng.ca

Re: Preliminary Geotechnical Assessment Report
Memorial Arena Building Upgrades
351 3 Street S.W., Salmon Arm, BC.

1.0 INTRODUCTION

As requested by BAR Engineering (client), Evertek Engineering Limited (Evertek) conducted a preliminary geotechnical assessment of the existing Memorial Arena building located at 351 – 3 Street SW in Salmon Arm, BC. The existing building was constructed around 1956 (refer to Figure 1 in Appendix A). Due to snow loading concerns and drainage issues, a structural assessment and lifecycle analysis of the aged building is requested. A geotechnical review of the footing subgrade conditions is required to facilitate the structural assessment. The geotechnical assessment has been undertaken in accordance with Evertek's fee proposal dated January 19, 2024.

This report has been prepared based on subsurface information collected on site by Evertek and our past geotechnical experience in the region. Evertek's scope of work neither includes environmental assessments nor evaluates the structural integrity of the footings.

2.0 SITE DESCRIPTION & PROPOSED DEVELOPMENT

The property with the civic address 351 3 Street, Salmon Arm, BC, is also identified with the legal description LOT 1, PLAN KAP45452, SECTION 14, TOWNSHIP 20, RANGE 10, MERIDIAN W6, KAMLOOPS DIV OF YALE LAND DISTRICT (PID: 017-415-900). The property has an approximate area of 6,260.7 m^2 (1.55 acres).

Based on City of Salmon Arm Webmap the property is bordered with 3 Avenue SW and 3 Street SW in north and east, respectively, and two lots to the south and west (Figure 2 in Appendix A).

3.0 DESKTOP STUDIES

Evertek has reviewed available technical reports from previous studies for the area. Geological and geohazard information from these studies are summarized as follows:

- Geotechnical Investigation for Proposed R.C.M.P. Building North of 5th Avenue, S.W., Salmon Arm, BC, Prepared by Golder Associates, September 1996.
    - Drilled auger holes to depths of about 6 m.
    - Performed laboratory testing for moisture content.
    - Proposed foundation design and preloading recommendations
- Geotechnical Investigation for Proposed Building across 5th Avenue, South of the Present Site, Prepared by Golder Associates, March 1996.
    - Drilled boreholes to depths of about 25.9 m.
    - Drilled augerholes to depths of about 4.6 m.

- Preliminary Geotechnical Investigation Report for Salmon Arm Municipal Hall, 31 Hudson Ave NE, Salmon Arm, BC, Prepared by Evertek Engineering Ltd., April 2023.
    - Laboratory testing was conducted on samples taken from a depth of 1.2 meters to determine Atterberg Limits and moisture content.
    - Investigated the potential causes of the cracking and proposed recommendation for remediation.

4.0 SURFICIAL GEOLOGY

According to the Geological Survey of Canada map 1391A titled “Surficial Geology Shuswap Lake” with a scale of 1:126,720, the surficial soil deposits in the area consist of Collapsed Lacustrine Deposits, Lc: silt, sand, clay, and minor gravel; ridged and kettled deposits disrupted by melting of underlying ice.

5.0 FIELD GEOTECHNICAL INVESTIGATION

On February 27, 2024, a geotechnical investigation was conducted by Mr. Andrzej Sidorowicz P.Eng., a representative of Evertek Engineering. Site surface conditions including surficial soil, slopes, and surface drainage were visually examined. The results of our visual observation are summarized below:

- The property is occupied by a sports complex; and the building is of timber structure.
- There is a parking lot to east of the property and is accessed via both 3 Avenue S.W. and 3 Street S.W.
- There is a paved area on the west of the property, which is connected to the eastern parking lot via a sidewalk.

A total of two (2) test pits (TP24-01 to TP24-02) were excavated to depths varying between approximately 1.5 m to 1.7 below the existing grade using a track mounted excavator. The approximate locations of the test pits are indicated on Figure 3 in Appendix A, attached to this report. It should be noted that subsurface conditions on the site may vary outside the test pit locations and below the test pit depths explored.

TP24-01 encountered a 0.3 m thick layer of moist, dark brown, loose organic sandy topsoil, overlying moist, stiff, plastic clay which was 0.6 m thick. The building’s concrete footing was

observed between depths of 0.9 m to 1.2 m. Extending between 1.2 m and test pit termination depth of 1.5 m, there was stiff, moist, clay with more plasticity.

TP24-02 encountered a 0.3 m thick layer of moist, dark brown, loose organic sandy topsoil, overlying moist, stiff, plastic clay which was 0.5 m thick. The building's concrete footing was observed between depths of 0.8 m to 1.1 m. Extending between 1.1 m and test pit termination depth of 1.7 m, there was stiff, moist, clay with more plasticity.

No groundwater was encountered upon completion of the test pit excavation to a maximum depth of 1.7 m below the existing grade. The detailed soil logs are attached for reference (Appendix C). The test pits were backfilled with the excavated soils and compacted with a jumping jack plate compactor in 1 foot lifts, immediately upon completion of logging of the soils.

Furthermore, a geotechnical investigation was conducted by Golder in September 1996 for an R.C.M.P. building located at North of 5th Avenue, S.W. (approximately 65 m away from the subject property) and three boreholes were drilled to a depth of approximately 6 m (Appendix D). During the field investigation, the groundwater level at each augerhole was estimated to be around 1.4 meters below the existing ground surface.

6.0 DISCUSSIONS

6.1 GROUND SETTLEMENT POTENTIAL

Clay was encountered in two test pits, which is consistent with the subsoil conditions identified in the adjacent site by Golder. Soft to very soft clayey silt and clay was reported in Golder's 1996 geotechnical report. Therefore, ground settlement under the structural load is an important factor to be considered for the proposed upgrade project.

Evertek has conducted a preliminary settlement analysis using the subsoil information from Golder's 1996 geotechnical report and structural loading information provided by BAR Engineering. Based on the structural information, the existing building was initially designed with a service load of 60 kips in 1956. To comply with the current BC Building Code 2024, a column service load of 80 kips (355.8 kN) must be considered. As per the foundation plan drafted by Alan W. Gray architect (Dated June 1956), the dimensions of the existing footing pads are 56 inches in length, 56 inches in width, and 15 inches in thickness. This results in a service load of 132 kPa. Under this service load the long-term consolidation settlement has been predicted to be in the order of 100 mm. Therefore, considering that the arena was constructed in 1956 (68 years ago), it is likely that most of consolidation settlement has already occurred.

Although an increase in design loads under BC Building Code 2024 is required, introduction of net dead structural loads is not expected. Additional settlement is not anticipated. However, should the existing foundation system be modified, a settlement analysis should be performed.

6.2 BEARING CAPACITY ESTIMATION (ULTIMATE LIMIT STATE)

Based on the blow counts from the study conducted by Golder Associates in a nearby site (September 1996, Appendix D) and Evertek's field review soft clay might be present under the footings. Hence, a factored Ultimate Limit State (ULS) bearing pressure of 120 kPa, for a resistance factor ϕ = 0.5 can be considered for the footings in accordance with the Canadian Foundation Engineering Manual (CFEM). Given that the current design service load of columns based on BC Building Code 2024 is 80 kips (356 kN), they would exert a load of approximately 175 kPa on the soil via the existing footings which exceeds the specified ultimate limit state bearing capacity. From this sense the existing foundation is inadequate. Evertek recommends that the footing sizes be enlarged. As the size of the footing increases, the load is distributed across a greater surface area of soil. This effectively lowers the pressure exerted on each unit area, potentially keeping it below the specified Ultimate Limit State (ULS) of 120 kPa. If this method is considered, it is crucial to undertake it under the supervision of a structural engineer to ensure its effectiveness and compliance with safety standards.

6.3 SEISMIC ANALYSIS

According to BC Building Code 2024, Table 4.1.8.4.A the Site Classification falls to "E – soft soil". The Peak Ground Acceleration (PGA) for this site is 0.108g for a probability of occurrence of 2% in 50 years (0.000404 per annum) which was obtained from 2020 National Building Code Seismic Hazard from the web-site http://www.earthquakescanada.nrcan.gc.ca of National Resources Canada. The Spectral Response Acceleration Values Sa (T) for Class E are:

$S_a(0.2) = 0.267$, $S_a(0.5) = 0.265$, $S_a(1.0) = 0.205$, $S_a(2.0) = 0.149$

6.0 FURTHER WORK AND CONSTRUCTION INSPECTIONS

Soft to very soft soil may be present in great depths on the site. The clay in the area is high plastic with swelling potential. Evertek recommends that a further geotechnical investigation be carried out. A borehole investigation using a drill rig may be used to identify subsoil and groundwater conditions at greater depths.

There is evidence of past ground movement (settlement) for the existing building. Evertek recommends that a ground settlement monitoring program by a certified land surveyor be initiated. This program is to confirm if ground movement is ongoing. A minimum of one year period may be considered for the monitoring program. The surveying results should be provided to Evertek for review.

7.0 CLOSURE

This preliminary geotechnical report is based on the findings of our field review and the relevant information provided to us at the time of the report preparation. This report has been prepared for the exclusive use of the client for the specified application structure described in this report. City of Salmon Arm may also rely on the findings of this report. It has been prepared in accordance

with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

Yours truly,

Evertek Engineering Limited

(EGBC Permit to Practice No. 1000729)

Amir Hejazi, M.Sc.
Junior Geotechnical Engineer

Reviewed by:

Larry H. Deng, M.Sc., P. Eng.
Senior Geotechnical Engineer, Principal

Appendix A
Figures

Appendix B
Photo Logs

Appendix C
Test Pit Logs & Testing Results

Appendix D
Previous Studies

Appendix A

- Figures

Evertek Engineering Limited
101 – 2493 Montrose Avenue,
Abbotsford, British Columbia V2S 0L5
Tel +1 (604) 776-0222 www.evertekengineering.com

Figure 1 - Existing Foundation Plan

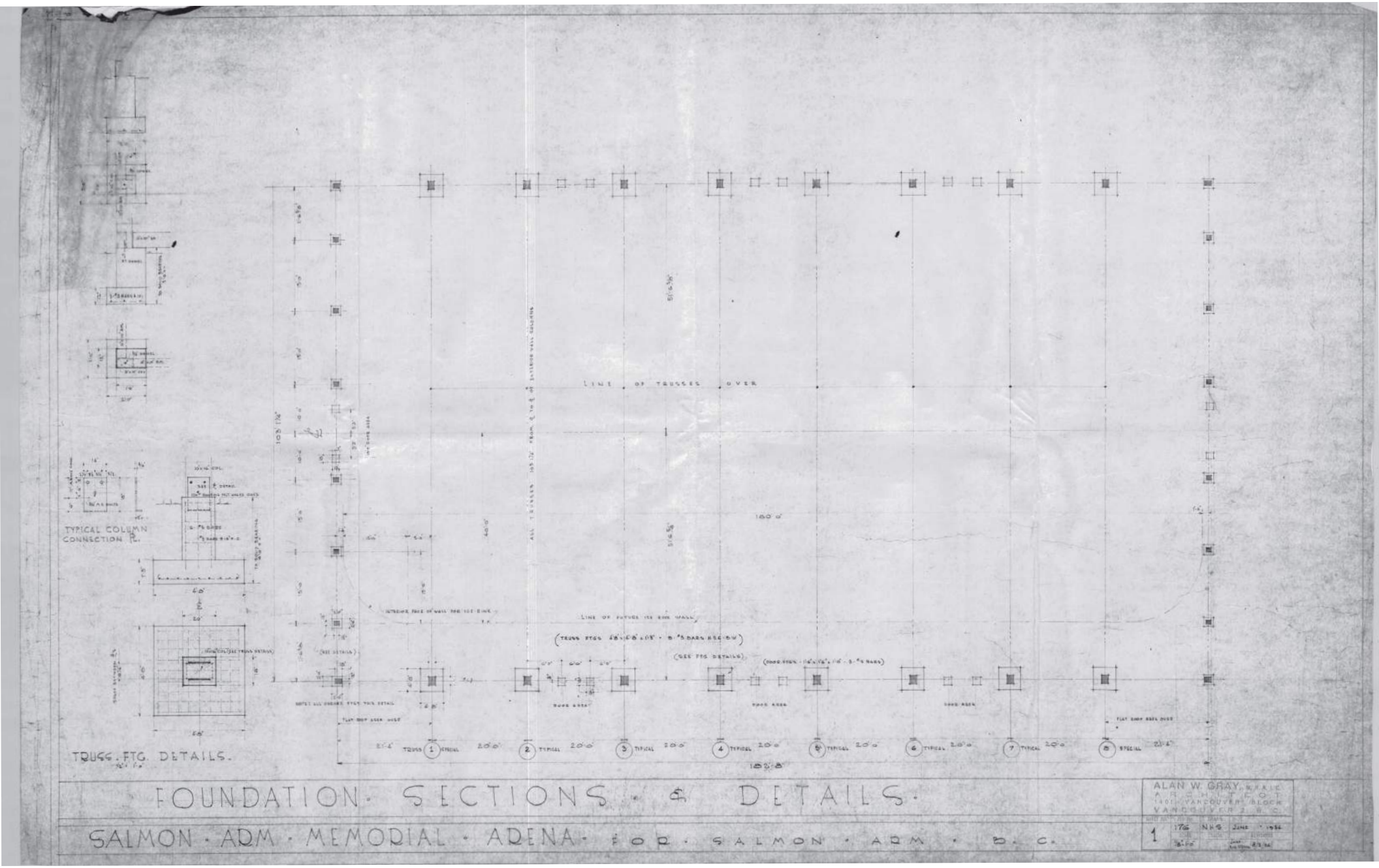


Figure 2 - Site Location Plan

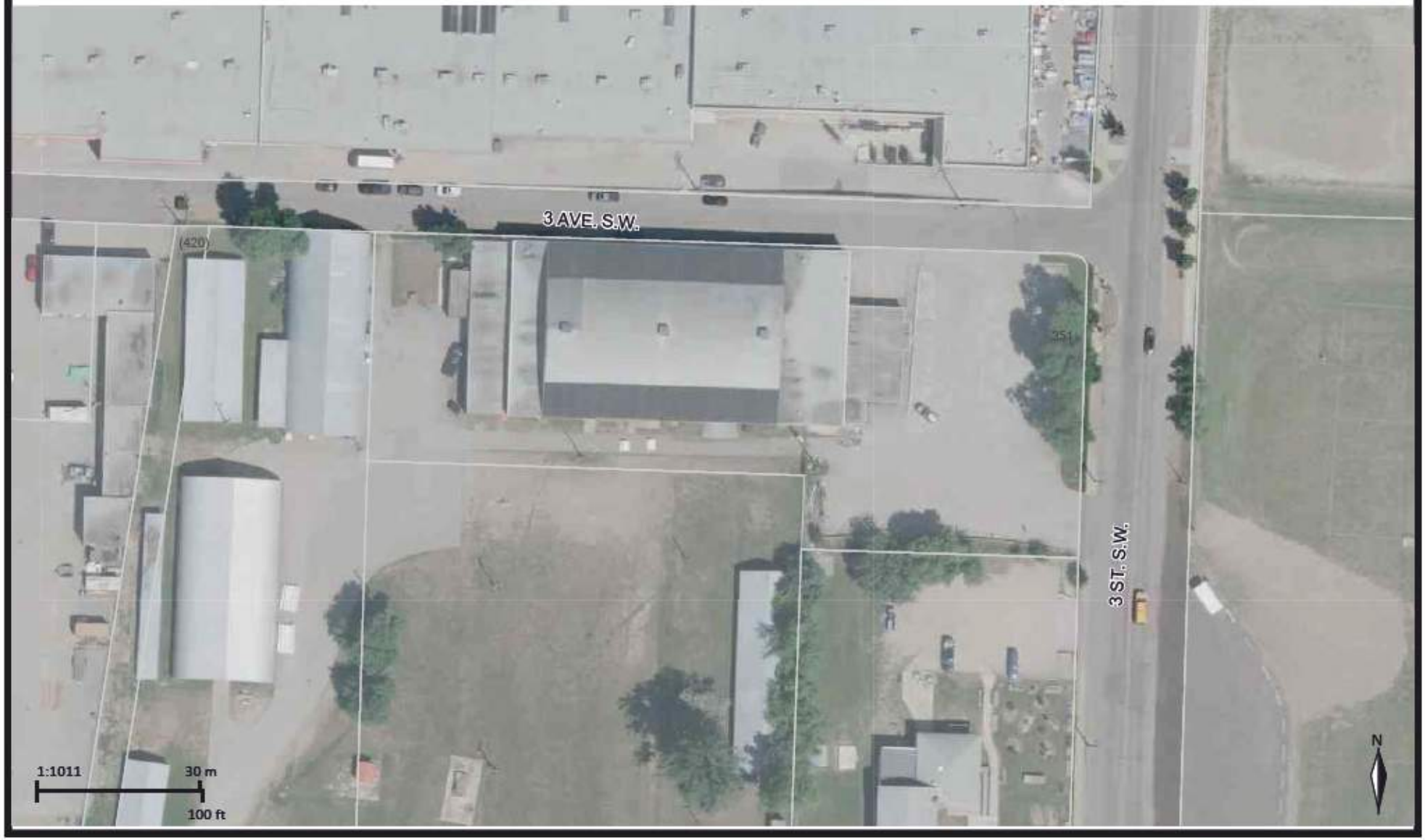


Figure 3 – Test Pit Locations

Appendix B

- Photo Logs

Evertek Engineering Limited
101 – 2493 Montrose Avenue,
Abbotsford, British Columbia V2S 0L5
Tel +1 (604) 776-0222 www.evertekengineering.com

Photograph 1 – TP1 Location, south wall, looking West.

Photograph 2 – TP Exposed the edge of existing footing.

Photograph 3 – TP1 Excavated profile.

Photograph 4 – TP1 Excavated material.

Photograph 5 – TP2 Location, south wall, looking West.

Photograph 6 – TP2 Exposed the edge of existing footing.

Photograph 7 – TP2 Excavated profile.

Photograph 8 – TP2 Excavated material, closeup.

Photograph 9 – Condition of existing footing, column, north wall, closeup.

Appendix C

- Test Pit Logs

Evertek Engineering Limited
101 – 2493 Montrose Avenue,
Abbotsford, British Columbia V2S 0L5
Tel +1 (604) 776-0222 www.evertekengineering.com

TEST PIT LOG TP24-01

PROJECT NUMBER: 100954
CLIENT NAME: BAR Engineering
PROJECT: Geotechnical Investigation
SITE ADDRESS: 351 3 Street SW, Salmon Arm, BC

DATE: February 27, 2024
EQUIPMENT: Mini-Excavator
SURFACE ELEVATION:
DEPTH OF TEST PIT: 1.5 m
DEPTH OF GROUNDWATER:

COMMENTS

LOGGED BY AH

Depth (m)	Graphic Log	Soils Description	Moisture (%) 0 100	DCPT Values 0 100	Depth (ft)
		Sandy TOPSOIL, organic, dark brown, moist, loose			
		CLAY, moist, stiff, plastic			1
					2
		Concrete Footing			3
1		CLAY, moist, stiff, more plasticity			4
		Termination of excavation at 1.5 m below existing grade. No groundwater was observed upon completion of test pit excavation.			5

TEST PIT LOG TP24-02

PROJECT NUMBER: 100954
CLIENT NAME: BAR Engineering
PROJECT: Geotechnical Investigation
SITE ADDRESS: 351 3 Street SW, Salmon Arm, BC

DATE: February 27, 2024
EQUIPMENT: Mini-Excavator
SURFACE ELEVATION:
DEPTH OF TEST PIT: 1.7 m
DEPTH OF GROUNDWATER:

COMMENTS

LOGGED BY AH

Depth (m)	Graphic Log	Soils Description	Moisture (%) 0 100	DCPT Values 0 100	Depth (ft)
		Sandy TOPSOIL, organic, dark brown, moist, loose			
		CLAY, moist, stiff, plastic			1
					2
		Concrete Footing			3
1					
		CLAY, moist, stiff, more plasticity			4
					5
		Termination of excavation at 1.7 m below existing grade. No groundwater was observed upon completion of test pit excavation.			

Appendix D

- Golder Associates (September 1996)
  - Borehole Logs
  - Testing Results (Atterberg Limits)

- Evertek Engineering (April 2023)
  - Testing Results (Moisture Content, Atterberg Limits)

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 1

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: August 29, 1996

DATUM:

PROJECT NUMBER: 962-4190

BORING LOCATION: See Figure 1

BOREHOLE TYPE: Hollow Stem

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT (Wp 20, W 40, Wl 60, 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE									
	Firm brown desiccated clayey SILT with some root fibres throughout. (TOPSOIL)		0.00							
			0.60							
1	Soft ligth brown slightly desiccated clayey SILT with occasional layers of silt.			1	DO	1,1,2	3			Hole Cuttings
	Loose brown medium SAND with a trace of fine gravel.		1.70							
2			1.80	2	AS					
	Very soft to soft light brown silty CLAY grading to a clayey SILT at depth and occasional thin sand seams throughout with a 8 cm. thick sand layers encountered at 2.5 m depth.			3	DO	WH/WH/1	1			Sept. 3/96
3										
			3.30	4	AS					
4	Interlayered very loose light brown to grey SILT with some seams of grey clayer silt grading to a soft grey SILT with some clay at depth.			5	DO	1,1,2	3			25mm PVC
5				6	AS					Slotted PVC
				7	DO	1,1,2	3			
6	END OF AUGERHOLE		5.94							
7										
8										
9										
10										

DRILL RIG: MOBILE B61

DRILLING CONTRACTOR: Sandwell

DRILLER: DM

Golder Associates

LOGGED: RR

CHECKED: RT

DATE: August 29/96

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 2

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: August 29, 1996

DATUM:

PROJECT NUMBER: 962-4190

BORING LOCATION: See Figure 1

BOREHOLE TYPE: Hollow Stem

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT (Wp 20, W 40, Wl 60, 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE		0.00							
	Firm brown desiccated clayey SILT with some root fibres grading to a SILT with some clay at depth.									
1				1	DO	1,1,3	4			Hole Cuttings
	Loose orange-brown medium SAND with a trace of fine gravel.		1.20							
			1.32							
	Soft to very soft light brown slightly mottled SILT and CLAY with occasional thin sand seams grading to a clayey SILT at depth.			2	AS					
2										
			2.44	3	DO	1,1,2	3			
3	Interlayered very soft light brown to grey clayey SILT and very loose SILT with some clay.									
				4	AS					
										Sept. 3/96 25mm PVC
4				5	DO	1,1,2	3			
			4.70							
5	Very soft grey SILT and CLAY.			6	AS					Slotted PVC
				7	DO	1,1,1	2			
6	END OF AUGERHOLE		5.94							
7										
8										
9										
10										

DRILL RIG: MOBILE B61

DRILLING CONTRACTOR: Sandwell

DRILLER: DM

LOGGED: RR

CHECKED: RT

DATE: August 29/96

Golder Associates

PROJECT: RCMP BUILDING

RECORD OF BOREHOLE - AH 3

SHEET: 1 OF 1

PROJECT LOCATION: SALMON ARM

BORING DATE: August 29, 1996

DATUM:

PROJECT NUMBER: 962-4190

BORING LOCATION: See Figure 1

BOREHOLE TYPE: Hollow Stem

Sampler Hammer: 63.5 kg., Drop 0.76m.

DEPTH SCALE (m)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 0.15m.	N	OTHER TESTS	PENETRATION RESISTANCE BLOWS/0.3m / WATER CONTENT, PERCENT Wp 20 W 40 60 Wl 80	PIEZOMETER OR STANDPIPE INSTALLATION
0	GROUND SURFACE		0.00							
	Firm brown desiccated clayey SILT with some root fibres.									
1	Loose brown SILT with occasional thin sand seams throughout.		1.00	1	DO	3,2,2	4			Sept. 3/96
2	Soft light brown slightly mottled and slightly fissured silty CLAY with occasional thin sand seams.		1.83	2	AS					
				3	DO	1,1,2	3			
3			3.05							Hole Cuttings
4	Interlayered very soft light brown to grey SILT and CLAY, clayey SILT and very loose SILT with a trace to some clay.			4	AS					
				5	DO	1,1,1	2			25mm PVC
5				6	AS					Slotted PVC
				7	DO	1,1,1	2			
6	END OF AUGERHOLE		5.94							
7										
8										
9										
10										

DRILL RIG: MOBILE B61

DRILLING CONTRACTOR: Sandwell

DRILLER: DM

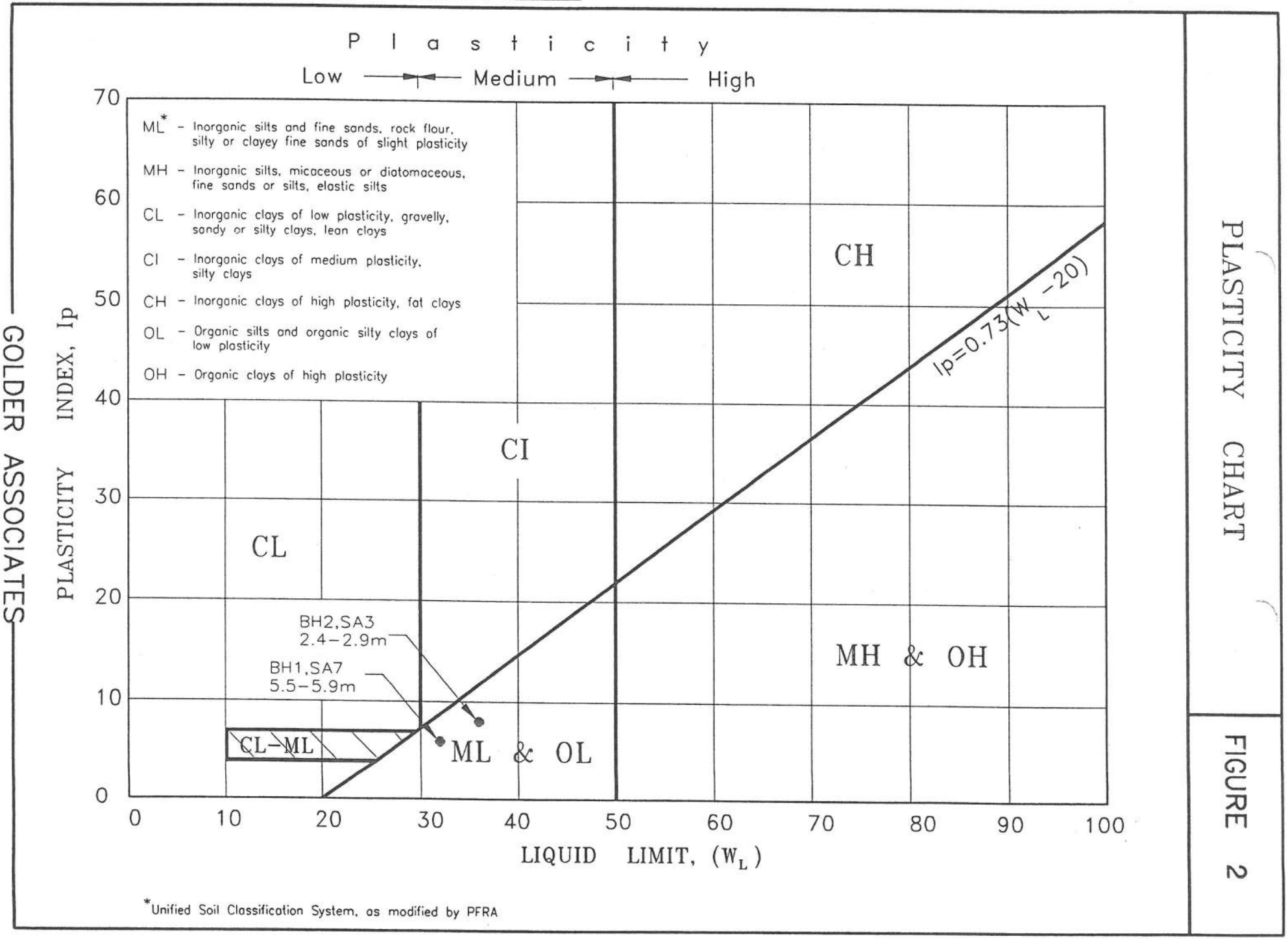
LOGGED: RR

CHECKED: RT

DATE: August 29/96

Golder Associates

PROJECT No. 962-4190 DRAWN rt REVIEWED DATE Sept 12/96



*Unified Soil Classification System, as modified by PFRA

PLASTICITY CHART

FIGURE 2

GOLDER ASSOCIATES

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	Old Municipal Hall, Salmon Arm, B.C.	Sample No.:	KS-10296
Project No.:	ENG.KGEO03854-01	Date Tested:	March 16, 2023
Client:	Evertek Engineering	Tested By:	CP
Address:	31 Hudson Avenue NE, Salmon Arm, B.C.	Page:	1 of 1

Sample Number	Depth (ft)	Moisture Content (%)	Visual Description of Soil
S1	4.0	38.3	
S2	4.0	30.1	
S3	4.0	31.0	

Reviewed By: _____ C.Tech.

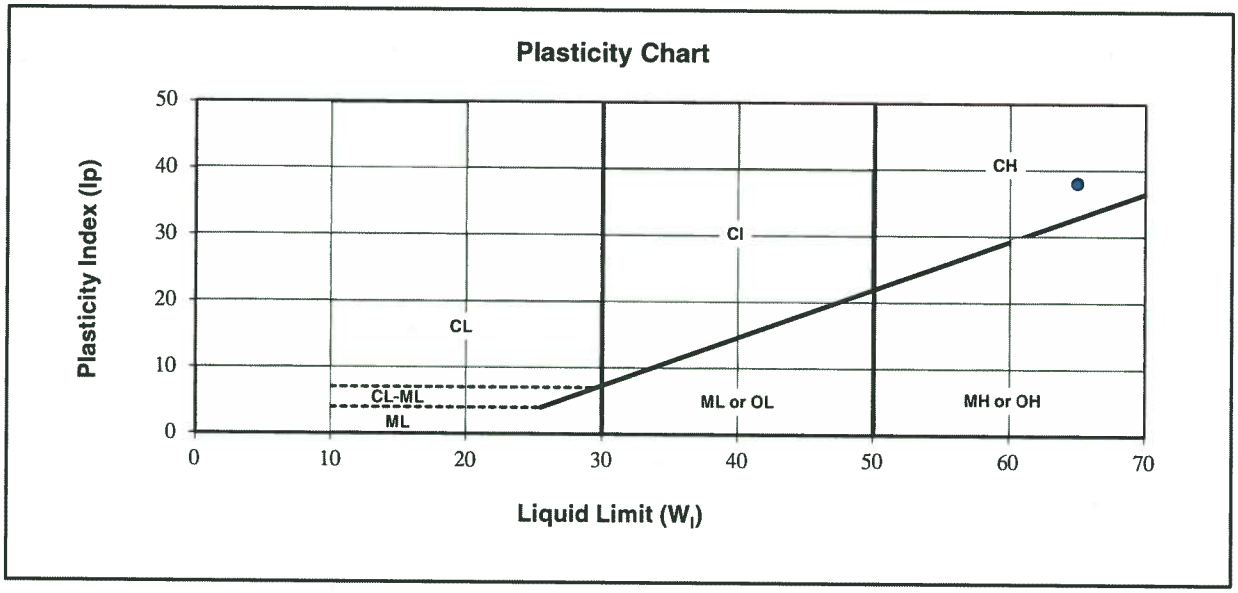
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Old Municipal Hall, Salmon, Arm, B.C.	Sample Number:	KS-10297
	Materials Testing Services	Sample Location:	S1
Project No:	ENG.KGEO03854-01	Depth:	4.0 ft
Client:	Evertek Engineering	Sampled By:	JF Tested By: TJ
Attention:	Larry Deng	Date Sampled:	March 15, 2023
Email:	larry.deng@evertekengineering.com	Date Tested:	March 17, 2023

Sample Description: CLAY, High Plasticity (CH)



Liquid Limit ($W_{1)}$:	65	Natural Moisture (%)	38.3
Plastic Limit :	27	Soil Plasticity:	High
Plasticity Index (Ip) :	38	Mod.USCS Symbol:	CH

Remarks:

Reviewed By: Dylan Byke P.Eng.

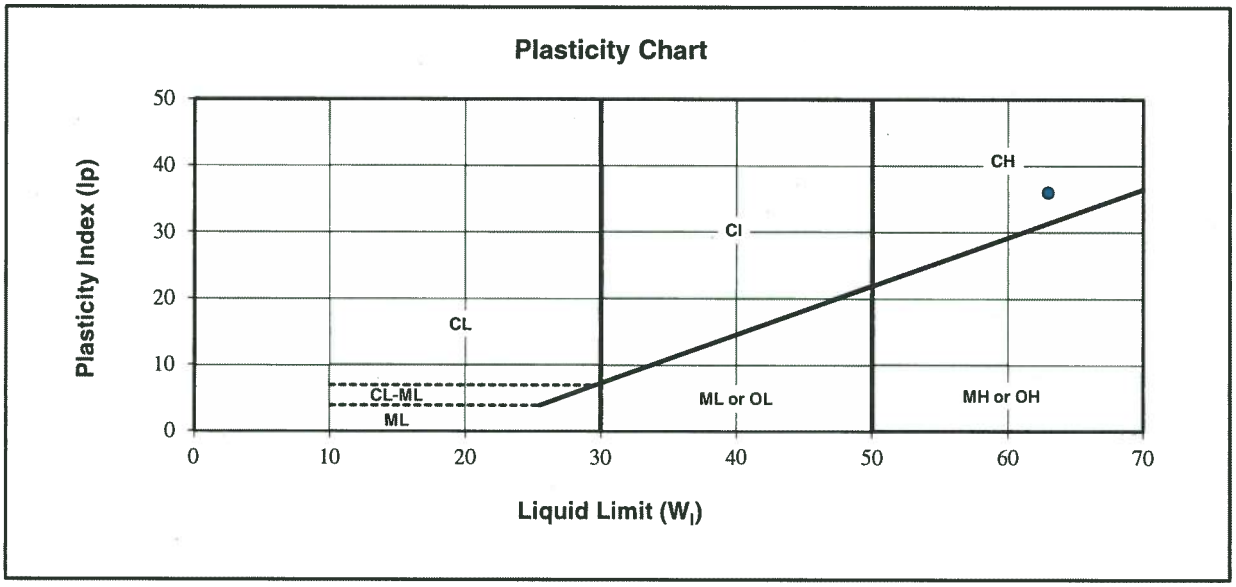
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Old Municipal Hall, Salmon, Arm, B.C.	Sample Number:	KS-10298
	Materials Testing Services	Sample Location:	S3
Project No:	ENG.KGEO03854-01	Depth:	4.0 ft
Client:	Evertek Engineering	Sampled By:	JF Tested By: CP
Attention:	Larry Deng	Date Sampled:	March 15, 2023
Email:	larry.deng@evertekengineering.com	Date Tested:	March 17, 2023

Sample Description: CLAY, High Plasticity (CH)



Liquid Limit ($W_{1)}$:	63	Natural Moisture (%)	31.0
Plastic Limit :	27	Soil Plasticity:	High
Plasticity Index (Ip) :	36	Mod.USCS Symbol:	CH

Remarks:

Reviewed By: _____ P.Eng.

TETRA TECH

APPENDIX G

Cost Estimate – Partial Occupancy

Cost Estimate – Full Occupancy

Client: City of Salmon Arm
Project: Memorial Arena Structural Assessment & Life Cycle Analysis
Project No. 24VR-600400
Date: March 22, 2024
Prepared by: Joey Funk, P. Eng.

Cost D Class Estimate: Repair Recommendation - Partial Occupancy

Item		Quantity	Unit	Unit Cost	Sub-total	Comments
1.0	**General Requirements**				**$ 20,990.00**	
1.01	Overhead/ Admin	15.00%	allow		$ 7,995.00	15% of Construction Cost
1.02	Engineering	15.00%	allow		$ 7,995.00	15% of Construction Cost
1.03	Temporary Facilities	1	allow	$ 5,000.00	$ 5,000.00	Contractor Office
2.0	**Bracing**				**$ 20,000.00**	
2.01	Cable Bracing	10	allow	$ 2,000.00	$ 20,000.00	Cross bracing in arena, 2 sets each end, 3 sets each side
3.0	**Shoring**				**$ 17,000.00**	
3.01	Jacking	1	allow	$ 2,000.00	$ 2,000.00	Jacking truss H to within 1 inch of truss G elevation
3.02	Temporary Shoring	3	unit	$ 5,000.00	$ 15,000.00	Shoring of trusses F, G, and H
					$ -	
4.0	**Exterior Works**				**$ 16,300.00**	
4.01	Clean Eavestroughs	360	lin. Ft	$ 5.00	$ 1,800.00	Clean arena eavestroughs
4.02	Replace Downspouts	8	unit	$ 250.00	$ 2,000.00	Replace downspouts and tie into existing storm sewer where possible
4.03	Roof video Surveillance	1	allow	$ 10,000.00	$ 10,000.00	Cameras installed on roof so that all roof areas visible
4.04	Wind Station	1	allow	$ 2,500.00	$ 2,500.00	Wind station on roof
	SUB-TOTAL				**$ 74,290.00**	
	Contingency (15%)				$ 11,143.50	
	GST (5%)				$ 4,271.68	
	TOTAL				**$ 89,705.18**	

Client: City of Salmon Arm
Project: Memorial Arena Structural Assessment & Life Cycle Analysis
Project No. 24VR-600400
Date: March 25, 2024
Prepared by: Joey Funk, P. Eng.

Cost D Class Estimate: Repair Recommendation - Full Occupancy

Item		Quantity	Unit	Unit Cost	Sub-total	Comments
1.0	**General Requirements**				**$ 565,159.00**	
1.01	Overhead/ Admin	15.00%	allow		$ 276,095.40	15% of Construction Cost
1.02	Engineering	10.00%	allow		$ 184,063.60	10% of Construction Cost
1.03	Temporary Facilities	1	allow	$ 5,000.00	$ 5,000.00	Contractor Office
1.04	Temporary Shoring	10	ea	$ 10,000.00	$ 100,000.00	Shoring to suit foundation replacement, exterior wall replacement
2.0	**Arena Roof Repairs**				**$ 665,700.00**	
2.01	Rafter Reinforcing	20	ea	$ 500.00	$ 10,000.00	Repair split rafters
2.02	Truss Top Chord Reinforcing	8	ea	$ 15,000.00	$ 120,000.00	Epoxy injection of checks and delaminations, increase member size
2.03	Post-Tension Bottom Truss Chords	8	ea	$ 15,000.00	$ 120,000.00	Post tensioning of bottom chords to reduce axial tension
2.04	Truss Web Replacement	150	ea	$ 750.00	$ 112,500.00	Replace webs with split ends
2.05	Truss Web Reinforcing	224	ea	$ 350.00	$ 78,400.00	Increase member sizes
2.06	Web to Chord Connection Reinforcing	28	ea	$ 2,500.00	$ 70,000.00	Install gusset reinforcing at web to chord connections
2.07	Flat Roof Replacement	4160	sqft	$ 30.00	$ 124,800.00	Replace flat roof framing at east and west ends of arena
2.08	Truss Bracing	1	allow	$ 30,000.00	$ 30,000.00	Reinforce and add truss bracing
3.0	**Arena Exterior Wall Repairs**				**$ 244,920.00**	
3.01	Demolition	14768	sqft	$ 2.50	$ 36,920.00	Removal of existing infill framing between columns
3.02	Exterior Wall Replacement	400	lin. Ft	$ 400.00	$ 160,000.00	Shearwall infill framing between columns (sheathing, wrb, siding, framing)
3.03	Endwall Braced Frames	4	ea	$ 12,000.00	$ 48,000.00	Steel braced frames at each end of arena
4.0	**Arena Foundation Replacement**				**$ 131,450.00**	
4.01	Demolition	724	cu.ft	$ 50.00	$ 36,200.00	Demolition of existing arena foundation
4.02	Footings	3128	cu.ft	$ 15.00	$ 46,920.00	New spread pad footings and strip footings
4.04	Foundation Walls	2272	cu.ft	$ 15.00	$ 34,080.00	New foundation walls on north and south sides of arena
4.05	Partial Slab replacement	950	cu.ft	$ 15.00	$ 14,250.00	Replace slab areas removed to suit foundation replacement
5.0	**East & West Addition Structural Repairs**				**$ 41,000.00**	
5.01	Reinforce Rafters and planking	1	allow	$ 40,000.00	$ 40,000.00	Reinforce west addition rafters, add rafters to east addition
5.02	Replace Column	1	ea	$ 1,000.00	$ 1,000.00	Replace south wood column in reception area
6.0	**Building Envelope Repairs**				**$ 476,646.00**	
6.01	Roofing	26920	sqft	$ 15.00	$ 403,800.00	2-ply SBS membrane replacement
6.02	Flashing	1	allow	$ 10,000.00	$ 10,000.00	Replace all window, door, eave, base, and gable flashings
6.03	Soffit and Facia	1	allow	$ 8,000.00	$ 8,000.00	Replace aluminum soffit and facia
6.04	Eavestroughs and Downspouts	672	lin. ft	$ 18.00	$ 12,096.00	Replace eavestroughs and downspouts, tie into new stormwater system
6.05	Wall Penetrations	1	allow	$ 5,000.00	$ 5,000.00	Flash and seal all exterior wall penetrations
6.06	Mandoor	9	ea	$ 1,500.00	$ 13,500.00	Replace exterior mandoors
6.07	Overhead Door	1	ea	$ 5,000.00	$ 5,000.00	Replace overhead doors
6.08	Barn Door	1	ea	$ 5,000.00	$ 5,000.00	Replace barn door on south side of arena
6.09	Windows	19	ea	$ 750.00	$ 14,250.00	Replace exterior windows
7.0	**General Site Works**				**$ 175,920.00**	
7.01	Storm Sewer Replacement	768	lin. Ft	$ 125.00	$ 96,000.00	Replace stormsewer system
7.02	Weeping Tile	768	lin.ft	$ 5.00	$ 3,840.00	Install weeping tile system and tie into new stormwater system
7.03	Grading	7680	sqft	$ 2.00	$ 15,360.00	General grading following foundation replacement
7.04	Landscaping	7680	sqft	$ 4.00	$ 30,720.00	General landscaping following site works
7.05	Excavation	1	allow	$ 30,000.00	$ 30,000.00	Excavations to suit foundation replacement.
	SUB-TOTAL				**$ 2,300,795.00**	
	Contingency (15%)				$ 345,119.25	
	GST (5%)				$ 132,295.71	
	TOTAL				**$ 2,778,209.96**	

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