JRS ENGINEERING
BUILDING ENVELOPE CONSULTANTS

BUILDING ENVELOPE CONDITION ASSESSMENT

KYLE CENTER
125 KYLE STREET
PORT MOODY, BC

JRS Project No. VR11262A

July 14, 2020

Prepared for:
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APPENDICES

1.0 EXECUTIVE SUMMARY

The City of Port Moody Kyle Center located at 125 Kyle Street, in Port Moody BC, is a complex that is approximately 40 years old, completed circa 1978. The site consists of one building which JRS Engineering Ltd was engaged by the City of Port Moody to conduct a condition assessment of the building envelope. This assessment included visual reviews, and exploratory openings in walls (interior and exterior) and two different roof assemblies.

In general, the wall cladding of the building is in poor condition. Most elevations, but particularly the south and east-facing elevations, and wall areas extending above the rooftop are damaged, deteriorated, or missing cladding. The underlying building paper is starting to show signs of deterioration, particularly where exposed behind damaged cladding. Sealant joints at cladding transitions and terminations are failing. At this time, the sheathing was found to be in generally good condition, though replacement of the cladding is recommended within the next 1 to 3 years, to prevent accelerated deterioration of the sheathing and framing and maintain the continued use of the building for the long-term.

The roof assemblies at the complex have generally exceeded their expected service life and most roof areas are in poor condition. Evidence of past and active failures in the roof systems were observed throughout the building. Replacement of all roofing assemblies (sloped and low sloped) is recommended within the next year.

The existing aluminum T-bar skylights are in poor condition. In addition to being a poor system that has undergone repairs, there is evidence of active water ingress. Replacement of the skylights is recommended within the next year. It would be prudent to pair the skylight replacement with the roof replacement work.

The aluminum and steel windows are generally in poor condition and have reached the end of their expected service life. Windows displayed evidence of gasket and sealant failure, insulated glazing unit failure, and evidence of water ingress. Window replacement is recommended in the next 1 to 3 years and is recommended to be conducted in conjunction with future cladding replacement.

The storage area below grade is in generally good condition. Some localized evidence of efflorescence and staining was observed at cold joint locations, suggesting periodic, localized below-grade leaks. Based on the apparent limited extent of these leaks, interior-side injection repairs are recommended in the next 1 to 3 years and could be timed to coincide with future cladding replacement work.

An Opinion of Cost has been prepared for the recommended repairs and renewals, based on the short-term and medium-term recommendations. The Opinion of Cost for the recommended repairs is $2,308,000, in the scenario where all of the recommended work is completed as a large, single-phase project. Multiple phasing scenarios exist for the work and we remain available to discuss these in further detail with the City of Port Moody.

2.0 INTRODUCTION

2.1 TERMS OF REFERENCE

JRS Engineering (JRS) was retained by the City of Port Moody to undertake a building envelope condition assessment of the Kyle Center, located at 125 Kyle Street, Port Moody, BC. The purpose was to evaluate the present condition of the various building envelope systems on the building and provide a report outlining recommendations for the long-term, continued operation of the building. This work was done under the Engineering Services Agreement dated May 14, 2020.

2.2 REPORT ORGANIZATION

Section 1.0 of this report consists of the executive summary.

Section 2.0 of this report provides basic background information relative to this complex.

Section 3.0 presents our observations and discussion on the current condition of the investigated assemblies, as well as any additional information gathered during our assessment. The section is organized into the following subsections:

- Walls
- Windows and Doors
- Roofs
- Skylights
- Below Grade

Section 4.0 summarizes our conclusions, recommendations as well as repair strategies. Each recommendation has been assigned a recommended time period to assist the City of Port Moody in managing their building envelope over the remaining service life of the building and prioritize the various repairs.

Section 5.0 includes "Order-of-Magnitude" opinions of cost associated with our recommendations.

Section 6.0 provides a step by step process of the typical process after the owners decide to move forward with any of the recommendations.

Section 7.0 concludes the report with closure and disclaimer statements related to the assessment and use of the report.

Included as part of this report are the following appendices:

Appendix A – Site Observation Photos

Appendix B – Exterior & Interior Exploratory Openings

Appendix C – Plans and Elevations

Appendix D – Fungal Air Sampling Report (by Total Safety)

Appendix E – Glossary

2.3 DOCUMENTS REVIEWED

The following documents were provided for our review as resources for the building envelope condition assessment:

- Original Architectural Drawings by Carlberg Jackson Partners Architects – Dated 21-02-1977.
- Roof Condition Assessment Report by JRS Engineering – Dated 21-01-2012

2.4 BACKGROUND INFORMATION

The one-story wood framed building was constructed in 1977 and is clad with cedar cladding, (installed in horizontal and diagonal orientations with two different size profiles and colours). It is a recreational center and we understand there have been a number of renovations over the years, including localized roof repairs, localized window IGU replacements and targeted sealant repairs.

PROPERTY DESCRIPTION	
Type of Property	Recreational Center
Number of Buildings	1
Number of Storeys	1
Gross Floor Area	9,000 ft^2
Construction Date	1977
Applicable Building Code	NBC 1970 (reg #140/73)

Table 1: Property Description

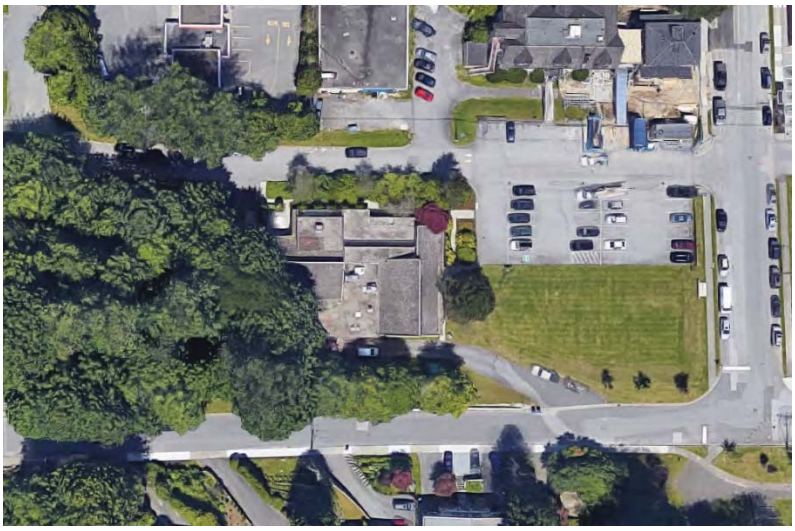

Figure 1: Overview of the Kyle Center Site

Each elevation of the building is clad with channel cedar siding, installed in either a diagonal or horizontal orientation with widths of the siding lengths varying throughout. Wall areas extending above the roof line are also clad with channel cedar siding. The windows at the building consist of steel frame windows with aluminum operable inserts (ground level) and aluminium framed windows (at roof level and clerestory glazing) windows. The roofs are a combination of sloped cedar shakes and low-slope roof assemblies. Originally, the low-slope roof assembly was a 4-ply built-up asphalt and felt roof (BUR); however a large repair was done sometime in the past, replacing a large portion of the main BUR roof with a 2-ply SBS-modified bitumen membrane system. There are two aluminum, T-bar skylight assemblies on the north side of the building.

BUILDING ENVELOPE DESCRIPTION	
Roofing	Low Slope Roof: 2-ply SBS
	Low Slope Roof: Multiply built-up asphalt
	Sloped Roof: Cedar shakes
Wall Cladding	Channel Cedar Siding
Windows	Steel frame, with operable aluminum inserts
	Aluminium frame windows
Skylights	Aluminum T-Bar system
Doors	Steel frame swing (some glass inserts)
Below Grade	Damp proofing

Table 2: Building Envelope Description

Three areas of the building have overhead protection provided via the roofline projecting beyond the walls below, creating a soffit. These three areas include the north elevation (east half with 6-8ft overhangs); west elevation (north corner 3-4ft overhangs); and east elevation (all 3 ft overhangs). All other wall areas on the main level and at the roof level have no overhang protection.

As a result of the combinations of exposure and protection, most of the building walls are classified as medium to high exposure to wind-driven rain, according to the CMHC Wood Frame Envelopes in Coastal Climates of British Columbia, Best Practice Guide. Exposure is influenced by building height, roof overhang size and local wind characteristics, as well as size and proximity of adjacent buildings.

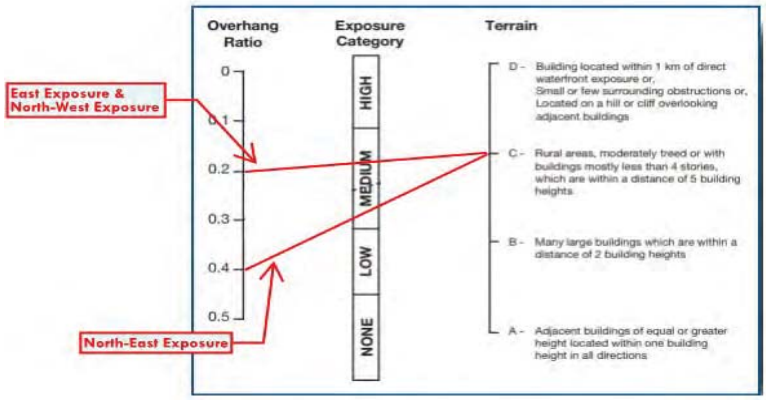

Figure 2: CMHC Exposure Nomograph Chart

The facility managers reported significant roof leakage in several areas in the past. The underside of roof decks and ceiling tiles were visibly stained in several areas, see appendix C. A significant portion of the sloped roof areas have been tarped over as a means of temporary protection, until such time that permanent repairs can be completed. A large section of the low-slope roof has also been replaced in the past, to attempt to control recurring leaks (see appendix C).

Based on the date stamp on certain insulated glazing units (IGUs), it appears targeted IGU replacements have also occurred since 2009.

2.5 SITE VISITS

On May 20th, 2020 Marco de Schryver P.Eng. and Kurtis Topping P.Eng, RRO from JRS along with contractors from HLC Demolition and Hazmat Inc and Marine Roofing conducted on-site investigations and exploratory openings. The temperature on this date was 15 C with a humidity of 75%. On May 29th, Marco de Schryver (JRS) and HLC returned to conduct mould material testing. The temperature on this date was 18C with a humidity of 75%.

3.0 ASSESSMENT OF BUILDING ENVELOPE

3.1 WALLS

Visual Observations

The building is a one storey recreational center with vaulted ceilings, with cedar cladding on all elevations, including wall areas which extend above the roof level (photo 1).

The Architectural drawings indicate that the wall assembly consists of the following (exterior to interior):

- Channel cedar siding (1"x6" or 1" x 4")
- Building Paper
- ½" plywood sheathing
- 2" x 6" wood stud framing at 16" o/c
- 6" fibreglass batt insulation (between studs)
- Polyethylene vapour barrier

- Drywall and interior finishes

The assemblies observed onsite via interior and exterior exploratory openings reflect the original architectural drawings. JRS recorded the following observations during our review of the walls:

- The cedar siding itself is in very poor condition, with significant deterioration, separation and missing cladding observed. (photos 2-5).
- Evidence of insect damage and wood rot within the cedar cladding was observed (photo 6).
- Wall sealants were found to be in poor condition (photo 7).
- A mechanical rooftop penetration with multiple plies of loose membrane adhered to the cladding was noted (photo 8).
- Several fastener penetrations through the cladding were noted, for the installation of roof tarps as part of emergency repairs (photo 9)
- Exposed building paper was noted behind damaged cladding, much of which was damaged and torn. (photo 10)
- Exploratory openings through the exterior cladding revealed dry plywood sheathing, which appeared to be in visibly good condition in most areas (see appendix B). In some localized areas, the plywood sheathing was found to be wet or was found to be in poor condition.

Moisture Probe Testing

Moisture probe testing was performed on the plywood sheathing, roof deck and/or underlying framing. Moisture content readings can indicate the relative amount of moisture present at the time of sampling, and are used to help determine the locations, extent, and severity of moisture-related problems. When correlated with the results from the exploratory openings and visual observations, they can be used to indicate the probable condition of the underlying framing and sheathing.

It is important to note that moisture probe testing is only a guide—results can vary significantly, depending on a number of conditions, including the presence of environmental moisture leading up to and during the assessment. Wetting is influenced by the proximity of the moisture probe to a problematic detail and by the extent of recent precipitation and winds. During the period of time leading up to our site visits, the weather was generally cool and dry.

The moisture content readings were taken with a Delmhorst BD-2100 moisture meter, which uses the electrical resistance between two points at a known distance apart to determine the moisture content of the material.

Several areas of the cladding were deteriorated to the point where a moisture meter probe could be inserted through the cladding and to retrieve a moisture content reading in the plywood sheathing without having to cut an exploratory opening.

The results of each moisture probe have been coded to indicate moisture content range. Table 3 is a list of moisture contents and their significance to the relative condition of wood-based wall materials:

●	Recorded moisture content less than 20 percent. This is the general equilibrium moisture content of wood.
▲	Recorded moisture content at and between 20 and 28 percent. Infrequent contact with external moisture, with varying drying potential. Moisture content is sufficient to sustain fungal growth.
■	Recorded moisture content greater than 28 percent, indicating constant contact with external moisture. Moisture content will initiate fungal growth and cause significant decay. Deterioration likely exists.

Table 3: Moisture Content Ranges

Twenty-seven moisture probes were conducted in May 2020. Individual moisture content and exploratory opening test locations and results have been plotted on drawings and attached as Appendix C. Results are summarized in Table 4 below.

Detail	Number of Probes	< 20% ●	20 – 28% ▲	> 28% ■
Walls	21	20	1	0
Roofs	6	6	0	0
Totals:	**27**	**26**	**1**	**0**
Percentage:	100%	96%	4%	0

Table 4: Summary of Moisture Probes

Despite the poor condition of the cedar siding and the roof assemblies, most moisture probe readings taken indicated less than 20% moisture content in the plywood sheathing and roof decking. This is likely due to the time of year in which the assessment was conducted (May) and the dry conditions during the days leading-up to the on-site review. While the moisture probe results indicate that the sheathing and roof decks were primarily dry at the time of our review, we did observe some evidence of staining and other indicators of moisture-related deterioration. In general, however, the results of our assessment indicated that the sheathing and decking beneath the roof and wall assemblies are still likely in good-to-fair condition. While some targeted reframing repairs can be expected, widespread structural deterioration does not appear to be an issue at this time.

Exploratory Openings

Exploratory openings were made by removing a portion of the exterior cladding, the interior drywall or localized portions of the roof assembly at various, representative locations, where the likelihood of moisture

damage ranges from low to high. Exploratory openings permit observation of the underlying sheathing and framing. This is important because moisture related damage cannot be accounted for by moisture probing alone. Thirty exploratory openings were conducted, as follows; Sixteen exterior openings through the cladding, eight interior openings through the interior drywall, and six exterior openings through the roof assemblies.

Detailed observations of each exploratory opening are attached as appendix B. The results of each exploratory opening have been categorized into one of the following Three condition categories, based on the condition of the assembly within the exploratory opening. These categories are defined as follows:

No damage: Exploratory opening is generally clean with no evidence of past or present moisture-related deterioration (stains, corrosion, rot, etc.) observed.

Evidence of moisture: Exploratory opening displayed some evidence of moisture-related deterioration (minor staining, corrosion or rot, minor organic growth, elevated moisture content, etc).

Damage: Exploratory opening displayed significant evidence of moisture-related deterioration (major staining, corrosion, or rot, significant organig growth, wet sheathing or framing, visible moisture, etc).

Table 5: Exploratory Opening Condition Categories

Exploratory opening test locations, their relative conditions and moisture probe results have been plotted on drawings in appendix C. The visual results of our exploratory openings are summarized in the following table:

Location	No Damage	Evidence of Moisture	Damage (incl. wet sheathing and/or framing)
Walls	15	4	5
Roofs	5	0	1
Totals:	**20**	**4**	**6**
Percentage:	66%	13%	20%

Table 6: Summary of Exploratory Openings

Discussion

The cedar wall cladding is in poor condition. As listed in the visual observations, issues with the existing cladding include missing, deteriorated and separated cedar siding, exposing the underlaying building paper. This condition is widespread, but is most notable at the

south, east and wall areas at the roof top. This coincides with the wall areas which are of the highest exposure (least overhang protection) and facing the prevailing wind-driven rain direction.

The wall assemblies used are commonly referred to as "concealed barrier", where the surface of the cladding is intended to deflect the majority of the rainwater. The building paper installed between the cladding and the sheathing is intended to intercept small amounts of moisture that penetrate past the cladding.

Due to the lack of a cavity between the siding and building paper, this type of wall assembly is limited in the amount of moisture it can manage that penetrates past the face of the cladding.

Fortunately, at this stage the building paper appears to be functioning as intended, keeping the moisture away from the wall sheathing in most locations. Of the sixteen exterior wall exploratory openings, four of these openings demonstrated some evidence of moisture penetrating behind the building paper (staining, etc.). Of those four, one opening was found to have moisture in behind the building paper.

Building paper, however, is not intended to be exposed to the elements and its condition will rapidly deteriorate if left exposed for extended periods of time. If the exterior walls are left in their current condition, it is reasonable to expect that occurrences of water ingress will increase in frequency and the rate of deterioration of the wall assembly will accelerate.

The expected service life for cedar cladding installed in this configuration is between 25 and 30 years, depending on the maintenance, quality of the materials and installation. At this point in time, the siding has exceeded its expected service life. Localized repair efforts will likely result in damage to the surrounding building paper and siding, which can lead to further water ingress and deterioration related issues. As such, targeted cladding replacement will not be a feasible approach for the long-term continued operation of this building. Based on the information gathered via the visual observations and the exploratory openings, we recommend full cladding replacement within the next 1 to 3 years. While targeted emergency repairs may be required until such time that the cladding can be replaced in its entirety, we do not recommend relying on such repairs for the long-term performance of the cladding system.

At this time, it appears that the plywood wall sheathing is in generally good-to-fair condition and much of the sheathing can likely be retained when completing future repairs. It is likely that localized areas of sheathing will require replacement once the cladding and building paper are removed. Once the sheathing is exposed, localized repair of deteriorated sheathing or framing members can be done to address such areas of concern.

During the exterior wall cladding replacement, we also recommend incorporating a rainscreen cavity into the wall assembly. A rainscreen cavity, typical in modern construction and mandated by Code, is a space between the outboard side of the moisture barrier and behind the cladding that allows for any water that penetrates behind the cladding

to drain away more easily. This rainscreen cavity also allows the wall assembly to dry out after periods of rain. Facilitating drainage and drying will increase the durability of the entire wall assembly.

Recommendation:

1) Remove and replace cedar cladding with rainscreen cladding assembly, including replacement of moisture barrier and targeted framing restoration as required (1 to 3 years).

3.2 WINDOWS AND DOORS

The windows at the building consist of aluminium-framed and steel-framed, double glazed windows. The insulated glazing units (IGUs) include an aluminum spacer bar (photo 11). Some of the steel-framed windows have aluminium operable inserts fastened into the steel frames (photo 12). The IGUs are held in place with removable exterior glazing stops which vary in type and material, depending on the window assembly. In general, all the windows have an interior butyl wet seal, sealing the glass to the frame. At the exterior, the aluminum windows and inserts have a dry rubber gasket sealing the glass to the removable glazing stops. Many of the IGUs are dated 2009, indicating an IGU replacement occurred during or after that year.

JRS recorded the following observations during our review of the windows:

- Failing and flaking paint finish was noted on both the aluminium and steel window frames (photos 12-13).
- Exterior dry rubber gaskets are in poor condition (photo 13). The rubber has dried out and cracked and many of the gaskets have shrunk, providing a location for water to penetrate into the window the assembly.
- Multiple layers of failed sealant were observed around the window perimeters (photo 14).
- Corrosion was observed on aluminium spacer bars within the IGU's indicating IGU failure (photo 15).
- The interior butyl wet seal has compressed out of the joint between the frame and glass, which affects the air seal and weather tightness of the window assembly (photo 16).
- Visible moisture droplets and fogging was observed within several IGUs, indicating failure of the IGUs (photo 17).
- Visible moisture staining on interior sills was noted (photo 18).

All of the exterior doors on the building are steel swing doors (photo 19) installed into pressed-steel frames. The front doors have glass inserts set into the door leafs. All doors are located under overhang protection (ranging between 3 ft to 8 ft) except for the basement door, which has no overhang protection.

JRS recorded the following observations during our review of doors:

- The lower portions of the basement doors (roughly 1 foot high) are corroded (photo 20)
- Minor paint flaking and surface corrosion were observed on the steel frame doors (photo 21)

Discussion

Doors and windows have a heavy impact on the air barrier and thermal performance of the building. Exterior air entering at the doors can result in thermal discomfort and increased humidity in occupied spaces.

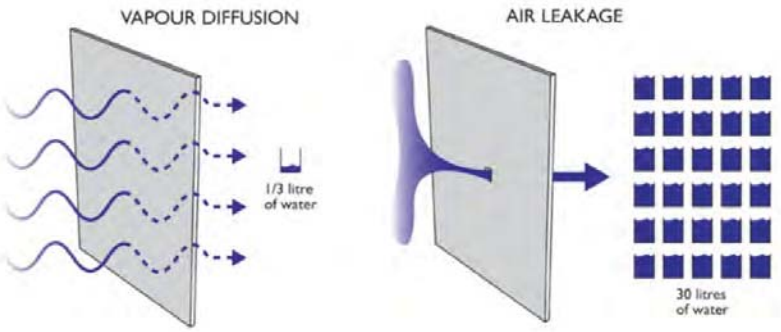

Figure 3: Vapour diffusion vs. air leakage

The windows reviewed on-site are in generally poor condition. As listed in the visual observations above, there is evidence of moisture ingress as noted by the interior staining. It is likely that the multiple layers of failed sealant were attempts to mitigate this issue. The interior butyl and exterior rubber gaskets have failed, which provide a possible source of water ingress and a likely source of air leakage. The IGU's show presence of moisture (condensation) between the panes of glass, indicating that the IGU seals have failed. Failed IGUs, present a cosmetic issue due to the fogging between the panes of glass which cannot be removed. Further, a failed IGU will not perform well thermally, due to the loss of insulating air (or gas) from within the sealed cavity. The aluminium and steel frames are also thermally inefficient, making them prone to condensation and occupant comfort issues. Water ingress or condensation are both potential sources of noted water damage observed at the window sills. Poor thermal performance is also related to poor energy efficiency associated with heating.

The window frames and IGU's show signs of deterioration and are not acting as proper air, moisture, or thermal barriers. The steel-frame and aluminum windows of the type installed at this site have an expected service life of 25 to 30 years, depending on the quality of the material, installation, and ongoing maintenance. Based on the current condition of the windows, it appears that the windows have exceeded their expected service life and we recommend full window replacement.

It would be prudent to replace the windows at the same time as the major cladding replacement project, in order to facilitate proper building envelope integrations between these elements and to benefit from improved thermal, moisture, and air barrier performance.

The doors reviewed on-site are in fair condition. Although there are signs of surface deterioration as indicated by the corrosion and flaking paint, they are generally located under overhang protection and do not appear to be sources of water ingress at this time.

The expected service life for steel frame doors of the type found at the Kyle Centre ranges between 25 to 30 years, depending on the level of exposure and frequency of use. The steel frame doors on the site have met their expected service life and will likely continue to perform as intended with ongoing maintenance; however, the steel construction of these doors offers poor thermal performance. Further, future cladding replacements will trigger removal of the doors in order to facilitate proper interface detailing between these two elements. While it may be possible to remove and reinstall the doors and frames, there are some risks involved. For example, it is possible that the frames become damaged during the removals process or no longer fit in the openings due to the additional build-up of moisture and air barrier control layers.

Due to the poor thermal performance offered by the existing doors, the pending replacement of the surrounding windows and walls, and the complications of trying to retain and reinstall the existing doors, we recommend budgeting for replacement of the existing doors during the future cladding replacement project.

The basement door and frame can likely be retained, as it is encased in the surrounding foundation wall concrete. The surface corrosion can be treated and painted and a through-wall flashing installed in the cladding directly above to offer better protection at the door head.

Recommendation:

2) Replace windows and doors, including proper interface detailing with adjacent roof and wall assemblies. Conduct targeted maintenance to basement door. (1 to 3 years)

3.3 ROOFS

Visual Observations

There are two types of low slope roofs on the building: Multi-ply Built-Up-Roof (BUR) and 2-ply SBS roof (photos 22 and 23). Architectural drawings indicate that the low slope roof assembly consists of the following (exterior to interior):

- BUR (asphalt and felt)
- 2 layers of 5/8" fibreboard
- 2 layers of 1 ½" rigid extruded polystyrene insulation
- 3" x 6" tongue and groove plank deck

The BUR assembly observed onsite via exterior exploratory openings reflects the original architectural drawings. A significant portion of the low slope roof on the south side of the building has been replaced with a 2-ply SBS-modified bitumen membrane assembly. The 2-ply portion of the roof generally includes the same layers and materials as the BUR

roof assembly listed above, except with the BUR replaced with 2-ply SBS-modified bitumen membrane system.

JRS made the following observations on the roofs:

- Gravel protection for the underlying BUR asphalt was noted to be missing and exposing the underlaying assembly in several areas (photo 24).
- Deterioration of the built-up roof assembly was observed across all the BUR roof areas, including drying and shrinking of exposed asphalt (aligatoring, photo 25), blistering, and asphalt blueberries (photo 26).
- At-risk roof membrane interface detailing was noted at mechanical rooftop penetrations, access hatches, wall upturns and at interface details with adjacent roof assemblies (photo 27).
- A large area of the low-slope roof has been replaced with a 2-ply SBS-modified bitumen membrane assembly. The new roof assembly has simply been lapped onto the original BUR in some areas, which continues to serve as an at-risk tie-in within the existing roof systems (photo 28).
- Water was observed between plies of the SBS-modified bitumen roof membrane at exploratory opening 2 (appendix B).
- Significant staining was observed on several ceiling areas beneath the low slope roofs (photo 29).
- An active leak was observed at the northwest corner of the activity room at the northwest corner of the building.

There are several sloped roof areas on all elevations of the complex (photo 30). Architectural drawings indicate that the sloped roof assembly consists of the following:

- 24" pressure treated cedar shakes
- 15lb roofing felt interlay
- 1"x4" strapping at 10" o/c
- 2"x4" @ 2' – 1 ½" o/c vertical
- 2 layers 1 ½" rigid insulation
- 3"x4" tongue and groove plank decking

The sloped cedar roofs were not disassembled as part of this investigation, so we could not confirm the sloped roof assembly. All sloped roofs terminate onto the low-slope roofs at the base of the slope. The original architectural documents indicate that the BUR continues 3' up the sloped roof and is lapped onto by #90lb felt for 2'. It is unclear how the new 2-ply SBS-modified bitumen membrane roof has been detailed at the interface with the original cedar shake roof.

JRS recorded the following observations during our review of the sloped roofs:

- Damaged and split shingles were observed throughout. In general, the cedar shakes are in poor condition (photo 31).
- Evidence of past, incompatible repairs were observed throughout, including asphalt shingles, sheet metal patches, etc. (photo 32).
- Large areas of the sloped roofs have been tarped over to address recurring leaks (photo 33).
- Fastener penetrations for the tarps were observed throughout the sloped roof assemblies (photo 34).
- Significant staining and water damage was observed beneath the roof decks for the sloped roof areas (photos 35-36).

Discussion

The sloped roofs are protected with cedar shakes which are in poor condition. The expected service life for this type of roof system, installed in this configuration is between 25 and 35 years, depending on maintenance and the quality of the materials and installation. Stresses and weathering caused by thermal cycling, wetting, and exposure to the sun's UV rays will also cause the shingles to weaken and deteriorate over time. This deterioration is apparent in the form of split and damaged shakes. Much of the sloped roof areas are tarped over, indicating an attempt to lessen the water ingress issues as confirmed by the building management. There is evidence of past water ingress demonstrated by visible staining on the underside of the sloped roof deck throughout the building. Due to the issues outlined above, the sloped roof assemblies have exceeded their expected service life and we recommend full replacement. This replacement would include the removal of shakes, felt, strapping and insulation, review the condition of the roof deck, targeted framing repairs as required, and installation of a new roof assembly.

The low slope roof assemblies are in poor condition. The original built-up roof system appears to have been installed during the original building construction circa 1977-78. The expected service life for this type of roof system installed in this configuration is 20 to 30 years, depending on the level of maintenance and the quality of the materials and installation. As listed in the visual observations, this roof assembly is experiencing visible deterioration and is actively leaking (according to building management and water staining in ceiling tiles). A portion of the built-up roof assembly was replaced with 2-ply SBS; however, according to the building managers this replaced area is continuing to experience active leaks. The condition of the tie-in between the 2-ply and the adjacent BUR and pitched roofs is uncertain and a potential source of the ingress. An exploratory opening also revealed moisture between the base and cap sheet membrane plies. Due to the issues outlined above, the low slope roofs have exceeded their expected service life and we recommend full replacement in the near-term. Replacement would include the removal of membrane, fibreboard and insulation, review of the condition of the existing roof deck, targeted framing repairs as required, and installation of a new roof assembly including air/vapour barrier, insulation, overlay boards and roof

membrane. Roof replacement of the low slope roof areas is expected to include the low slope roof area that was previously replaced.

Recommendation:
3) Replace roof assembly over all low-slope roof areas, including proper interface detailing with adjacent building envelope assemblies. (0 to 1 years)
4) Replace roof assembly over all sloped roof areas, including proper interface detailing with adjacent building envelope assemblies. (0 to 1 years)

3.4 BELOW-GRADE

Visual Observations

There is a below-grade storage area with an entry on the west side of the building. The walls and floor are exposed concrete. The architectural drawings do not indicate waterproofing on the basement foundation walls. It appears that a damp proofing has been applied to the exterior side of the below grade concrete walls.

JRS recorded the following observations during our review of the below grade areas:

- Evidence of damp-proofing was observed on the foundation walls at grade level (photo 37).
- Localized efflorescence and staining was observed on the north elevation wall, primarily at the conctrete cold-joint between the slab and below-grade wall (photo 38).
- Extensive corrosion was observed on the frame and exterior face of the entry door to the basement. This may be due to past issues of standing water or snow at the bottom of the stairwell photo 39).

Discussion

The below grade walls of the basement are in generally good condition. The walls displayed very minor evidence of efflorescence and staining on the north elevation, indicating previous occurrences of water ingress. This appears to be a localized and infrequent issue at this time. While the best approach to managing below-grade leaks is to repair the waterproofing from the exterior side of the below grade wall, this requires excavation and disturbing the exterior landscaping and finishing items above. The current use of the basement area and the relatively minor extent of the staining likely does not justify the substantial cost of excavating and replacing the fill around the foundation wall to attempt to address waterproofing repairs on the exterior side of the wall at this time.

When exterior-side repairs to below-grade assemblies are not practical, interior-side repair approaches, such as crack injection or crystalline concrete patch applications are a reasonable alternative approach to managing moisture ingress into below grade structures. The relative disadvantage to interior side, below grade repairs, is that localized moisture ingress may continue to occur after initial repairs are complete.

This has to do with the porous nature of concrete and the tendency for moisture to migrate to the path of least resistance. As such, interior side repairs are also typically completed as part of a continued monitoring approach. Following the initial round of repairs, follow up reviews are typically completed to determine whether new leaks have developed. In the case where new leaks are discovered, additional localized interior side repairs can be undertaken, as necessary. Based upon the impracticality of completing exterior side waterproofing repairs to the below grade walls at this time, and the relatively limited extent of below-grade leaks occurring, an interior side repair approach is recommended to manage localized instances of moisture ingress.

The corrosion on the basement entry door suggests previous occurrences of standing water or snow build-up at the landing at the bottom of the stairs. As noted previously in this report, JRS recommends repainting and refinishing the door and frame, which is likely cast in place as part of the foundation wall. We further recommend scoping the area drain at the bottom of the stairs to ensure it is functioning as intended and flushing the drain system as necessary to ensure the continued operation of the drainage system at this area. As drain scoping and flushing is considered to be part of ongoing building maintenance, an Opinion of Cost has not been provided for this item at this time.

Recommendation:
5) Interior-side below-grade leak repairs (injection or crystalline concrete patch repair) on north elevation, at location of efflorescence. (1-3 years)

3.5 SKYLIGHTS

Visual Observations

There are two areas of sloped skylights (sloped south to north). One is located between roofs C and A (drains onto roof A, photo 40) and the other is located north of roof H and drains into an eavestrough on the side of the building (photo 41).

JRS recorded the following observations during our review of the skylights:

- The skylights were found to be aluminium framed 'T-bar' type construction.
- Moss and organic growth on interior condensation tracks was noted (photo 42).
- Glazing beads at the glazing-frame interface were found to be replaced with sealant (photo 43).
- An active leak was noted at the east corner of the skylights at location H (photo 44).

Discussion

The general condition of the skylights is poor. The T-bar system is an inadequate long-term installation as it utilizes a face sealed approach to moisture management and is open to the exterior to permit drainage

of accumulated water and condensation. These types of skylight systems do not maintain air barrier continuity, nor are they thermally broken, which, in combination, result in poor thermal performance. The gaskets have already been replaced with sealant, likely as an attempt to control water ingress issues, and staining on the wall beneath the skylight in the community room indicates current water ingress problems. The glazing beads, which retain the glass in place, have fallen out in numerous areas, some have been replaced with sealant.

The expected service life for this type of skylight system is between 20 and 25 years depending on maintenance and level of exposure. Based on the current condition of the skylight systems, they have exceeded their expected service life and are no longer functioning as intended.

As a result of the issues associated with the skylights outlined above, we recommend a full replacement of the skylight system. The skylights should be replaced with a more modern, thermally broken, pressure-plate type assembly, which offers much improved drainage, moisture management, airtightness, and thermal performance characteristics. Due to the way in which the skylights are interfaced with the roofing, it would be prudent to replace the skylights at the same time as the roof replacement work. We therefore recommend budgeting for replacement of the skylights within the next year.

Recommendation:
6) Replace all sloped T-bar skylights with aluminium pressure-plate type skylights. (0-1 years)

3.6 SOUTH-WEST STORAGE ROOM

Visual Observations

There is a storage room on the south-west corner of the building. Prior to JRS investigation, the room had been sectioned off as a safety hazard, due to recurring water ingress, organic growth, and structural deterioration.

JRS recorded the following observations of the storage room:

- The storage room is not shown on the architectural drawings (see appendix C).
- The roof framing is in very poor condition, with significant evidence of moisture-related deterioration. It has been tarped over and a “Danger” sign posted on the rooftop (photo 45)
- The roof joists and deck appear to have deflected indicating structural failure (photo 46).
- Increased moisture and humidity levels were recorded within room.

Discussion

The south-west storage room is in very poor condition. The room appears to be an extension of the original building as it is not shown on the original architectural drawings and has a lower roof than the adjacent low-slope

roof area. The roof joists are significantly deteriorated and do not appear to be providing their full structural capacity. Access to this room has already been blocked off by the City of Port Moody, and we recommend access to both the room and the roof above the room continue to be restricted until proper repairs can be completed. For safety reasons, JRS was unable to enter the room, but took photos from an exploratory opening in the blocked doorway.

The framing, roof assembly, and exterior wall assembly of this room need to be rebuilt in their entirety. The existing structure is substantially deteriorated and will likely require full replacement, should the City of Port Moody wish to re-build this area. To prevent the risk of existing rot from propagating further into the structure of the main building, we recommend full scale repairs be undertaken within the next year.

Recommendation:
7) Demolish and rebuild storage room at south-west corner of the building. (0-1 years)

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

The following points summarize our findings:

- The cedar wall cladding is in poor condition and requires replacement.
- The wall sheathing appears to be in generally good condition at this time, with some instances of localized deterioration observed.
- The existing aluminum and steel-framed windows are in poor condition and should be budgeted for replacement with the cedar cladding.
- The sloped cedar roofs and low-slope BUR and SBS-modified bitumen membrane roofs are in poor condition and require near-term replacement.
- The aluminum T-bar skylights are in poor condition and require near-term replacement.
- There are localized instances of efflorescence on the below grade walls of the basement, but otherwise the concrete walls are in generally good condition.
- The south-west storage room is in very poor condition, and the structural framing (roof and wall) within this area is likely not providing its full structural capacity. Access to this area and its roof should continue to be restricted until such time that comprehensive repairs can be completed.

4.2 RECOMMENDATIONS

Our recommendations for addressing the issues listed above are the following (listed from highest to lowest priority):

- Demolish and rebuild the south-west storage room within 1 year.
- Remove and replace all low-slope and sloped roof assemblies within 1 year.
- Remove and replace all sloped skylights within 1 year, timed with the roof replacement.
- Remove and replace the cedar wall cladding with a new rainscreen cladding assembly within 1 to 3 years.
- Remove and replace all aluminum and steel-frame windows and doors within 1 to 3 years, timed with the cladding replacement.
- Conduct localized, interior-side, below grade crack injection repairs at areas displaying efflorescence within 1 to 3 years.

4.3 REMEDIAL REPAIR STRATEGY

There are a number of repair and renewal options available, and a number of issues must be considered by the City of Port Moody when evaluating potential remedial repair options, including:

- Performance issues
- Existing damage and potential for additional damage
- Risk of future performance problems
- Code requirements
- Legislative requirements
- Economics
- Capital costs
- Life cycle costs
- Market values/saleability of units

When planning remedial repairs and renewals, the extent and timing of the work should be considered. It is often practical and economical to undertake the repairs and replacements of elements consecutively. For example, it would be practical to replace all of the windows, roofing, and cladding during a single project to ensure proper interface detailing across the assemblies. In addition, there are significant savings related to economies of scale associated with a larger project and a single contractor's access and mobilization costs. In our experience, separating the project into multiple phases over several years can increase the overall project costs by 20-30% or more. In addition, delaying the repair work will permit ongoing leakage and associated deterioration of concealed framing elements to continue, likely requiring more extensive repairs and further increasing overall project costs.

While completing the project as one concurrent project is the most practical and cost-effective approach, there are a number of ways in which the recommended work could potentially be phased to permit the City of Port Moody additional time to raise funds if required to meet budgetary constraints.

When considering phasing of repairs and renewals, some work can be considered short-term (0 to 1 year), some medium-term (1 to 3 years) and some long-term (5 to 15 years). Short-term repairs are undertaken as soon as possible because of legislative requirements, safety issues or risk of further damage. Work can be considered medium-term if it is reasonable to undertake the work within the next 1 to 3 years without the risk of incurring major damage. Long-term work generally applies to the planned renewal of major envelope components.

We recommend that a comprehensive risk management strategy and corresponding remedial solution for addressing repairs and renewals at the complex be developed. There are usually a number of different approaches that vary in levels of risk and cost. Lower costs are generally associated with a higher risk of performance problems. The cost associated with repairs will vary dramatically, depending upon the final scope of work adopted.

Cladding, window and roofing replacements all offer an opportunity to perform upgrades that will reduce energy use. There may be government-funded incentive programs available to subsidize the cost of energy upgrades. Repairs can also provide the opportunity to improve the exterior aesthetics of the building. For example, the cladding type and colour schemes can be changed to provide an updated appearance.

JRS would work with the City of Port Moody as part of the Design Development phase of future projects, to determine a suitable project structure, scope and timeline to meet their specific needs and objectives.

5.0 OPINIONS OF COST

Opinions of Cost have been prepared to provide the City of Port Moody with long-term, order-of-magnitude budgets for the recommended actions. These Opinions of Cost are based on rough estimated area take-offs, as well as recently obtained, broad unit rates from recent similar past projects, and discussions with contractors. Actual construction costs will vary due to a number of different factors including access considerations, availability of contractors, construction market fluctuations, changes in material costs, the scope of work undertaken, and phasing or sequencing decided upon by the City of Port Moody.

The Opinions of Cost do not allow for all contractor mobilization and front-end costs, as this would require the preparation of drawings, specifications, details, material schedules, and tender documents. As such, JRS cannot guarantee the accuracy of these costs, and shall incur no liability where actual construction costs are exceeded. To obtain the actual construction cost, design documents should be created and tendered.

The Opinions of Cost below have been prepared assuming that the major repair and remediation items will be completed as one large, single-phase project. Multiple phasing scenarios exist and could be explored in more detail; however, phasing the work over multiple projects will generally increase the overall cost of the work, due to increased costs associated with multiple contractor mobilizations, multiple access costs,

inflation of construction costs, and additional consulting fees associated with multiple tenders, design packages, and administration of multiple contracts.

Further, the Opinions of Cost have been prepared based on replacement of roofing, cladding, and window assemblies with assemblies of similar form and appearance. For example, we have assumed that the cedar cladding would be replaced with a rainscreen cedar cladding of similar appearance, the sloped cedar roof would be replaced with a new cedar roof, and that existing aluminum windows would be replaced with new aluminum frame windows. Alternative cladding, window and roofing types or materials may be possible and could be explored in further detail as part of the Design Development phase. Based on the desired material cost, the construction prices may vary accordingly.

Structural Restoration Contingency Allowances and General Construction Contingency Allowances have been included to allow for localized structural repairs and repair of unforeseen conditions which may arise during construction. The amount of contingency to carry is a decision for the City of Port Moody; however, we have provided the recommended allowances based upon our experience as well as our observations during this condition assessment.

An Estimated Permitting and Consulting Fee Allowance has been included in the Opinions of Cost, however actual fees will vary depending on a number of different factors including the overall scope of work and phasing options selected by the Owners. Consulting Fees will be determined by way of a fee proposal once a scope of repairs has been established. Similar to construction costs, the City of Port Moody will realize an overall cost savings in consulting fees if they group the medium-term work together with the near-term work and complete the work as a single-phase project. This is primarily due to less fees associated with multiple tenders, multiple permit applications, and economies of scale in the field review and contract administration services associated with a larger project.

It should be noted that repair costs can be expected to increase as repairs are delayed and deterioration continues to occur. Further, we are currently observing volatile cost fluctuations, more specifically significant increases in construction costs due to a labour shortage in the construction industry. Based on recent tenders, we have seen costs increase anywhere between 20% to 50% per year. This should be taken into consideration when deciding next steps and timing of the recommended work.

Recommendation Item	Opinion of Cost
1. Replace Cedar Cladding With Rainscreen Cladding Assembly	$ 450,000
2. Replace Aluminum & Steel Frame Windows and Doors	$ 175,000
3. Replace Low Slope Roof Assemblies	$ 220,000
4. Replace Sloped Roof Assemblies	$ 350,000
5. Below Grade Injection Repairs (North Foundation Wall)	$ 8,000
6. Replace Aluminum Skylight Assemblies	$ 80,000
7. Reconstruct Storage Room at SE Corner	$ 80,000
Subtotal	**$ 1,363,000**
Project Soft Costs (25%)*	$ 341,000
Structural Restoration Contingency Allowance (10%)**	$ 137,000
General Construction Contingency (10%)**	$ 137,000
Total Hard Construction Cost	**$ 1,978,000**
Estimated Permitting & Consulting Fee Allowance	$ 220,000
Total Construction Cost *(before taxes)*	**$ 2,198,000**
Applicable Taxes (GST 5%)**	$ 110,000
Total Construction Cost	**$ 2,308,000**

* Project soft costs generally include Contractor mobilization, access, general requirements, etc.
** Values have been rounded up to the nearest $1,000.

6.0 NEXT STEPS

The Client can proceed with a number of possible options. The most typical and prudent option is to proceed with design documents and competitive pricing, with which JRS can assist. The next steps that we recommend consist of the following phases:

- Design Development

  The design development phase consists of meeting with the Client to discuss the scope of work, funding, project costs, warranties, permits, as well as to confirm the final aesthetic and technical conceptual design.

- Construction Documents

  A complete set of project drawings and specifications are prepared, per current industry practices and building code requirements. The Client then reviews the design package, and any required revisions are made. Once finalized, the drawings and specifications are distributed to contractors as part of the competitive bidding process, as well as the municipality's building department for a building permit.

- Building Permit

The signed and sealed project drawings and specifications are submitted to the appropriate authority of jurisdiction along with professional letters of assurance and other required documentation for approval.

- Tendering

  The design documents are distributed to contractors for bidding, depending on the tender format selected by the Client. Upon the close of the tender, the consultant will summarize the bid results and provide recommendations on the selection of a contractor to perform the work. This is when the Client will have the most accurate project estimates.

- Field Services & Contract Administration

  In this phase, the Consultant will attend the site at regular intervals to monitor the progress of the work and conformance to the design drawings and specifications. The Consultant will act as contract administrator per CCDC-2 and act as the primary contact between the Owners and General Contractor. One of the duties is to review the Contractor's claims for payment and prepare Certificates of Payment.

- Project Close-out

  The Consultant coordinates the close-out of the project with the Owners, Contractors, and Building Officials including issuing required documentation and project record drawings at project completion.

7.0 CLOSURE

This report was prepared by JRS for City of Port Moody. Any use that a third party makes of this report, or any reliance or decisions made based on it, are the sole responsibility of such third parties.

The findings herein are based on exploratory openings, and visual review of the surface conditions. Deficiencies that may exist but were not recorded in this report were not apparent, given the level of study undertaken.

This assessment is in part based on information provided by others. Unless specifically noted, we have assumed this information to be correct and have relied upon it in reaching our conclusions and recommendations.

The material in this report reflects the best judgment of JRS in light of the information available at the time of preparation.

Please contact the undersigned if you should require any additional information.

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Appendix A

Site Observation Photos

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Photo 17

Photo 18

Photo 19

Photo 20

Photo 21

Photo 22

Photo 23

Photo 24

Photo 25

Photo 26

Photo 27

Photo 28

Photo 29

Photo 30

Photo 31

Photo 32

Photo 33

Photo 34

Photo 35

Photo 36

Photo 37

Photo 38

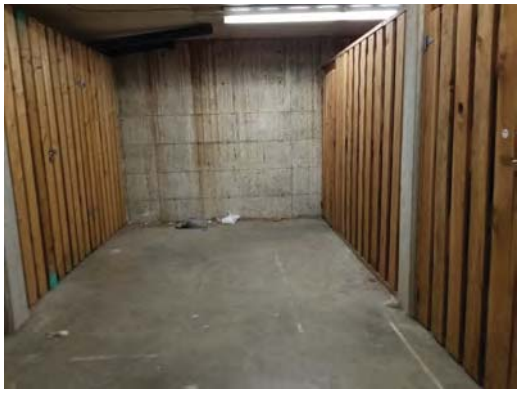


Photo 39

Photo 40

Photo 41

Photo 42

Photo 43

Photo 44

Photo 45

Photo 46

Appendix B

Exterior & Interior Exploratory Openings

Location:	Roof E – (south-east corner)
Detail:	2-ply SBS roof, field of roof
Moisture Content:	7.5%

EO 1

Assembly

- 2-Ply SBS-modified bitumen membrane
- 2 layers 5/8" fibreboard, adhered
- 2 layers 1½" extruded polystyrene insulation
- Tongue and groove plank decking

Condition

- Membrane was well-adhered to fireboard.
- Fibreboard and insulation appeared dry.
- Deck is in good condition.

Comments

- Cut test was prepared in area where roof has been previously replaced.
- No moisture detected within assembly

Location:	Roof E – (north-east from rooftop mechanical)
Detail:	2-ply SBS roof, field of roof
Moisture Content:	7.6%

EO 2

Assembly	Condition
• 2-Ply SBS-modified bitumen membrane • 2 layers 5/8" fibreboard, adhered • 2 layers 1½" extruded polystyrene insulation • Tongue and groove plank decking	• Blistering in membrane. • Water between base and cap sheet. • Roof deck appeared dry and generally good condition.

Comments

- Cut test was conducted near area with significant blistering and towards tie-in area with existing BUR roof system.
- Moisture detected between base and cap sheet.
- Assembly beneath fibreboard appeared to be dry

Location:	Roof C – (center)	**EO 3**
Detail:	Asphalt (build-up-roof), field of roof	
Moisture Content:	7.3%	

Assembly

- 4-ply BUR (asphalt and felt)
- 2 layers 5/8" fibreboard, adhered.
- 2 layers 1 ½" extruded polystyrene insulation
- Tongue and groove plank decking

Condition

- BUR was well-adhered to fireboard.
- Fibreboard and insulation appeared dry.
- Deck is in good condition.

Comments

- Cut test was prepared in area where original BUR is still in place.
- No moisture detected within assembly

Location:	Roof H – (north-east)
Detail:	Asphalt (build-up-roof), field of roof
Moisture Content:	7.5%

EO 4

Assembly

- 4-ply BUR (asphalt and felt)
- 2 layers 5/8" fibreboard, adhered.
- 2 layers 1 ½" extruded polystyrene insulation
- Tongue and groove plank decking

Condition

- BUR was well-adhered to fireboard.
- Fibreboard and insulation appeared dry.
- Deck is in good condition.

Comments

- Cut test was prepared in area where original BUR is still in place.
- No moisture detected within assembly

Location:	Roof A – (north-west)	**EO 5**
Detail:	Asphalt (build-up-roof), field of roof	
Moisture Content:	7.6%	

Assembly	Condition
• 4-ply BUR (asphalt and felt) • 2 layers 5/8" fibreboard, adhered. • 2 layers 1 ½" extruded polystyrene insulation • Tongue and groove plank decking	• BUR was well-adhered to fireboard. • Fibreboard and insulation appeared dry. • Deck is in good condition.

Comments

- Cut test was prepared in area where original BUR is still in place.
- No moisture detected within assembly

Location:	Roof A – (south-east)
Detail:	Asphalt (build-up-roof), field of roof
Moisture Content:	7.5%

EO 6

Assembly

- 4-ply BUR (asphalt and felt)
- 2 layers 5/8" fibreboard, adhered.
- 2 layers 1 ½" extruded polystyrene insulation
- Tongue and groove plank decking

Condition

- BUR was well-adhered to fireboard.
- Fibreboard and insulation appeared dry.
- Deck is in good condition.

Comments

- Cut test was prepared in area where original BUR is still in place.
- No moisture detected within assembly

Location:	East-facing wall on roof
Detail:	Cedar cladding, at interface with roof slope
Moisture Content:	11.2%

EO 7

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in fair condition at this location.
- Nearby sealant was in poor condition.
- Building paper was in generally good condition at the time of our review.
- Some staining visible on plywood sheathing.

Comments

- Stains on sheathing indicate prior water ingress behind building paper.
- Assembly was dry at the time of review.

Location:	East-facing wall on roof
Detail:	Cedar cladding, base of wall detail
Moisture Content:	11.1%

EO 8

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Significantly deteriorated cladding.
- Missing and torn building paper
- Sheathing appeared to be in good condition and was dry at the time of our review.

Comments

- Significant damage to cladding.
- Assembly was dry at the time of review.

Location:	North-facing wall on roof
Detail:	Cedar cladding
Moisture Content:	12.3%

EO 9

Assembly	Condition
• Channel cedar siding • Building Paper • ½" plywood • 2"x6" wood framing at 16" o/c • 6" batt insulation between studs • 6 mil polyethylene vapour barrier • Interior finishes	• Cladding in fair condition at this location. • Building paper was in generally good condition at the time of our review. • Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	West-facing wall on roof
Detail:	Cedar cladding, below window sill
Moisture Content:	10.7%

EO 10

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in fair condition at this location.
- Building paper was in generally good condition at the time of our review.
- Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	West-facing wall on roof
Detail:	Cedar cladding, below window sill
Moisture Content:	9.2%

EO 11

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in fair condition at this location.
- Building paper was in generally good condition at the time of our review.
- Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	East-facing wall on roof
Detail:	Cedar cladding, cladding damage at base of wall
Moisture Content:	9.4%

EO 12

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Significantly deteriorated cladding.
- Missing and torn building paper
- Sheathing appeared to be in good condition and was dry at the time of our review.

Comments

- Significant damage to cladding.
- Assembly was dry at the time of review.

Location:	North-facing wall on roof
Detail:	Cedar cladding, below window sill
Moisture Content:	10.3%

EO 13

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in fair condition at this location.
- Building paper was in generally good condition at the time of our review.
- Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	North-facing wall on roof
Detail:	Cedar cladding, top of wall, below parapet cap flashing
Moisture Content:	19.0%

EO 14

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in poor condition at this location.
- Building paper was in generally good condition at the time of our review.
- Moisture observed behind building paper.
- High moisture content in sheathing.

Comments

- Moisture noted behind building paper.
- Poor sealant and separated cladding noted at roof parapet above this location.

Location:	North elevation, west corner
Detail:	Cedar cladding, below skylight sill
Moisture Content:	13.5%

EO 15

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in fair condition at this location.
- Building paper was in generally good condition at the time of our review.
- Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	West elevation, north corner
Detail:	Cedar cladding, below sloped wall at soffit overhang
Moisture Content:	14.2%

EO 16

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in poor condition at this location.
- Building paper was in generally good condition at the time of our review.
- Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	West-elevation, south corner
Detail:	Cedar cladding, below sloped roof area
Moisture Content:	14.4%

EO 17

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding in poor condition at this location.
- Building paper was in generally good condition at the time of our review.
- Staining visible on sheathing.

Comments

- Evidence of past moisture ingress behind building paper at this location.

Location:	West-elevation, south corner
Detail:	Cedar cladding, below parapet flashing.
Moisture Content:	14.1%

EO 18

Assembly	Condition
• Channel cedar siding • Building Paper • ½" plywood • 2"x6" wood framing at 16" o/c • 6" batt insulation between studs • 6 mil polyethylene vapour barrier • Interior finishes	• Cladding in fair condition at this location. • Building paper was in generally good condition at the time of our review. • Staining visible on sheathing.

Comments

- Evidence of past moisture ingress behind building paper at this location.

Location:	South-elevation
Detail:	Cedar cladding, adjacent to vertical sealant joint
Moisture Content:	13.2%

EO 19

Assembly	Condition
• Channel cedar siding • Building Paper • ½" plywood • 2"x6" wood framing at 16" o/c • 6" batt insulation between studs • 6 mil polyethylene vapour barrier • Interior finishes	• Cladding in poor condition at this location. • Building paper was in generally fair condition at the time of our review. • Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	East-elevation, south corner
Detail:	Cedar cladding, below parapet flashing
Moisture Content:	9.7%

EO 20

Assembly	Condition
• Channel cedar siding • Building Paper • ½" plywood • 2"x6" wood framing at 16" o/c • 6" batt insulation between studs • 6 mil polyethylene vapour barrier • Interior finishes	• Cladding in poor condition at this location. • Building paper was in generally fair condition at the time of our review. • Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	East-elevation, north corner
Detail:	Cedar cladding, below roof parapet flashing
Moisture Content:	13.0%

EO 21

Assembly	Condition
• Channel cedar siding • Building Paper • ½" plywood • 2"x6" wood framing at 16" o/c • 6" batt insulation between studs • 6 mil polyethylene vapour barrier • Interior finishes	• Cladding in poor condition at this location. • Building paper was in generally fair condition at the time of our review. • Sheathing appeared dry at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	East-elevation, at signage
Detail:	Cedar cladding, near light penetration
Moisture Content:	Not measured at this location

EO 22

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Cladding significantly deteriorated at this location.
- Building paper was in generally fair condition at the time of our review.

Comments

- Assembly was dry at the time of our review.

Location:	Billiards Room, west elevation (See Appendix C)	IO 1
Detail:	Cedar cladding, base of wall.	
Moisture Content:	Sheathing: 14.3% / Framing: 10.1%	

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Organic growth between drywall and poly.
- Stained studs, sill plate and sheathing.
- Fibreglass batt insulation is dirty, indicating air movement across the wall assembly.

Comments

- Organic growth observed on backside of interior gypsum finish.
- Fungal air sampling was conducted at this location (see Appendix D, Sample S4).
- Evidence of moisture related deterioration observed at this location.

Location:	Rock & Gem Room, south elevation (See Appendix C)	IO 2
Detail:	Cedar cladding, base of wall.	
Moisture Content:	Sheathing: 16.9% / Framing: 10.3%	

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Staining and organic growth observed on interior face of sheathing.
- Fibreglass batt insulation is dirty, indicating air movement across the wall assembly.

Comments

- Fungal air sampling was conducted at this location (see Appendix D, Sample S6).
- Evidence of moisture related deterioration observed at this location.

Location:	Ball Room, south elevation (see Appendix C)	IO 3
Detail:	Cedar cladding, base of wall	
Moisture Content:	Sheathing: 10.6% / Framing: 10.5%	

Assembly

- Channel cedar siding
- Building Paper
- ½” plywood
- 2”x6” wood framing at 16” o/c
- 6” batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Stained studs, sill plate and sheathing.
- Fibreglass batt insulation is dirty, indicating air movement across the wall assembly.

Comments

- Evidence of moisture related deterioration observed at this location.

Location:	Ball Room, east elevation (see Appendix C)	IO 4
Detail:	Cedar cladding, base of wall	
Moisture Content:	Sheathing: 9%	

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Sheathing not visible at this location.
- Fibreglass batt insulation is dirty, indicating air movement across the wall assembly.
- Polyethylene vapour barrier is discontinuous across this area.

Comments

- Exploratory opening was conducted at plumbing cleanout access hatch.
- Wall assembly behind access hatch should be cleaned.
- Evidence of moisture related deterioration observed at this location.

Location:	Front Office, north elevation (see Appendix C)	IO 5
Detail:	Cedar cladding, base of wall	
Moisture Content:	Sheathing: 12.8% / Framing 8.6%	

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Sheathing was clean and generally good condition at this location.
- Fibreglass batt insulation is dirty, indicating air movement across the wall assembly.

Comments

- No evidence of moisture-related deterioration was observed at this location.
- Fungal air sampling was conducted at this location (see Appendix D, Sample S2).

Location:	Storage Room, east elevation (see Appendix C)	IO 6
Detail:	Cedar cladding, base of wall	
Moisture Content:	Could not be measured at this location	

Assembly	Condition
• Channel cedar siding • Building Paper • ½" plywood • 2"x6" wood framing at 16" o/c • 6" batt insulation between studs • 6 mil polyethylene vapour barrier • Interior finishes	• Sheathing was clean and generally good condition at this location. • Fibreglass batt insulation is dirty, indicating air movement across the wall assembly.

Comments

- No evidence of moisture-related deterioration was observed at this location.

Location:	Activity Room, north elevation (see Appendix C)	IO 7
Detail:	Cedar cladding, base of wall	
Moisture Content:	Sheathing: 24.8% / Framing 13.2%	

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Stained and deteriorated sheathing observed at base of wall.
- Sheathing was wet at the time of our review.
- Staining observed on studs at sill plate.
- Fibreglass batt insulation is dirty, indicating air movement across the wall assembly

Comments

- Evidence of moisture-related deterioration was observed at this location.
- Fungal air sampling was conducted at this location (see Appendix D, Sample S3).

Location:	Storage Room, southwest corner of building	IO 8
Detail:	Cedar cladding	
Moisture Content:	Could not be measured at this location	

Assembly

- Channel cedar siding
- Building Paper
- ½" plywood
- 2"x6" wood framing at 16" o/c
- 6" batt insulation between studs
- 6 mil polyethylene vapour barrier
- Interior finishes

Condition

- Framing is in poor condition due to moisture-related deterioration.
- Strong musty smell within the room.
- Visible organic growth on exposed framing within the room.

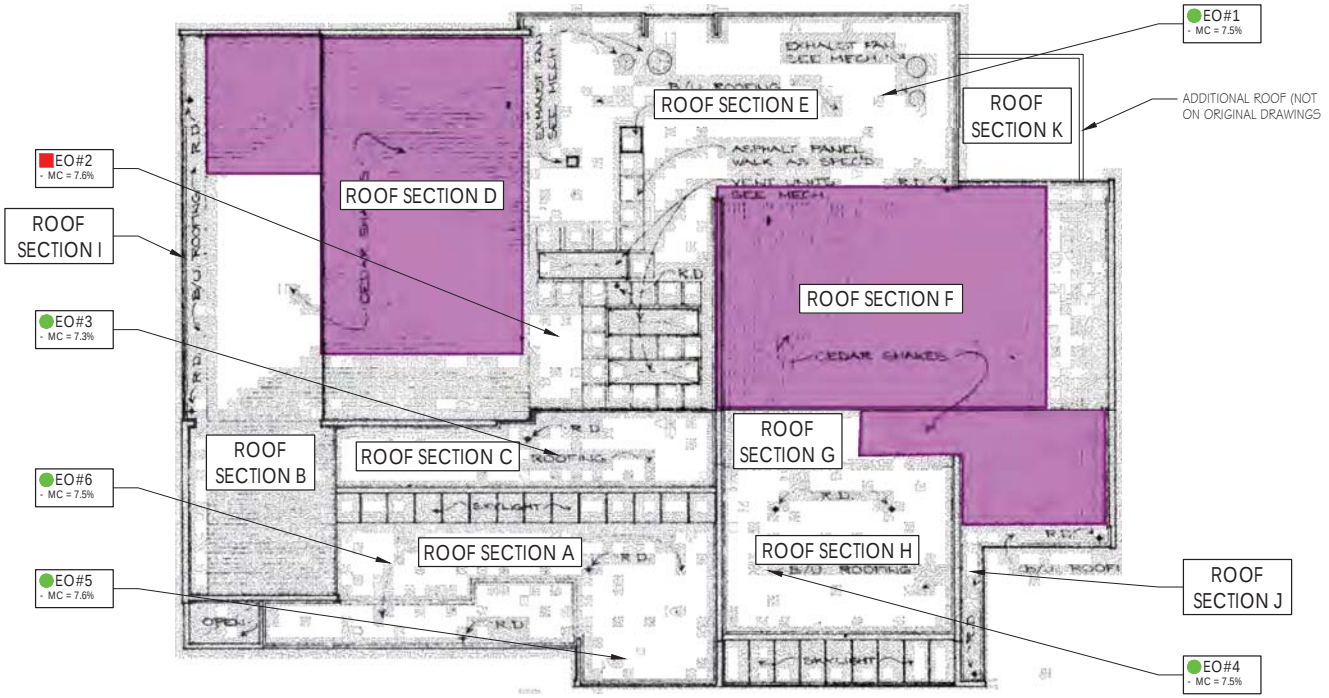
Comments

- Access to this room has been closed off due to past issues with leaks and deterioration of the wood structure.
- Significant evidence of moisture-related deterioration was observed at this location, including organic growth and deterioration of the wood structure.
- Fungal air sampling was conducted at this location (see Appendix D, Sample S5).

Appendix C

Plans & Elevations

NOTE:
PLANS PREPARED BY JRS ARE BASED ON INFORMATION TAKEN FROM CARLBERG JACKSON PARTNERS ARCHITECTS DRAWINGS DATED FEBRUARY 21, 1977.



1 - ROOF PLAN
SCALE: N.T.S.

NOTE: DO NOT SCALE FROM DRAWING. ALL DIMENSIONS TO BE OBTAINED AND VERIFIED ON SITE.

JRS ENGINEERING
BUILDING ENVELOPE CONSULTANTS
300 - 4595 CANADA WAY, BURNABY, BC
604.320.1999 JRSENGINEERING.COM

LEGEND

- NO DAMAGE
- EVIDENCE OF MOISTURE
- DAMAGE (INCLUDING WET SHEATHING & OR FRAMING
- TARPED AREAS

No.	ISSUE / REVISION	MM/DD/YY
1	REVIEW	07/07/20

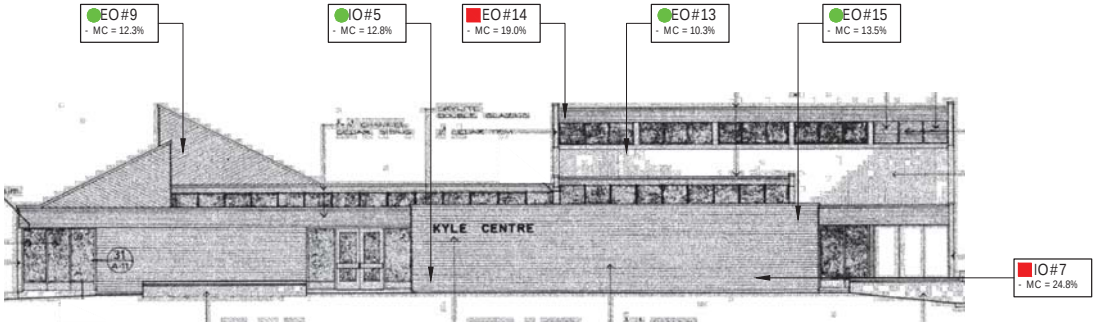
KYLE CENTRE BECA
(CITY OF PORT MOODY)
125 KYLE STREET, PORT MOODY, BC

APPENDIX C

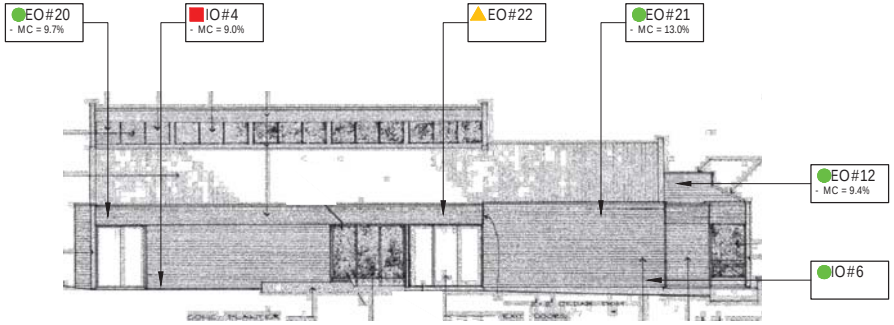
ROOF PLAN

DATE:	JULY 2020
SCALE:	AS SHOWN
DESIGNED:	MDS
DRAWN:	MC
REVIEWED:	KT
DRAWING No:	PAGE 1
PROJECT No:	VR11262A

NOTE:
PLANS PREPARED BY JRS ARE BASED ON INFORMATION TAKEN FROM CARLBERG JACKSON PARTNERS ARCHITECTS DRAWINGS DATED FEBRUARY 21, 1977.



1 - NORTH ELEVATION
SCALE: N.T.S.



2 - EAST ELEVATION
SCALE: N.T.S.

NOTE: DO NOT SCALE FROM DRAWING. ALL DIMENSIONS TO BE OBTAINED AND VERIFIED ON SITE.

JRS ENGINEERING
BUILDING ENVELOPE CONSULTANTS
300 - 4595 CANADA WAY, BURNABY, BC
604.320.1999 JRSENGINEERING.COM

LEGEND

- NO DAMAGE
- EVIDENCE OF MOISTURE
- DAMAGE (INCLUDING WET SHEATHING & OR FRAMING

No.	ISSUE / REVISION	MM/DD/YY
1	REVIEW	07/07/20

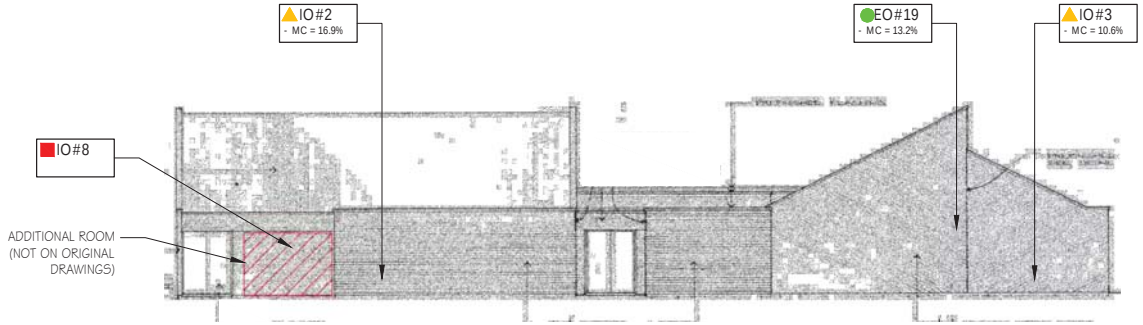
KYLE CENTRE BECA
(CITY OF PORT MOODY)
125 KYLE STREET, PORT MOODY, BC

APPENDIX C

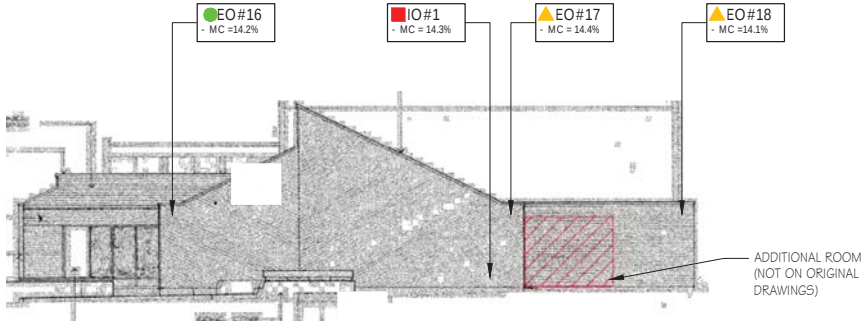
ELEVATIONS

DATE:	JULY 2020
SCALE:	AS SHOWN
DESIGNED:	MDS
DRAWN:	MC
REVIEWED:	KT
DRAWING No:	PAGE 2
PROJECT No:	VR11262A

NOTE:
PLANS PREPARED BY JRS ARE BASED ON INFORMATION TAKEN FROM CARLBERG JACKSON PARTNERS ARCHITECTS DRAWINGS DATED FEBRUARY 21, 1977.



1 - SOUTH ELEVATION
SCALE: N.T.S.



2 - WEST ELEVATION
SCALE: N.T.S.

NOTE: DO NOT SCALE FROM DRAWING. ALL DIMENSIONS TO BE OBTAINED AND VERIFIED ON SITE.

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BUILDING ENVELOPE CONSULTANTS
300 - 4595 CANADA WAY, BURNABY, BC
604.320.1999 JRSENGINEERING.COM

LEGEND

- NO DAMAGE
- EVIDENCE OF MOISTURE
- DAMAGE (INCLUDING WET SHEATHING & OR FRAMING

No.	ISSUE / REVISION	MM/DD/YY
1	REVIEW	07/07/20

KYLE CENTRE BECA
(CITY OF PORT MOODY)
125 KYLE STREET, PORT MOODY, BC

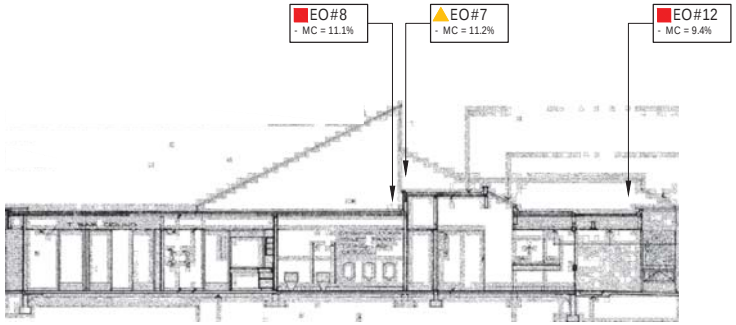
APPENDIX C

ELEVATIONS

DATE:	JULY 2020
SCALE:	AS SHOWN
DESIGNED:	MDS
DRAWN:	MC
REVIEWED:	KT

DRAWING No:
PAGE 3
PROJECT No:
VR11262A

NOTE:
PLANS PREPARED BY JRS ARE BASED ON INFORMATION TAKEN FROM CARLBERG JACKSON PARTNERS ARCHITECTS DRAWINGS DATED FEBRUARY 21, 1977.



1 - SECTION B-B
SCALE: N.T.S.

2 - SECTION C-C
SCALE: N.T.S.

NOTE: DO NOT SCALE FROM DRAWING. ALL DIMENSIONS TO BE OBTAINED AND VERIFIED ON SITE.

JRS ENGINEERING
BUILDING ENVELOPE CONSULTANTS
300 - 4595 CANADA WAY, BURNABY, BC
604.320.1999 JRSENGINEERING.COM

LEGEND

- NO DAMAGE
- EVIDENCE OF MOISTURE
- DAMAGE (INCLUDING WET SHEATHING & OR FRAMING

No.	ISSUE / REVISION	MM/DD/YY
1	REVIEW	07/07/20

KYLE CENTRE BECA
(CITY OF PORT MOODY)
125 KYLE STREET, PORT MOODY, BC

APPENDIX C

SECTIONS

DATE:	JULY 2020
SCALE:	AS SHOWN
DESIGNED:	MDS
DRAWN:	MC
REVIEWED:	KT

DRAWING No: PAGE 4
PROJECT No: VR11262A

Appendix D

Fungal Air Sampling Report (By Total Safety)

TOTAL SAFETY®

Building **HEROES.** Protecting **HEROES.**

June 9, 2020 Total Safety Reference: 20-145 L01

ProHazTech Environmental Inc.
1044 245B Street
Maple Ridge, BC, V2W 1G5

Email: harry@hlcdemolition.com

Attention: Harry Caya

cc: Andrew Dodge via email: andrew@prohaztech.com

Reference: **Fungal Air Sampling at 125 Kyle Street, Port Moody, BC**

Introduction

In response to your request, TSS Total Safety Services Inc. (Total Safety) conducted a brief fungal assessment and sampling at the above referenced site. This work was requested to assess the level of airborne fungal contamination after cut-outs were made in the exterior walls and one interior wall by ProHazTech Environmental Inc. (ProHazTech) to investigate for the presence of fungal contamination. The site assessment and sampling were conducted on May 29, 2020.

Assessment and Sampling Methodology

Visual Assessment

A visual assessment was conducted of the immediate areas where the samples were collected. The visual assessment included a brief assessment of building materials for fungal growth as well as general observations on the environment that the samples were collected in to ensure correct interpretation of the air sample results. At the time of our site visit ProHazTech had covered the wall cut-outs and therefore no visual assessment of the cut-outs was conducted. Our observations were documented on site with photographs and written notes.

Spore Trap Sampling

Spore trap samples were collected using AllergencoD spore trap cassettes (manufactured by Environmental Monitoring Systems) connected to a Zefon Air-O-Cell Bio Pump Plus. Sampling was conducted for 5 minutes at a flow rate of 15 liters per minute, for a total sampling volume of 75 liters per sample. Spore sampling cassettes were analyzed by EMSL Canada Inc. Laboratories (Burnaby, BC) using optical microscopy (EMSL methods MICRO-SOP-201, ASTM D7391). This laboratory is deemed proficient by the Canadian Association for Laboratory Accreditation Inc. (CALA). Please refer to Table 1 for sample locations. Indoor sample locations were selected by ProHazTech.

Assessment and Sampling Results

Visual Assessment

The building was a one-level community centre with a gymnasium, a community kitchen, a lounge, a pool (Snooker) room, a workshop, public washrooms, and other multi-use spaces. The building had a central HVAC system.

We did not observe any visible fungal growth during this assessment; however, ProHazTech confirmed the presence of fungal growth within the wall cavities. The building was generally clean. We detected a musty smell, which can indicate the presence of fungal contamination, throughout the building, especially in the Kyle Members Lounge.

Spore Trap Sampling

Airborne fungal spores originate from many sources, most of which are located outdoors, such as decaying leaves or disturbed soil. Levels of fungal spores outdoors can reach levels well over 100,000 spores per cubic meter (spores/m^3)[1]. In healthy indoor environments the levels of fungal spores indoors should be less than the level detected outdoors. In buildings with doors and windows that are opened regularly, such as schools and homes, the levels of fungal spores indoors are often similar to the levels detected outdoors. In buildings with filtered ventilation systems, such as large office buildings, the levels indoors are normally much lower than the levels outdoors. However, if fungi have colonized building materials there may be higher concentrations of spores identified indoors and they may be different than those found outdoors. Please refer to Appendix A for additional information.

There are no regulated exposure limits for fungal spore counts within Canada. Due to the lack of regulated exposure limits, spore trap sampling results cannot be used to assess risks to health of building occupants[2]. However, the results may be used to supplement the visual assessment in instances where the source of mould contamination is unclear and health concerns are raised[3]. Total Safety's interpretation of spore trap data is based on a number of factors, including the results of the visual assessment, our experience, and the reasons that the samples were collected. Generally, Total Safety compares the individual spore types present and their relative amounts in the indoor sample versus the outdoor sample. If specific spore types are significantly greater in the indoor sample than the outdoor sample, an indoor source of fungal contamination may be present. The interpretation of spore trap data in this manner is recommended by WorkSafeBC[3].

Total airborne fungal spore counts inside ranged from 650 spores/m^3 to 3,300 spores/m^3, compared to counts of 34,560 spores/m^3 and 16,700 spores/m^3 recorded outdoors. No elevated total indoor spore concentrations were detected compared to outdoors. The results are detailed in Table 1. A copy of the laboratory results is available in Appendix B.

[1] Total Safety, Unpublished Data
[2] Health Canada. Residential Indoor Air Quality Guidelines, Moulds. 2007
[3] WorkSafeBC Guidelines Part 4 – G4.79 Moulds and indoor air quality. 2007

Table 1: Fungal Spores in Air – Sampling Results (1 of 2)

Organism (Fungi) Type	S1 Outdoor Ambient (spores/m^3)[1]	S2 NE Room (spores/m^3)	S3 Kyle Members Lounge (spores/m^3)
Ascospores	1,400	-	90
Basidiospores	32,600	980	560
Botrytis	40	-	-
Chaetomium	30[2]	-	-
Cladosporium	90	-	-
Ganoderma	400	-	-
TOTAL	**34,560**	**980**	**650**

Notes:
1. Spores/m^3 refers to the concentration all fungal structures counted by the lab.
2. Particles were found at 300 X magnification.
3. "-" indicates that the concentration for that spore type was less than the detection limit of analysis.

Table 1: Fungal Spores in Air – Sampling Results (2 of 2)

Organism (Fungi) Type	S4 Pool Room (spores/m^3)	S5 Storage Room (spores/m^3)	S6 Workshop (spores/m^3)	S7 Outdoor Ambient (spores/m^3)
Ascospores	90	10[2]	-	300
Basidiospores	2,000	3,200	1,800	16,300
Botrytis	-	-	-	-
Chaetomium	-	-	-	-
Cladosporium	-	90	-	-
Ganoderma	-	-	-	100
TOTAL	**2,090**	**3,300**	**1,800**	**16,700**

Notes:
1. Spores/m^3 refers to the concentration all fungal structures counted by the lab.
2. Particles were found at 300 X magnification.
3. "-" indicates that the concentration for that spore type was less than the detection limit of analysis.

Conclusions and Recommendations

A brief fungal assessment and sampling was conducted on May 29, 2020 in five areas selected by the client. No visible fungal growth was observed, and air sampling did not identify any elevated levels of fungal spores indoors. A strong musty smell was present throughout the building, and ProHazTech confirmed the presence of fungal contamination within the wall cavities.

All fungal contamination should be properly remediated following safe work procedures to ensure protection of the workers and successful remediation. This work should be conducted by trained remediation personnel who should develop a detailed remediation plan.

Limitations

This report has been prepared in accordance with established Industrial Hygiene and Mycological practices. It is intended for the exclusive use of ProHazTech Environmental Inc. to assist them in complying with the current accepted industry guidelines for the assessment and remediation of fungi in indoor environments. The use of this document for any other purposes is at the sole risk of the user.

Statement of Qualifications

Total Safety has been providing consulting services in the environmental and industrial hygiene fields in British Columbia, since 1990. Our personnel include the following:

- Industrial Hygienists (CIH, ROH)
- Canadian Registered Safety Professionals (CRSP)
- Occupational Health and Safety Consultants

Our company also carries Comprehensive General Liability and Environmental Errors & Omissions Liability Insurance.

Yours truly,

Total Safety

Eve Neesham-Grenon, MSc OEH
IH Consultant
Field Assessment and Report

Jennifer Blair, MSc, CIH
Senior Project Manager
Report Review

Ref: 20-145 L01

Appendix A: Additional Information

Fungi

Background

Fungi are plant-like but lack chlorophyll. Each fungal "colony" is a mass of interwoven mycelium, made up of millions of tiny branching filaments, known as hyphae. The group includes many familiar types such as the mushrooms, toadstools, puffballs, bracket fungi, morels, truffles and yeasts. Those most commonly found growing in indoor environments are often called moulds (i.e. *Cladosporium*, *Penicillium* and *Aspergillus*).

Most fungi gain their energy by breaking down "dead" organic material, including both plant and animal matter and, thus, perform many important functions in nature. Fungi are also economically important as they are used to produce beer, wine and cheese. They are also medically important as many important drugs, including penicillin and cyclosporine (used to treat organ rejection) are derived from fungi.

Fungi grow very quickly almost anywhere, including inside buildings. One of the reasons fungi are so successful is their ability to produce and disperse huge numbers of microscopic spores, which can be transported vast distances. By their sheer numbers, fungi can quickly take advantage of any new food supplies that become available, as all they need to colonize a material is water and a source of carbon, which is present in many building materials.

The air we breathe can contain tens of thousands of spores per cubic meter, while soil holds vast numbers. Many of the spores produced by fungi remain viable for years, therefore, there will always be fungal spores present in the air that we breathe, both outdoors and indoors and it is almost impossible to completely exclude fungi from any environment (including the cheese we seal in plastic and put in the refrigerator).

Fungi and Human Health

There are several ways in which fungi can affect the health of building occupants. The primary route of exposure to fungi is the inhalation of the fungal spores, hyphal fragments and portions of other fungal structures. This exposure may result in allergic reactions, increased asthma, upper respiratory tract irritation, and even fungal infections in some people. The exact mechanism that results in the health effects is still being researched, but there are likely many contributing factors. These contributing factors include the mycotoxins produced by the fungi, antigens on the surface of the fungi as well as the presence of B-glucans in the cell walls.

The health effects experienced by people vary significantly. Some people are unaffected by high levels yet others are affected by low levels of fungal spores. As the exposure duration and concentration of fungal spores increases, so do symptoms. The most common symptom is allergies, particularly allergic rhinitis. Allergy-related problems become particularly apparent, when the concentration of airborne spores is relatively high and the majority consists of only 1 or 2 species.

The following are some of the fungal genera that grow indoors and are implicated in causing respiratory problems:

- *Alternaria*
- *Aspergillus*
- *Chaetomium*
- *Cladosporium*
- *Epicoccum*
- *Fusarium*
- *Mucor*
- *Penicillium*
- *Phoma*
- *Pithomyces*
- *Stachybotrys*
- *Trichoderma*

Some fungi can be quite pathogenic (cause systemic illness in people), including *Histoplasma*, *Cryptococcus*, *Sporothrix*, *Blastomyces* and *Candida*. At least three species of *Aspergillus* (*A. fumigatus, A. niger* and *A. flavus*) can be included in this group, however, most others (there are between 100 and

200 species of *Aspergillus*) are relatively benign. People with compromised immune systems are at the greatest risk for fungal infections.

Repeated inhalation and sensitization to a wide variety of organic material, including fungi, can cause hypersensitivity pneumonitis (HP), a lung disease, in a small percentage of exposed people. Additional health effects caused by fungi may include aggravation of pre-existing asthma, sinusitis, histoplasmosis and rhinitis.

Other substances produced by fungi, besides spores, can also cause health problems. These include mycotoxins (substances produced by fungi which may interfere with the growth of other fungi or bacteria) and Volatile Organic Compounds (VOC's – responsible for the musty odor characteristic of fungi). Note however, that health effects associated with mycotoxins are typically associated with only very high exposures that are likely only to occur during the consumption of fungal contaminated food or during high risk activities, such as fungal remediation.

References

Bioaerosols: Assessment and Control. American Conference of Governmental Industrial Hygienists (ACGIH). 1999

Fungal Contamination in Public Buildings: Health Effects and Investigation Methods. Health Canada. 2004.

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Mold Remediation in Schools and Commercial Buildings, United States Environmental Protection Agency (EPA). 2008.

Mould Guidelines for the Canadian Construction Industry. Canadian Construction Association. 2004. Standard Construction Document CCA 82 – 2004.

New York City Department of Health and Mental Hygiene. Guidelines on Assessment and Remediation of Fungi in Indoor Environments. November 2008.

Recognition, Evaluation and Control of Indoor Mold. Second Edition. L. Hung, S. Caulfield and J. Miller (eds). American Industrial Hygiene Association (AIHA). 2020.

Report of Microbial Growth Task Force, American Industrial Hygiene Association (AIHA) Press. 2001.

Residential Indoor Air Quality Guidelines. Moulds. Health Canada. 2007

WorkSafeBC. Guidelines Part 4 – Indoor Air Quality (G4.79 Moulds and indoor air quality). Occupational Health & Safety Regulation. 2007

Appendix B: Laboratory Reports

Please find included the following report:

- EMSL Canada, Inc. – Spore Trap Results

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Tel/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Order: 692001215
Customer ID: 55PECS50
Customer PO:
Project ID:

Attention: Jennifer Blair
TSS Total Safety Services Inc.
Suite 112 - 4595 Canada Way
Burnaby, BC V5G 1J9

Phone: (604) 292-4700
Fax: (604) 980-2188
Collected Date: 05/29/2020
Received Date: 05/29/2020
Analyzed Date: 06/04/2020

Project: 20-145

Test Report: Allergenco-D(™) Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7391)

Lab Sample Number:	692001215-0001			692001215-0002			692001215-0003		
Client Sample ID:	S1			S2			S3		
Volume (L):	75			75			75		
Sample Location:	OUTDOOR REFERENCE			NE ROOM			KYLE MEMBERS LOUNGE		
Spore Types	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**
Alternaria (Ulocladium)	-	-	-	-	-	-	-	-	-
Ascospores	32	1400	4.1	-	-	-	2	90	13.8
Aspergillus/Penicillium	-	-	-	-	-	-	-	-	-
Basidiospores	765	32600	94.3	23	980	100	13	560	86.2
Bipolaris++	-	-	-	-	-	-	-	-	-
Chaetomium	2*	30*	0.1	-	-	-	-	-	-
Cladosporium	2	90	0.3	-	-	-	-	-	-
Curvularia	-	-	-	-	-	-	-	-	-
Epicoccum	-	-	-	-	-	-	-	-	-
Fusarium	-	-	-	-	-	-	-	-	-
Ganoderma	9	400	1.2	-	-	-	-	-	-
Myxomycetes++	-	-	-	-	-	-	-	-	-
Pithomyces++	-	-	-	-	-	-	-	-	-
Rust	-	-	-	-	-	-	-	-	-
Scopulariopsis/Microascus	-	-	-	-	-	-	-	-	-
Stachybotrys/Memnoniella	-	-	-	-	-	-	-	-	-
Unidentifiable Spores	-	-	-	-	-	-	-	-	-
Zygomycetes	-	-	-	-	-	-	-	-	-
Botrytis	1	40	0.1	-	-	-	-	-	-
Total Fungi	**811**	**34560**	**100**	**23**	**980**	**100**	**15**	**650**	**100**
Hyphal Fragment	-	-	-	-	-	-	-	-	-
Insect Fragment	-	-	-	-	-	-	-	-	-
Pollen	1	40	-	-	-	-	-	-	-
Analyt. Sensitivity 600x	-	43	-	-	43	-	-	43	-
Analyt. Sensitivity 300x	-	13*	-	-	13*	-	-	13*	-
Skin Fragments (1-4)	-	2	-	-	2	-	-	2	-
Fibrous Particulate (1-4)	-	1	-	-	2	-	-	2	-
Background (1-5)	-	3	-	-	3	-	-	3	-

++ Includes other spores with similar morphology; see EMSL's fungal glossary for each specific category.

No discernable field blank was submitted with this group of samples.

Nicole Yeo, Laboratory Manager
or other Approved Signatory

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Samples analyzed by EMSL Canada Inc. Burnaby, BC

Initial report from: 06/04/2020 02:51 PM

For information on the fungi listed in this report, please visit the Resources section at www.emsl.com

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EMSL Order: 692001215
Customer ID: 55PECS50
Customer PO:
Project ID:

Attention: Jennifer Blair
TSS Total Safety Services Inc.
Suite 112 - 4595 Canada Way
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Phone: (604) 292-4700
Fax: (604) 980-2188
Collected Date: 05/29/2020
Received Date: 05/29/2020
Analyzed Date: 06/04/2020

Project: 20-145

Test Report: Allergenco-D(™) Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7391)

Lab Sample Number:	692001215-0004			692001215-0005			692001215-0006		
Client Sample ID:	S4			S5			S6		
Volume (L):	75			75			75		
Sample Location:	POOL ROOM			STORAGE ROOM			WORKSHOP		
Spore Types	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**	**Raw Count**	**Count/m³**	**% of Total**
Alternaria (Ulocladium)	-	-	-	-	-	-	-	-	-
Ascospores	2	90	4.3	1*	10*	0.3	-	-	-
Aspergillus/Penicillium	-	-	-	-	-	-	-	-	-
Basidiospores	47	2000	95.7	74	3200	97	42	1800	100
Bipolaris++	-	-	-	-	-	-	-	-	-
Chaetomium	-	-	-	-	-	-	-	-	-
Cladosporium	-	-	-	2	90	2.7	-	-	-
Curvularia	-	-	-	-	-	-	-	-	-
Epicoccum	-	-	-	-	-	-	-	-	-
Fusarium	-	-	-	-	-	-	-	-	-
Ganoderma	-	-	-	-	-	-	-	-	-
Myxomycetes++	-	-	-	-	-	-	-	-	-
Pithomyces++	-	-	-	-	-	-	-	-	-
Rust	-	-	-	-	-	-	-	-	-
Scopulariopsis/Microascus	-	-	-	-	-	-	-	-	-
Stachybotrys/Memnoniella	-	-	-	-	-	-	-	-	-
Unidentifiable Spores	-	-	-	-	-	-	-	-	-
Zygomycetes	-	-	-	-	-	-	-	-	-
Botrytis	-	-	-	-	-	-	-	-	-
Total Fungi	**49**	**2090**	**100**	**77**	**3300**	**100**	**42**	**1800**	**100**
Hyphal Fragment	-	-	-	-	-	-	-	-	-
Insect Fragment	-	-	-	-	-	-	-	-	-
Pollen	-	-	-	-	-	-	-	-	-
Analyt. Sensitivity 600x	-	43	-	-	43	-	-	43	-
Analyt. Sensitivity 300x	-	13*	-	-	13*	-	-	13*	-
Skin Fragments (1-4)	-	3	-	-	2	-	-	2	-
Fibrous Particulate (1-4)	-	1	-	-	1	-	-	1	-
Background (1-5)	-	2	-	-	2	-	-	2	-

++ Includes other spores with similar morphology; see EMSL's fungal glossary for each specific category.

No discernable field blank was submitted with this group of samples.

Nicole Yeo, Laboratory Manager
or other Approved Signatory

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Phone: (604) 292-4700
Fax: (604) 980-2188
Collected Date: 05/29/2020
Received Date: 05/29/2020
Analyzed Date: 06/04/2020

Project: 20-145

Test Report: Allergenco-D(™) Analysis of Fungal Spores & Particulates by Optical Microscopy (Methods MICRO-SOP-201, ASTM D7391)

Lab Sample Number:	**692001215-0007**
Client Sample ID:	**S7**
Volume (L):	**75**
Sample Location:	**OUTDOOR REFERENCE**

Spore Types	Raw Count	Count/m³	% of Total
Alternaria (Ulocladium)	-	-	-
Ascospores	6	300	1.8
Aspergillus/Penicillium	-	-	-
Basidiospores	383	16300	97.6
Bipolaris++	-	-	-
Chaetomium	-	-	-
Cladosporium	-	-	-
Curvularia	-	-	-
Epicoccum	-	-	-
Fusarium	-	-	-
Ganoderma	3	100	0.6
Myxomycetes++	-	-	-
Pithomyces++	-	-	-
Rust	-	-	-
Scopulariopsis/Microascus	-	-	-
Stachybotrys/Memnoniella	-	-	-
Unidentifiable Spores	-	-	-
Zygomycetes	-	-	-
Botrytis	-	-	-
Total Fungi	**392**	**16700**	**100**
Hyphal Fragment	-	-	-
Insect Fragment	-	-	-
Pollen	-	-	-
Analyt. Sensitivity 600x	-	43	-
Analyt. Sensitivity 300x	-	13*	-
Skin Fragments (1-4)	-	2	-
Fibrous Particulate (1-4)	-	1	-
Background (1-5)	-	3	-

++ Includes other spores with similar morphology; see EMSL's fungal glossary for each specific category.

No discernable field blank was submitted with this group of samples.

Nicole Yeo, Laboratory Manager
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Appendix E

Glossary

GLOSSARY OF TERMS

A number of the terms that may be used in this assessment report or included in information contained in the manual have specific meaning in the context of this report as defined below:

ABRASION RESISTANCE: The ability of a membrane to resist being worn away by contact with a moving abrasive surface, such as foot traffic, mechanical equipment, wind-blown particles, etc.

ACCELERATED WEATHERING: The process in which materials are exposed to a controlled environment where various phenomena – such as heat, water, condensation, and light – are altered to magnify their effects, thereby accelerating the weathering process. The physical properties that result from this exposure are then measured and compared to those of the original unexposed material.

ADHERE: To cause two surfaces to be held together by adhesion. Single-ply membranes are often "partially" or "totally adhered" to a substrate with the use of contact cements, such as air-cured phenolic-neoprene mixtures, or other similar adhesives. See ADHESION, ADHESIVE, BOND.

ADHESION: The combined ultimate strength of the molecular forces and the mechanical interlocking achieved between the adhesive and the surfaces bonded. See ADHERE, ADHESIVE, BOND.

ADHESIVE: A substance capable of holding materials together by surface attachment.

AGGREGATE: Crushed stone, crushed slag or water-worn gravel used for surfacing a built-up roof or any granular mineral material.

AIR BARRIER: A combination of materials and components that control the flow of air into or out of the interior conditioned space, thus limiting the potential for heat loss and condensation due to air movement.

AIR LEAKAGE: The uncontrolled flow of air through a building envelope or assembly, which occurs as a result of pressure differential caused by wind or stack effect.

ALLIGATORING: The cracking of the surfacing bitumen on a built-up roof, which produces a pattern of cracks similar to an alligator's hide; the cracks may or may not extend through the surfacing bitumen. Usually caused by oxidizing of the asphalt due to weathering and/or shrinkage stresses.

ALLOY: A combination of two or more chemically different polymers which have been reformed through processing into a new material from which the original materials cannot be separated.

APPLICATION RATE: The quantity (mass, volume or thickness) of material applied per unit area.

AREA DIVIDER: See CONTROL JOINT.

ASPHALT: A dark brown to black cementitious material in which the predominating constituents are bitumens, which either occur in nature or are obtained in petroleum processing.

ASPHALT FELT: An asphalt-saturated felt or an asphalt-coated felt. A mat of organic or inorganic fibres in sheet form impregnated with bitumen supplied in roll form.

ASPHALT MASTIC: A mixture of asphaltic material and graded mineral aggregate that can be poured when heated but requires mechanical manipulation to apply when cool.

ASPHALT, AIR BLOWN: An asphalt produced by blowing air through molten asphalt at an elevated temperature to raise its softening point and modify other properties.

ASPHALT, STEAM BLOWN: An asphalt produced by blowing steam through molten asphalt to modify its properties, normally used for highway bitumen.

ASSEMBLY: The collective layers of components and materials which together comprise a wall, roof, deck or balcony.

ASTM: American Society for Testing and Materials.

ATACTIC POLYPROPYLENE (APP): A group of high molecular weight polymers formed by the polymerization of propylene. Both atactic (amorphous, non-crystalline) and isotactic (highly crystalline) polymers are formed during the polymerization. The atactic polymer is the primary modifier used in combination with bitumen, although a small quantity of the isotactic polymer may be used as well.

AWNING VENT: Operable vent with hinges at its sill or head.

BACKMOPPING: Applying hot asphalt to what will be the concealed side of a material (insulation sheet, felt, etc.) before turning it over and arranging it in place.

BACKNAILING: The practice of blind nailing (in addition to hot-mopping) all the plies of a substrate to prevent slippage.

BALCONY: A horizontal surface exposed to the outdoors, but projected from the building so that it is not located over a living space.

BALLAST: An anchoring material, such as rounded river rock, gravel, or pre-cast concrete pavers, which is used to hold single-ply roofing membranes in place and to stabilize the roof system from wind uplift forces. Although ballasting materials differ greatly in size, composition, and weight, they are typically applied at the rate of ten (10) pounds or more per square foot of roof area. Thus, ballast should only be applied to those roof structures able to support this added weight. Also, ballast materials should be large and heavy enough to resist being blown off the roof, yet light and smooth enough to avoid damaging the membrane.

BASE FLASHING: The extension of the roofing membrane over the cant and up the vertical surface or a flashing at the bottom of a wall.

BASE PLY: The base ply is the first ply when it is a separate ply, and not part of a shingled system.

BASE SHEET: A saturated and coated felt placed as the first ply in some multi-ply built-up roof membranes, also a modified and / or saturated and coated sheet used in modified bitumen roofing systems.

BATTEN: A narrow metal band or plate, usually of galvanized steel or aluminum, which is used to fasten or hold in place a single-ply membrane, to prevent its displacement - Also known as a "strip fastener." (see MECHANICALLY FASTENED MEMBRANES)

BEAD: Sealant or compound after application in a joint.

BITUMEN: The generic term for an amorphous, semi-solid mixture of complex hydrocarbons derived from any organic source. Asphalt and coal tar are the two bitumens used in the roofing industry.

BITUMINOUS: Containing or treated with bitumen. Examples: Bituminous concrete, bituminous felts and fabrics, bituminous pavement.

BITUMINOUS EMULSION: A suspension of minute globules of bituminous material in water or in an aqueous solution or a suspension of minute globules of water or an aqueous solution in a liquid bituminous material (invert emulsion).

BLISTER: A spongy, raised portion of a roof membrane, ranging upwards in size from 25 mm (1") in diameter and of barely detectable height. Blisters result from the pressure build-up of gases entrapped in the membrane system. The gases most commonly are air and / or water vapour. Blisters usually involve delamination of the underlying membrane plies.

BOND: The adhesive and cohesive forces holding two roofing components in intimate contact.

BROOMING: Embedding a ply of roofing material by using a broom to smooth out the ply, thereby ensuring contact with the adhesive under the ply.

BTU: British thermal unit – the heat energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit (1 BTU = 0.252 kilocalories (kcal)). (see KILOCALORIE)

BUILDING ENVELOPE: Those parts in a building that separate interior conditioned space from unconditioned exterior environment and normally includes walls, windows, roofs and foundations.

BUILDING PAPER: A breather-type asphaltic sheathing paper, rated in minutes, based on preventing water flow through it for number of minutes in accordance with a standard test.

BUILT-UP ROOF MEMBRANE: A continuous, semi-flexible roof membrane assembly consisting of plies of saturated felts, coated felts, fabrics or mats between which alternate layers of bitumen are applied, generally surfaced with mineral aggregate, bituminous materials, or granule-surfaced roofing sheet. (Abbreviation: BUR)

BUR: Built-up-roofing consisting of layers of felt saturated in bituminous asphalt with gravel ballast.

BUTT JOINT: Two components joined end to end without a overlap.

BUTYL: A rubber material produced by copolymerizing isobutylene with a small amount of isoprene. Butyl is manufactured into various sheet goods, blended with other rubber materials, and is often used to make sealants.

BUTYL (GLAZING) TAPE: glazing tape extruded from butyl mastic material and associated with wet glazing.

CANT STRIP: A beveled strip of wood or wood fibre that fits into the angle formed by the intersection of a horizontal surface and a vertical surface. The 45° slope of the exposed surface of the cant strip provides a gradual angular transition from the horizontal surface to the vertical surface.

CAP FLASHING: The covering, usually sheet metal, which covers the base flashing or caps a higher wall such as a parapet.

CAP SHEET: A granule-surfaced coated sheet used as the top ply of a built-up roof membrane or flashing or also in modified bitumen roofing systems.

CAPILLARITY: The action by which the surface of a liquid (where it is in contact with a solid) is elevated or depressed, depending upon the relative attraction of the molecules of the liquid for each other and for those of the solid.

CAPILLARY BREAK: The gap between parallel layers of material sufficient to break the surface tension of water, which is typically at least 3/8".

CAULKING: A composition of vehicle and pigment, used at ambient temperatures for filling joints, that remains plastic for an extended time after application.

CGSB: Canadian General Standards Board.

CLADDING: A material or assembly that forms the exterior skin of the wall and is exposed to the full force of the environment. Typical low-rise claddings include brick, stucco, wood siding, and vinyl siding.

COAL TAR PITCH: A dark brown to black, semi-solid hydrocarbon formed as a residue from the partial evaporation or distillation of coal tar. It is used as the waterproofing agent in dead-level or low slope built-up roofs.

COATED BASE SHEET (OR FELT): Felt that has been impregnated and saturated with asphalt and then coated on both sides with harder, more viscous asphalt to increase its impermeability to moisture; a parting agent is incorporated to prevent the material from sticking in the roll.

COEFFICIENT OF THERMAL EXPANSION: The change in length of a material as a function of temperature. A dimensionless coefficient, it is usually reported in mm/mm°C (or inches/inch°F).

COLD PATCH: A method of repairing a BUR using plastic asphalt cement with either a glass mat or saturated cotton membrane, instead of hot asphalt.

COLD-PROCESS ROOFING: A continuous, semi-flexible roof membrane, consisting of plies of felts, mats, or fabrics that are laminated on a roof with alternate layers of cold-applied roof cement and surfaced with a cold-applied coating.

COLOUR STABILITY: The ability of a material to retain its original colour, even after long exposure to strong sunlight and / or other harsh environmental conditions, including air pollutants, acid rain, extremes of temperature, etc. Colour stability may be especially important for white or specially pigmented materials which may have been deliberately selected for their high degree of reflectivity or aesthetic effect.

COMPRESSIVE STRENGTH: The ability of roofing materials and components to resist deformation or other damage caused by the weight or compression of either "live" or "dead loads." High compressive strength may be especially important in insulation boards.

CONCEALED BARRIER: A building envelope strategy in which the moisture barrier is located behind and in direct contact with the cladding. This type of system has limited drainage and drying abilities.

CONDENSATION: The conversion of water vapour or other gas to liquid as the temperature drops or the atmospheric pressure rises. See DEW POINT.

CONTACT CEMENTS: Adhesives which may be used to adhere or bond together various components. The adhesive is applied in a liquid state to the two surfaces to be joined and then allowed to dry before the surfaces are mated. The bond is formed immediately as the surfaces touch.

CONTROL JOINT: A joint used to relieve stresses in a system where no expansion joints have been provided.

COPING: The covering piece placed on top of a wall that is exposed to the weather. It is usually sloped to shed water.

COUNTER-FLASHING: Formed metal or elastomeric sheeting secured on or into a wall, curb, pipe, rooftop unit or other surface to cover and protect the upper edge of a base flashing and its associated fasteners.

COVERAGE: The surface area to be continuously coated by a specific roofing material with allowance made for a specific lap.

CPE: Abbreviation for "chlorinated polyethylene".

CRACK: A separation or fracture occurring in a roof membrane or roof deck, generally caused by thermally induced stress or substrate movement.

CRAZING: A series of hairline cracks in the surface of weathered materials.

CRCA: Canadian Roofing Contractors Association.

CREEP: The permanent deformation caused by movement that results from continuous thermal stress or mechanical loading or gravity.

CRICKET: A superimposed construction placed in a roof area to assist drainage. Also sometimes referred to as a SADDLE.

CROSS-CAVITY FLASHING: A flashing that sheds water from the weather barrier plane to the exterior wall plane (at floor level)

CSA: Canadian Standards Association.

CSM: The designated nomenclature for "chlorosulfonated polyethylene".

CSPE: A common abbreviation for "chlorosulfonated polyethylene."

CURB: A raised area on which a skylight or fan or other accessory is to be placed.

CUTBACK: Any bituminous roofing material that has been solvent-thinned. Cutbacks are used in cold-process roofing adhesives, flashing cements, and roof coatings.

CUTOFF: A material seal that is designed to prevent lateral water movement into the edge of a roof system where the membrane terminates at the end of a day's work. It is also used to isolate sections of the roof system. Cutoffs are usually removed before the continuation of work.

DAMPROOFING: Treatment of a surface or structure to resist the passage of water in the absence of hydrostatic pressure.

DEAD LEVEL: The term used to describe an absolutely horizontal roof. Zero slope. See SLOPE.

DEAD LOADS: Non-moving loads, such as mechanical equipment, air conditioning units, and the building materials themselves.

DECK: A horizontal roof surface exposed to the outdoors, located over a living space, and intended for pedestrian use but not for access to other areas of the building. In roofing a DECK is sometimes referred to as the structural surface to which the roofing or waterproofing system (including insulation) is applied.

DEFLECTION: A bending or arching of the deck which results in a surface which deviates from truly flat and level and a water management strategy that limits exposure to rain by geometry such as flashings and overhangs.

DELAMINATION: Separation of the plies in a roof membrane system or separation of laminated layers of insulation.

DEW POINT: The temperature at which saturation will occur in air containing a constant amount of water vapour (100% relative humidity). If air is in contact with a surface at this temperature condensation will form on the surface.

DIFFUSION: The movement of water vapour caused by a vapour pressure difference through air or other materials.

DIMENSIONAL STABILITY: The change in length and / or width of a material that results from exposure to elevated temperatures over time. Expressed as a percentage.

DOUBLE-GLAZED: Two panes of glass spaced apart.

DRAIN: A device that allows for the flow of water from a roof area.

DRAINED CAVITY (also RAIN-SCREEN) - A design strategy, whereby a positive drainage plane is created immediately behind the exterior cladding material, sufficient in width to break the surface tension of water. Allowing incidental water entering the wall system to drain by gravity with the aid of flashing and membranes.

DRIP EDGE: The formed edge on metal installed at the eaves of a roof, balcony or deck.

DRY GLAZING: glazing with a flexible vinyl or rubber seal (gasket) or other acceptable materials that do not have adhesive properties.

DRY SHEET: An unsaturated felt or paper used in certain applications to help prevent bitumen drippage (not to be confused with a saturated felt "laid dry" meaning "un-mopped").

DRY-WET or WET-DRY GLAZING: A combination of the above-described methods as they apply to exterior and inferior interfaces between the glass and framing.

EDGE LAP: The overlap of the edge of a ply over a previous ply. Also called "SIDE LAP".

EDGE STRIPPING: Application of felt strips cut to narrower widths than the normal width of the full felt roll. They are used to cover joints.

EDGE VENTING: The practice of providing regularly spaced protected openings along a roof perimeter to relieve moisture vapour pressure.

EFFLORESCENCE: The deposits of dissolved salts typically found on the surface of concrete or masonry that has been wetted.

ELASTOMER: A macromolecular material that returns rapidly to its approximate initial dimensions and shape after substantial deformation by a weak stress and the subsequent release of that stress.

ELASTOMERIC: The term used to describe the elastic, rubber-like properties of a material.

ELASTO-PLASTIC: A term used to describe the whole range of synthetic rubber and plastic materials used in the manufacture of single-ply roofing membranes.

ELONGATION: The ability of a roofing membrane material to be stretched or elongated by the application of a force. (see ULTIMATE ELONGATION)

EMBEDMENT: The process of placing a material into another material so that it becomes an integral part of the whole material.

EMBRITTLEMENT: The loss of flexibility, elasticity, or ductility of a material. The transition of a flexible material to a brittle material.

EMULSION: The intimate dispersion of an organic material and water achieved by using a chemical or clay emulsifying agent.

ENDLAP: The overlap of the start of a roll over the previous roll.

EPDM: Designated nomenclature by ASTM for a terpolymer of ethylene, propylene, and a diene.

EQUILIBRIUM AT A MOISTURE CONTENT: The moisture content of a material stabilized given temperature and relative humidity, expressed as a percent of moisture by weight or the typical moisture content of a material in any given geographical area.

ETHYLENE PROPYLENE DIENE MONOMER (EPDM): An elastomeric material synthesized from ethylene, propylene, and small amounts of diene monomer. EPDM is widely used in single-ply roofing membranes. It may be used alone or in EPDM / butyl blends. See ELASTOMERIC.

EXPANSION JOINT: A joint in the building envelope which allows differential movement of portions of the building structure (expansion joint), or prevents or localizes cracking of brittle materials such as stucco, where movement needs to be controlled (control joint).

EXPOSURE: The portion or extent of a building or element of the building which is exposed to the weather.

EXTERIOR GLAZED: glass set from the exterior of the building.

EXTRUDING (ALUMINUM, RUBBER, PLASTIC): The process of squeezing material at high pressure, forcing through a steel die and therefore shaping into a desired hollow or solid profile.

FABRIC: A woven cloth of organic or inorganic filaments, threads, or yarns usually used for reinforcements in certain membranes, assemblies and flashing details.

FACTORY MUTUAL (FM): An organization that classifies roof assemblies for their fire characteristics and wind-uplift resistance for insurance companies in the United States.

FACTORY SEAM: A splice made by the manufacturer during the assembling of narrow width material into large sheets.

FAILED IGU: An insulating glass unit with permanent obstruction of vision due to accumulation of moisture, dust, or film on the internal surfaces of the glass.

FASCIA: The vertical trim board at the eave. The gutter is attached to the fascia.

FASTENERS: Any of a wide variety of mechanical fastening devices and assemblies, including clips, screws, or bolts, which may be used to secure battens, discs, termination bars, and wood nailers to the deck or other suitable substrate.

FELT: A fabric manufactured from cellulose (wood) fibres (organic felts). The manufacturing process involves mechanically interlocking the fibres of the particular felt material in the presence of moisture and heat.

FIELD SEAM: A splice made in the field that joins two sheets together by way of adhesive, splicing tape, heat, or solvent-welding. See FACTORY SEAM.

FISHMOUTH: A half-cylindrical or half-conical opening formed by an edge wrinkle.

FLANGE: The projection of a profile i.e. around the exterior perimeter of nail-on framing.

FLASH POINT: The temperature at which asphalt becomes volatile and can burst into flame.

FLASHING: sheet metal or other material used in roof or wall construction and designed to shed water (typically sloped outwards and with a drip edge to shed water). Typical flashings include: window head flashings, roof or balcony parapet cap flashings, through wall flashings.

FLOAT GLASS: glass with flat, parallel surfaces formed on the surface of a pool of molten tin.

GANA: the Glazing Association of North America.

GASKET: Pre-formed (extruded) profiles of rubber or rubber-like composition, used to fill and seal a joint or gap either alone or in conjunction with a supplemental application of sealant.

GCA: The Glazing Contractors Association of British Columbia

GLASS FIBRE MAT: A thin mat composed of glass fibres with or without binder used as reinforcing or carrier sheet for a roofing membrane.

GLASS: A transparent, brittle substance formed by fusing sand with soda or potash or both; it often contains lime, alumina, or lead oxide.

GLAZE COAT: The top layer of asphalt in a smooth-surfaced built-up roof assembly;

GLAZING: A securing glass in prepared openings in windows, doors, or other framing systems.

GLAZING CAVITY: A the part of framing where glass is secured.

GLAZING STOP: Exterior or interior removable molding, extruded metal profile or formed bead that holds the light or panel in place.

GRAVEL: Coarse, granular aggregate, containing pieces approximately 6 mm (1/4") to 19 mm (3/4") in size and suitable for use in aggregate surfacing on built-up roofs.

GRAVEL STOP: A formed strip of material, usually metal, nailed around the edges of a graveled roof to prevent the gravel from rolling or washing off and to add a finished appearance to the roof. It may be combined with the fascia flashing.

GUM PAN: See PITCH POCKET.

GUMLIP FLASHING: Metal flashing that typically protects the top edge of a waterproofing transition. The top edge of the metal flashing projects away from and not into the substrate where a bead of sealant exists between the metal and substrate. The bottom of the flashing typically consists of a hemmed dripped edge that projects water away from the waterproofing transition.

HEAD: The horizontal member forming the top of the frame.

HEAD/SILL FLASHING: at head or sill of window opening or other penetration

HEADLAP: The minimum distance, measured at 90° to the eaves along the face of a shingle or felt, from the upper edge of the shingle or felt to the nearest exposed surface.

HEAT AGING: Controlled exposure to elevated temperatures over time.

HEAT WELDING: A process or method of melting and sealing or fusing together the overlapping edges of separate sections of thermoplastic or uncured elastomeric membranes by the application of heat and pressure. Small, portable "hot air" or "heat welding" devices are available which can, without the use of chemicals or adhesives, heat seal or fuse together overlapping edges to form waterproof seams.

HORIZONTAL APPLICATION: The roofing materials are laid parallel to the eaves and at right angles to the slope.

HOUSEWRAP: a vapour permeable sheet plastic material generally installed between the exterior sheathing and cladding in wall construction. It is commonly installed as the air barrier.

HYGROSCOPIC: The term used to describe a material which attracts, absorbs and retains atmospheric moisture.

HYPALON: A registered trademark of E.I. duPont de Nemours, Inc., for "chlorosulfonated polyethylene" (CSPE).

ICE DAM: A build-up of ice at the eave drainage area or in the valley of a sloping roof. This build-up may cause water to back up under the roofing.

IGMAC: Insulating Glass Manufacturers Association of Canada

IGU: See Sealed IGU

INCLINE: The slope of a roof expressed either in percent or in the number of vertical units or rise per horizontal unit of run. See SLOPE.

INORGANIC: Being or composed of matter other than hydrocarbons and their derivatives, or matter that is not of plant or animal origin.

INSULATION: A material applied to reduce the flow of heat.

INTERIOR GLAZED: Glass set from the interior of the building.

INVERTED ROOF: See PROTECTED MEMBRANE.

IRMA ROOF: See PROTECTED MEMBRANE.

JAMB: The upright or vertical members forming the side of the frame adjacent to the structural members of a building.

LAMINATED GLASS: Two or more lights of glass bonded together with plastic interlayer.

LAP: The part of a roofing membrane that overlaps or covers any portion of another section of membrane which is then sealed to form a watertight connection.

LAP CEMENT: A cut-back asphalt used for cementing the laps in roll roofing or a proprietary adhesive used with certain types of single-ply roofing membranes.

LIGHT: Another term for a pane of glass used in a glazing system such as a window.

LIQUID APPLIED: The process of applying a product in liquid form, which then dries, or cures to a flexible solid, common for waterproofing.

LIVE LOADS: Any loads on a structure which are not part of the structure itself, typical live loads include those due to wind, show, occupants, etc.

LOOSE-LAID MEMBRANES: Membranes that are not attached to the substrate except at the perimeter of the roof. Loose-laid membranes are held in place with appropriate and adequate ballast, such as round river washed stone, gravel, pavers, etc. This assembly may only be used on roof structures able to support the added weight of the ballast, which is generally applied at the rate of ten pounds or more per square foot of roof area.

LOW TEMPERATURE FLEXIBILITY: The ability of a membrane or other material to remain flexible (resist cracking when flexed) after it has been cooled to a low temperature. Low temperature flexibility is important, especially in

a membrane which is to be installed during the winter and / or in a cold climate. See LOW TEMPERATURE RESISTANCE.

LOW TEMPERATURE RESISTANCE: The lowest temperature at which a material does not fracture or crack under prescribed impact and flexing conditions. Expressed in °C (or °F). See LOW TEMPERATURE FLEXIBILITY.

MAINTENANCE: A regular process of inspection of envelope elements and exterior systems such as roof, walls, windows, gutters, downspouts and drains, cleaning of those items as required on a regular basis (such as leaves from gutters and drains in the fall, and cleaning lint from dryer vents), and reinstating failed elements such as areas of cracked caulking or peeling paint.

MASTIC: A sealant that has a "non-sag" consistency to prevent the material from flowing away from the joint or surface to which it is applied. Mastics are usually applied using a standard caulking gun, a trowel, or a knife. See SEALANT. Mastic can also refer to a heavy-consistency bitumoius compounds that may remain adhesive and pliable with age.

MAT: A thin layer of woven, non-woven, or knitted fibre which serves as reinforcement to the membrane.

MECHANICALLY FASTENED MEMBRANES: Generally used to describe single-ply membranes that have been positively attached at intervals to the substrate, usually with various fasteners and other mechanical devices such as battens. Mechanical fastening makes it possible t install membranes over certain substrates, such as gypsum or lightweight concrete fills, which may not accept adhesive or heavy ballasting. Mechanical fastening permits the membrane to float free between the fasteners, and allows greater movement between the membrane and the substrate than in a fully adhered system.

MEMBRANE: A flexible or semi-flexible roof covering or waterproofing layer, whose primary function is the exclusion of water.

MESH: The square or circular opening of a sieve.

METAL FLASHING: See FLASHING; metal flashing is frequently used as through-wall flashing, cap flashing, counter flashing or gravel stops.

MIL: A unit of measure used to indicate the thickness of a roofing membrane. One mil is equal to 1/1000 (0.001) inches or 25.4000 microns (normally applies only to American manufactured materials). Often incorrectly used as an abbreviation of millimeter.

MINERAL SURFACED ROOFING: Built-up roofing materials whose top ply consists of a granule-surfaced sheet. Usually refers to organic roll roofing rather than "elastomeric" or "plastomeric" preformed sheets.

MINERAL SURFACED SHEET: A felt that is coated on one or both sides with asphalt and surfaced with mineral granules.

MITRE CUT JOINT: A mitered corner, usually made of two profiles cut at 45° and jointed together producing a 90° corner of framing unit.

MODIFIED BITUMEN: A material consisting of bitumen which has been modified through the inclusion of one or more polymers and may contain stabilizers and other additives. Modified bitumen roofing membranes usually also contain a reinforcing material such as glass fibre and / or polyester. See ATACTIC POLYPROPYLENE, STYRENE-BUTADIENE-STYRENE, and STYRENE-BUTADIENE-RUBBER.

MODIFIED PROTECTED MEMBRANE: A roofing system wherein the roofing membrane is applied over a portion of the insulation and under the other portion of insulation which is ballasted. The usual ratio is one-third of the insulation under and two-thirds over the membrane.

MODULUS: The measure of a material's stiffness. Since polymeric materials do not exhibit traditional elastic behavior, the modulus is not a constant. For a polymeric material, the modulus is reported as the tensile stress required at a given elongation. Expressed as force per unit area at a given percent elongation.

MOHAIR WEATHER-STRIPPING: weather-stripping utilizing mohair pile like material.

MOPPING: An application of hot bitumen applied to the substrate or to the felts of a built-up roof membrane with a mop or mechanical applicator.

MULLION: A vertical or horizontal frame member that separates two or more sashes, two or more fixed lights, or a combination of sashes and fixed lights.

MUNTIN: horizontal and vertical bars that divide the window into smaller lights – Similar to mullion but lighter in weight.

NAILING STRIPS: Strips of wood (also called nailers) which are fastened on walls, curbs and step / sloping non-nailable roof decks to allow the anchoring of flashings. Also used to prevent insulations and any required roof membrane from sliding.

NAIL-ON-FLANGE FRAMING: window framing with exterior flange allowing for integration seal and securing with fasteners.

NEOPRENE: A synthetic rubber (polychloroprene) used in liquid-applied and sheet-applied elastomeric roof membranes or flashings.

NON-VULCANIZED MEMBRANE: A membrane manufactured from thermoplastic compounds that retain their thermoplastic properties throughout the life of the membrane.

NON-WOVEN: A term used to describe the random arrangement of reinforcing fibres (glass, polyester, etc.) in a mat or scrim.

NRC: The National Research Council of Canada

NRCA: National Roofing Contractors Association (U.S.A.)

ORGANIC: Being composed of hydrocarbons or their derivatives, or matter that is of plant or animal origin.

PARAPET: A low wall along the edge of a roof which is frequently an extension of the perimeter wall of the building structure.

PATTERNED GLASS: rolled glass having a distinct pattern on one or both surfaces.

PENETRATION: A hole passing through the building envelope in which ducts, electrical wires, pipes, and fasteners are run between inside and outside.

PERLITE: A friable aggregate used in lightweight insulating concrete and in pre-formed perlitic insulation boards, formed by heating and expanding siliceous volcanic glass.

PERM A unit of water vapour transmission defined as one grain of water vapour per square foot per hour per inch of mercury pressure difference (one inch of mercury = 0.49 psi).

PERMEANCE: An index of a material's transmission resistance to water vapour. See VAPOUR.

PHASED APPLICATION: The installation of a system during two or more separate time intervals.

PIB: Abbreviation for "polyisobutylene".

PITCH (see TAR): A short form reference to coal tar pitch. The word may also refer to slope or to the angle above the horizontal of the roof incline.

PITCH POCKET: A flanged, open-bottomed, metal container placed around columns or other roof penetrations that is filled with hot bitumen and / or flashing cement to seal the joint. The use of pitch pockets is not recommended by RGC. Also called "gum pan".

PLASTIC: Any of a large group of synthetic materials, usually produced by the polymerization of various organic compounds, which can be formed (i.e., molded, cast, extruded etc.) into flexible sheets or membrane.

PLASTIC CEMENT: Although all caulking cements could be called plastic cement, there is a commonly held acceptance in the roofing industry that plastic cement means bituminous cement. These can be either asphalt or coal tar base with the former much more common. These are a mixture of bitumens, asbestos fibres, filler and suitable solvent.

PLASTICIZER: A chemical substance (e.g., an organic compound) added to natural or synthetic resins for the purpose of increasing flexibility, and facilitating processing and workability.

PLY: A single layer in a built-up system.

POLYCHLOROPRENE (NEOPRENE): A synthetic elastomer produced by the polymerization of chloroprene, and used in liquid-applied and sheet-applied roof membranes and flashings. Neoprene may be installed as both a cured (vulcanized) and an uncured (non-vulcanized) sheet membrane.

POLYESTER: A polymeric resin which is generally cross-linked or cured, and made into a variety of plastic materials and products. Polyester fibres are widely used as the reinforcing medium in reinforced flexible sheet membranes as they can provide high tensile strength, tear and puncture resistance.

POLYMER: A natural or synthetic chemical compound of high molecular weight, or a mixture of such compounds, formed when small individual molecules, called monomers, are combined and linked together to form large long-chain molecules, called polymers.

POLYVINYL CHLORIDE (PVC): A thermoplastic polymer, synthesized from vinyl chloride monomer. See PLASTOMERIC MEMBRANES, THERMOPLASTIC.

POND (also PONDING): The collection of water in shallow pools on the top surface of roofing usually caused by a roof surface that is incompletely drained. Good drainage is essential to good roof design.

POSITIVE DRAINAGE: The drainage condition in which consideration has been made for all loading deflections of the deck, and additional roof slope has been provided to ensure complete drainage of the roof area within 24 – 48 hours of rainfall.

POSITIVE LAP: A technique in which a material is applied, where the top layer is lapped over the lower layer. This applies to all types of water shedding materials.

PREPARED ROOFING: A general term applied to all asphalt roll roofing and shingles.

PRIMER: A thin, liquid bitumen applied to a surface to improve the adhesion of subsequent applications of bitumen. Also refers to non-bituminous adhesion enhancers used in proprietary roofing systems and caulking materials.

PROTECTED MEMBRANE: A roofing system wherein the roofing membrane is applied at the structural deck level and the insulation is placed above the membrane and ballasted. Also called inverted or upside-down roof.

PVC : Abbreviation for Polyvinyl Chloride.

RAINSCREEN: A building envelope strategy, where the moisture barrier (air barrier) is located behind and separated from the cladding (or rainscreen) by a cavity. The cavity serves a capillary break, and promotes drainage and drying. If the system is designed to maintain the same air pressure on the outside face as in the cavity it is referred to as a pressure-equalized rainscreen.

RAKE: The sloped edge of a roof at the first or last rafter.

RCABC: Roofing Contractors Association of British Columbia.

RE-ENTRANT: An inside corner of a surface wall intersection which may produce stress concentrations in the roofing or waterproofing membrane.

REGLET: A groove in a wall or other surface adjoining a roof surface for use in the attachment or counter flashing, or actual insertion of the roof membrane.

REINFORCED MEMBRANE: A roofing or waterproofing membrane reinforced with felts, mats, fabrics, or chopped fibres.

RELATIVE HUMIDITY: The ratio of the weight of moisture in a given volume of air-vapour mixture to the saturated (maximum) weight of water vapour at the same temperature, expressed as a percentage.

REROOFING: The practice of applying new roofing materials over existing roofing materials; or removal of existing roofing materials and replacement with new. Also and more correctly called Replacement Roofing.

RGC: Roofing Contractors Association of B.C. Guarantee Corp.

RIDGE: The horizontal where roofs sloping in different directions join at the highest point.

RIDGE CAPPING: Waterproofing units applied along the ridge to cover the join between roof surfaces. Ridge capping may be asphalt shingles, wood shingles or shakes, tiles, roll roofing, or metal shaped for the purpose.

RIDGING: An upward "tenting" displacement of a roof membrane, frequently occurring over insulation joints, deck joints, and base sheet edges.

ROLL ROOFING: The term applied to smooth-surfaced or mineral-surfaced coated felts.

ROOF ASSEMBLY: An assembly of interacting roof components (including the roof deck) designed to weatherproof, and normally insulate, a building's top surface.

ROOF DIVIDER: A low wall used to break up a large roof area into smaller section is in order to prevent the build-up of stress in the system which could be greater than the roof's ability to withstand.

ROOF SYSTEM: A system of interacting roof components (NOT including the roof deck) designed to weatherproof, and normally insulate, a building's top surface.

ROUGH OPENING: The opening in the framing of a building, in which the window, door, vent or other component is located.

SADDLE: The junction of a horizontal surface and vertical surface such as the top of a balcony wall with a building wall.

SASH: A unit assembly of stiles and rails for holding glass with or without dividing bars and muntins.

SATURATED FELT: A felt that has been partially saturated with low softening point bitumen.

SBS: Styrene Butadiene Styrene, which is a high-grade modified bituminous torch-applied roof membrane.

SCREEN: An apparatus with apertures for separating sizes of material.

SCRIM: A woven, non-woven, or knitted fabric, composed of continuous strands of material used for reinforcing or strengthening flexible sheet membranes. Scrim may be incorporated into the membrane by laminating or coating.

SCUPPER: A metal pipe or trough section creating a drainage overflow from a roof or balcony to a down-pipe or surface below.

SEALANT: Also called "caulking". A mixture of polymers, fillers, and pigments used to fill and seal joints where moderate movement is expected; it may cure to a resilient solid or remain in a mastic or semi-mastic state.

SEALED INSULATING GLASS UNIT (IGU): Two or more panes of glass spaced apart and hermetically sealed in a factory.

SEAM: A joint formed by mating together two separate sections of roofing membrane. Seams may be sealed in a variety of ways, including hot-air welding, solvent welding and adhesive bonding. Regardless of the method used, however, all seams should be permanently joined together to assure watertight integrity and to be able to withstand all strains and stresses caused by application, wind uplift, installation equipment and foot traffic.

SEAM STRENGTH: The force or stress required to separate or rupture a seam in the membrane material. See SEAM.

SELF-ADHESIVE MEMBRANES: Single-ply membranes which can adhere to a substrate and to itself at overlaps without the use of an adhesive. The undersurface of a self-adhesive membrane is protected by a "release paper," which prevents the membrane from bonding to itself during shipping and handling. Later, as the membrane is unrolled, the release paper is peeled away and the self-adhering undersurface is applied to the substrate. Successful application of a self-adhesive membrane requires a clean and dry substrate and the application of firm, uniform pressure.

SELVAGE: An edge or edging that differs from the main part of a fabric, or granule-surfaced roll roofing material.

SELVAGE JOINT OR EDGE: A lapped joint designed for mineral-surfaced cap sheets. The mineral surfacing is omitted over a small portion of the longitudinal edge of the sheet below in order to obtain better adhesion of the lapped cap sheet surface with the bituminous adhesive.

SETTING: The action of compound as it becomes firmer after application or it can refer to the placement of lights or panels in sash or frame.

SHEATHING: A material such as OSB (Oriented Strand Board), plywood or gypsum board used to provide backing for the cladding and sheathing membrane.

SHEATHING PAPER: A material or combination of materials in an exterior wall whose purpose is to retard penetration of incidental water further into the wall structure once past the cladding. Commonly used materials are building paper and house-wrap.

SHINGLE: A small unit of prepared roofing material designed to be installed with similar units in overlapping rows on inclines, or to apply any sheet material in overlapping rows like shingles.

SIDE LAP: See EDGE LAP.

SIEVE: An apparatus with apertures for separating sizes of material.

SILL: The main cross or horizontal member forming the bottom of the frame.

SINGLE-PLY MEMBRANES: Roofing membranes that are field applied using just one layer (usually) of membrane material (either homogeneous or composite) rather than multiple layers. However, the manufacture of the single-ply sheeting may involve lamination or several layers of the same or different materials.

SINGLE-PLY SYSTEM ASSEMBLIES: There are six major types of single-ply roofing systems assemblies: (1)Loose-laid (2)elf-adhesive (3)Partially-adhered (4)Totally-adhered (5)Technically-fastened (6) Protected Membrane Roof Assembly

SLAG: A hard, air-cooled aggregate that is left as a residue from blast furnaces. It is used as a surfacing aggregate and should be surface-dry, graded and free of sand, clay, or other foreign substances at the time of application.

SLIP SHEET: Sheet material, such as reinforced kraft paper, polyester scrim, or polyethylene sheeting, placed between two components of a roofing system (such as membrane and insulation) to ensure that no adhesion occurs between them, and to prevent possible damage from chemical incompatibility.

SLOPE: The tangent of the angle between the roof surface and the horizontal. The incline or pitch of a roof surface.

SMOOTH-SURFACED ROOF: A built-up roof membrane surfaced with a layer of hot-mopped asphalt, cold-applied asphalt-clay emulsion, cold-applied asphalt cutback, or sometimes with an unmapped inorganic felt.

SOLVENT CLEANERS: Heptane, hexane, white gas, and unleaded gas, used to clean the membrane prior to applying the splicing adhesive in some single-ply roofing systems. Also may be aromatic solvents such as Xylene, Toluene or Methyl Ethyl Ketone (MEK).

SOLVENT WELDING: A process used to chemically weld or join together two or more layers of certain membrane materials (usually thermoplastic), by applying a solvent, such as tetrahydrofuran (or THF), to the overlapping surfaces and mating them when the bonding surfaces become tacky. Used most often in welding or sealing seams.

SPLICE: See SEAM.

SPLICING TAPE: Cured or uncured synthetic rubber tape used for splicing in lieu of "contact adhesives".

SPLIT: A separation in roofing material resulting from movement of the substrata. See CRACK.

SPUNBOND POLYESTER MAT: Continuous filament, uniformly dispersed polyethylene terepthalate fibre mat. A binder is used to stabilize the mat, which serves as reinforcement to the membrane.

SQUARE: The common industry term used to describe 100 square feet of roof area (approximately 10 m^2).

STABILIZER: An ingredient in the formulation of single-ply membranes added to improve certain physical properties which are important for processing, storage, workability, and performance.

STACK EFFECT: the air pressure differential caused a difference in air temperatures and therefore densities. In colder months this causes an upward and outward force acting on ceilings and upper walls and an inward effect on lower levels.

STACK VENT: A vertical outlet in a built-up roof system designed to relieve any pressure exerted by moisture vapour between the roof membrane and the vapour retarder or deck.

STARTER STRIP: A material applied at the eaves and serving as a base for the first course of material (typically a membrane) to be applied.

STEP FLASHING: Individual pieces of flashing material used to flash the sides of chimneys and dormers and similar projections on steeper sloped roofs which are usually shingled. The individual pieces are overlapped and stepped up the slope.

STRAPPING: The use of wood, metal or other material to form a drainage cavity and act as a capillary break behind the cladding material.

STRAWBERRY: A small bubble or blister in the flood coating of a gravel-surfaced roof membrane which has penetrated to the gravel surface and is exposed to the weather.

STRIPPING OR STRIP FLASHING: The technique of sealing a joint between metal and the built-up roof membrane with one or two plies of felt and hot-applied or cold-applied bitumen; the technique of taping joints between insulation boards on deck panels

STUCCO: A cementitious cladding material typically consisting of sand, cement, lime and water. Stucco can different finishes including stone-dash (small stones embedded in the stucco) and acrylic finish (an acrylic polymer resin surrounding silica sand)

STYREN-BUTADIENE RUBBER: High molecular-weight polymers having rubber-like properties, formed by the random copolymerization of styrene and butadiene monomers. Polymers of this type are often cross-linked to give maximum rubber-like properties in service. These polymers are sometimes used as the modifying compound in certain modified bitumen roofing membranes.

STYRENE-BUTADIENE-STYRENE COPOLYMER (SBS): High molecular-weight polymers which have both elastomeric and thermoplastic properties, formed by the block copolymerization of styrene and butadiene monomers. The three block copolymer formed has a center block of butadiene with end blocks of styrene. These polymers are sometimes used as the modifying compound in certain modified bitumen roofing membranes.

SUBSTRATE: The surface upon which the roofing or waterproofing membrane is applied, i.e., the structural deck or insulation.

SYMPTOMS: Visual evidence such as staining and wetting of surfaces, loss of strength, de-lamination or cracking of materials, peeling paint and de-bonded coatings, etc.; which suggests a performance problem within the exterior envelope of a building.

TALC: A fine white powder which may be present on the surface of vulcanized EPDM or other membranes, used in the manufacturing process to prevent adhesion of the membrane to itself. The same purpose can also be served by the use of mica dust or in some cases, sand.

TAPERED EDGE STRIP: A tapered insulation strip used to elevate the roof at the perimeter and at curbs that extend through the roof or provide a gradual transition from one layer of insulation to another.

TAPING: Technique of taping joints between insulation or overlay boards to prevent drippage of bitumen.

TAR: A brown or black bituminous material, liquid or semi-liquid in consistency, in which the predominating constituents are bitumens obtained as condensates in the processing of coal, petroleum oil-shale, wood, or other organic materials. Rarely used. The term tar and gravel really means asphalt, felt, and gravel roofs.

TEMPERING: Heat treatment – Reheating of the glass to a temperature just below the softening point followed by rapid cooling.

TEST CUT: A sample taken by cutting to diagnose the condition or components of the existing assembly.

THERMAL BREAK: An insulating material with low thermal conductance incorporated in a metal (window) frame profile, to stop or reduce flow / transfer of heat.

THERMAL SHOCK: The stress-producing phenomenon resulting from sudden temperature changes.

THERMOPLASTIC: Polymers which soften when heated and harden when cooled. This process is repetitive provided the material is not heated above the point at which decomposition occurs.

THERMOPLASTIC ELASTOMERS: Compounds formulated from materials traditionally used for vulcanized rubber. Curing agents are controlled in the compound so cross-linking does not occur, and the final product exhibits the properties of a thermoplastic material.

THERMOSET: A material that solidifies or “sets” irreversibly when heated. This property is usually associated with cross-linking of the molecules induced by heat or radiation.

THROUGH WALL FLASHING: 1) A waterproof membrane or metal flashing installed under a segmented or permeable cap used over the top of an exposed wall. 2) The flashing installed at each floor level in a rainscreen wall assembly intended to deflect moisture in the cavity to the exterior. 3) Flashing extending completely through a masonry wall to prevent water infiltrating behind lower elements of the flashing system and roofing system.

TPO: Abbreviation for Thermoplastic Polyolefin.

TRANSOM: A horizontal frame member that separates two or more sashes, two or more fixed lights, or a combination of sashes and fixed lights.

ULTIMATE ELONGATION: The amount a membrane sample stretches during tensile testing before it ruptures. Usually expressed as a percentage of the original length.

ULTRAVIOLET (UV): Ultraviolet radiation from the sun is known to be potentially damaging to certain bitumens and chemical compounds used in roofing membranes. Formulations with stabilizers and UV absorbers effectively inhibit the potentially deleterious effects of UV exposure. Mineral surfaced sheets and roofing gravel are typical reflectants.

UNDERWRITERS LABORATORIES (UL): An organization that classifies roof assemblies for their fire characteristics and wind-uplift resistance for insurance companies in United States.

UNDERWRITERS LABORATORIES CANADA (ULC): An organization that classifies roof assemblies for their fire characteristics and wind-uplift resistance for insurance companies in Canada.

UNIT: A term normally used to refer to one single light of insulating glass.

UV: ultra violet radiation (from the sun), which has a degrading effect on membrane materials (asphalt based) unless protected by an appropriate shielding layer.

VALLEY: The junction of two sloping roof planes at the lower end of the slope. Opposite of a ridge or hip.

VAPOUR BARRIER / VAPOR RETARDER: The material in an assembly (wall or roof) with a low vapour permeability intended to control the flow of vapour thus limiting the potential for condensation.

VAPOUR MIGRATION: The movement of water vapour from a region of high vapour pressure to a region of lower vapour pressure.

VAPOUR-PRESSURE GRADIENT: A graph, analogous to a temperature gradient, indicating the changes in water vapour pressure at various cross-sectional planes through a roof or wall system.

VENT: An opening designed to convey water vapour or other gas from inside a building or a building component to the atmosphere, thereby relieving vapour pressure.

VISCOSITY: The measure of flow resistance of a fluid at a specific temperature and pressure. Viscosity is the reciprocal of fluidity.

WATERPROOFING: Treatment of a surface or structure to prevent the passage of water under hydrostatic pressure.

WEATHER-STRIPPING: A material around operable parts of window (vent) used to reduce air leakage or water penetration, or both.

WEEP HOLE: An opening, drain hole or notch at the base of a sash or frame to prevent water accumulation and allow for necessary drainage to the outside.

WET GLAZING: glazing with glazing compounds (glazing tapes, caulking, adhesives) or other acceptable materials that have adhesive properties.

WIND LOAD: A load created by the speed of and direction of wind.

WIND UPLIFT: Wind that is deflected around and across the surfaces of a building causes a drop in air pressure immediately above the roof surface causing an upward force, or a lifting action.

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