Building Enclosure Condition Assessment Report | Project 11892.000

Hornby Island Firehall, 3850 Central Rd, Hornby Island, BC

To: Mr. Bill Uhrich
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Submitted: May 18, 2017 by
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Contents

1 Introduction

1.1 Terms of Reference

RDH Building Science Inc. (RDH) was retained by Simcic + Uhrich Architects to undertake a targeted investigation of the of the wall assembly located at 3850 Central Rd, Hornby Island, BC.

Our scope of review and report is limited to the wall assemblies in the Apparatus Bay. This report may provide information related to the specific sources of moisture or other physical factors which have resulted in the observed conditions.

This report has been undertaken for Simcic + Uhrich Architects and the Comox Valley Regional District and is not to be relied on by others.

RDH visited site on May 01, 2017 with Bill Uhrich from Simcic + Uhrich Architects, James Bast from Comox Valley Regional District and Mike Butler from Island West Coast Developments Ltd. The weather was Overcast and 11°C.

1.2 Report Organization

Background information relevant to this building and the investigation is provided in Section 1 of this report.

The recommendations for repair are summarized in Section 3.

1.3 Documents Reviewed

The documents provided to and reviewed by RDH are listed in Table 1.1.

TABLE 1.1 DOCUMENTS REVIEWED	
DOCUMENT DESCRIPTION	
Architectural Drawings	Simcic + Uhrich Architects dated 2016 04 19 IFC

1.4 Building Description

A description of the buildings is provided in Table 1.2. Photographs of the principal elevations of the buildings are provided in Figure 1.1 to Figure 1.4.

TABLE 1.2 DESCRIPTION OF BUILDING	
Name	Hornby Island Fire Hall
Address	3715 Central Road Hornby Island, BC
Date of construction	2016
Applicable building codes	BCBC 2012
Building code classification	Part 5
Number of storeys	2
Type of construction	Wood frame
Structural system	Concrete foundation

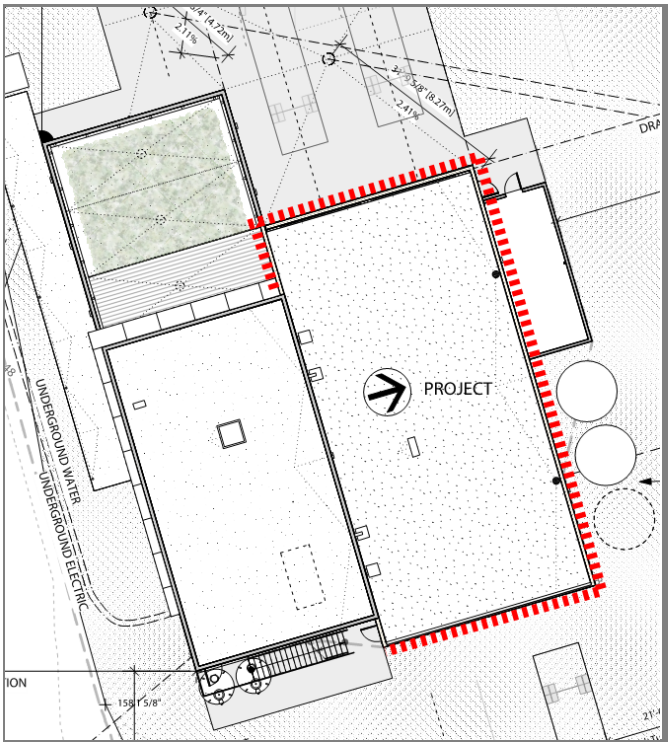


Figure 1.1

Building footprint with the Apparatus Bay area reviewed highlighted.

Figure 1.2
South West Elevation

Figure 1.3
West Elevation

Figure 1.4
North East Partial Elevation

1.1 Building History

A brief history of activities relating Apparatus Bay walls as reported to us include an interior opening into the upper floor to check condition of wall assembly at south elevation GL 1/D and an exterior opening through cladding at north elevation GL 6/F.

We understand that the BC Hydro energized the building the week of April 24th, and until then generators were used for temporary power during construction. At the time of our review the mechanical system and in-floor hydronic heating in the Apparatus Bay had not been commissioned.

RDH was contacted by Simcic + Uhrich Architects on April 21st,2017 after the general contractor, Island West Coast Developments (IWCD), observed water running down the outside face of the exposed footing in the storage shed. Prior to RDH attending site, IWCD removed exterior cladding and sheathing above the storage room to expose the stud cavity. Liquid water was reported to have formed on the outboard site of the mineral wool insulation and on the inboard face of the Agepan wood-fiber sheathing. Photos of the conditions were sent to us by Bill Uhrich, refer to Figure 1.5.

Figure 1.5

Photo provided bv Simcic + Uhrich Architects.

Staining on the outboard face oof the Agepan was reported to have occurred during construction

Studs and sheathing found to have high moisture content.

Moisture observed on the outboard face of the insulation and back face of the Agepan sheathing

2 Discussion of Building Enclosure Performance

2.1 Interior Operating Conditions

The interior temperature and relative humidity in the Apparatus bay was measured using a Kestrel 4200. It is noted that the interior heating was not in operation at the time of our review. The temperature and humidity in the Apparatus Bay was 14 °C and 62% RH respectively. The interior dew point was measured to be 6.8 °C. The outside temperature and humidity were 11.4 °C and 71% RH respectively. The exterior dew point was measured to be 6.4 °C.

We observed five catch basin type drains in the Apparatus Bay. Most of the basins were partially filled with water, refer to Figure 2.1.

Figure 2.1

One of 5 catch basins in the Apparatus Bay.

Although we have not reviewed the mechanical drawings, we understand there is no provision for mechanical exhaust ventilation in the bays other than the truck engine exhaust system specific to each bay section, refer to Figure 2.2. The catch basins create an open source of moisture in the apparatus bay that will lead to elevated humidity. Together with the drying of wet equipment in the bays, it is anticipated the interior humidity will be higher than normal. The seals around the overhead doors act as baffles for wind driven rain, but do not appear to be air tight. Therefore, there will likely be some air exchange with the outside.

Figure 2.2

Truck exhaust connections. Fumes evacuated through roof top mechanical unit.

We recommend that the interior humidity be monitored during operation of the building. To control high humidity, consider integrating a humidistat control with the ambulance fume exhaust fan.

2.2 Walls

Conditions and performance of the wall assembly as well as penetrations and other features within the Apparatus Bay walls areas is the focus of this investigation and report.

As reported to us, the walls of the Passive House equivalent portion of the fire hall are constructed from premanufactured wall panels as shown in the figure below. The air barrier and vapour barrier are formed by the OSB interior sheathing with taped joints between panels and joints in the OSB sheets. An Ampatop Aero synthetic water resistive barrier was site installed over the exterior Agepan sheathing. We did not review these walls during our site visit.

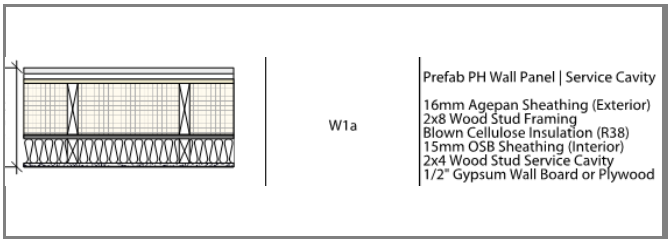


Figure 2.3

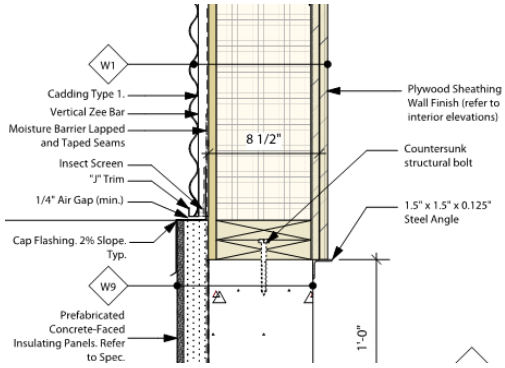
Premanufactured wall panel to exterior sheathing.

Interior OSB taped for vapour resistance and air-tightness

The wall assembly at the Apparatus Bay was built on site with 2x8 wood stud framing extending to the top of the parapet. The Ampatop sheathing membrane acts as the moisture resistive barrier, refer to Table 2.1.

It is our understanding that the interior OSB sheathing was intended to form the vapour retarder and air barrier for the wall assembly, however we understand that the joints in the OSB were not taped during construction and plywood sheathing was used along the top of the wall due to product availability.

TABLE 2.1 AGEPAN WALL ASSEMBLY AT APPARATUS BAY

Metal Clad Agepan Walls	Confirmed by Exploratory Openings
	**Exterior** ⇢ Corrugated metal cladding ⇢ Vertical metal Z-girts ⇢ Ampatop Aero sheathing membrane (WRB) ⇢ 16mm Agepan T&G sheathing ⇢ 2x8 Wood framing ⇢ Mineral wool insulation ⇢ OSB/plywood sheathing (AB/VR) ⇢ Gypsum wall board/plywood **Interior**
	

2.2.1 Observations

Key visual observations noted during the site investigation related to the walls include:

- Based on our review of the field installation, the air barrier strategy is not clear. The exterior sheathing membrane is discontinuous at numerous locations including penetrations, storage shed roof ledger and base of wall, refer to Figure 2.4.

Figure 2.4

The sheathing membrane terminates at the underside of the roof ledger in the unheated storage room.

- The interior sheathing air barrier/vapour retarder is not continuous. The interior sheathing is scheduled to act as the vapour retarder and we understand taped to be the primary air barrier. Several discontinuities in the OSB/plywood sheathing were observed including:
  - joints in the OSB or plywood sheathing were not sealed
  - penetrations through the sheathing such as interior outlets and fixtures were not sealed to the OSB
  - the base of wall transition to the concrete foundation was not sealed, refer to Figure 2.5.

We understand that plywood sheathing was used in place of the OSB in portions of the wall area. Plywood does not provide the same vapour resistance at OSB and even less when damp.

Figure 2.5

Smoke was injected into the wall through the two interior electrical outlets in the north wall of the Apparatus Bay. Smoke was observed streaming out the base of wall joint.

→ The seal between the exterior water resistive barrier sheathing membrane and wall penetrations is inconsistent. We found several penetrations including roof scuppers and electrical wiring through the sheathing membrane that were not sealed, refer to Figure 2.6. Deficiencies were identified when the wall cladding was removed at exterior opening locations. Based on the widespread pattern of wetting at the top half of the wall along the North elevation these deficiencies have not likely contributed to the moisture issues due rain water leakage, however are recommended to be properly sealed to reduce this risk.

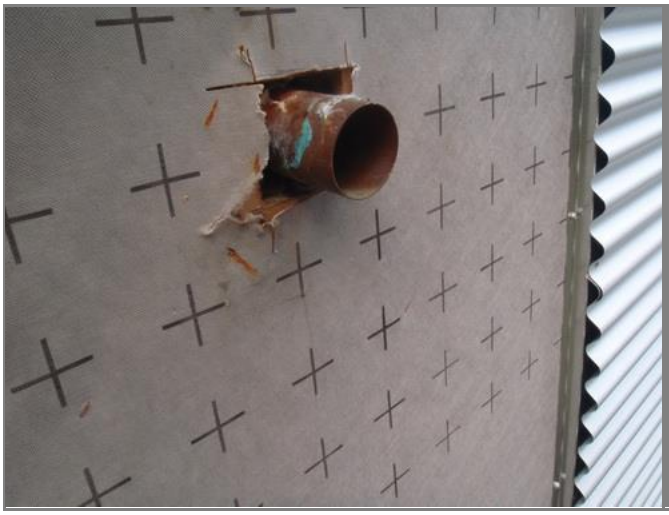


Figure 2.6

Sheathing membrane that forms the water resistive barrier not sealed to penetrations.

→ Testing uncovered that the Ampatop water resistive barrier is not fully sealed to the foundation wall. Smoke was injected into the interior outlet opposite the unheated storage area using a Rosco 1900 fog machine. The smoke was forced into the wall with an in-line fan in the smoke tube. Smoke was observed streaming out of the base of wall in the exterior storage room, refer to Figure 2.7. The smoke identifies potential air leakage paths indicating that the interior sheathing (air barrier/vapour retarder) has not been connected to the base of wall. Air leakage across the wall can also draw moisture laden air into the wall.

Figure 2.7

Smoke was observed streaming out the base of wall joint within the unheated storage room when smoke was injected into the wall through an interior electrical outlet.

→ Black staining which appears to be fungal growth on the inboard side of the Agepan was observed at the top and bottom of the samples removed in the exploratory openings. Even in the lower wall areas with low moisture content in the wood components there was some staining observed, refer to Figure 2.8.

Figure 2.8

Black staining on the inboard side of the Agepan. Sample taken from lower portion of wall.

→ We performed smoke testing of the wall assembly at targeted locations including the two interior electrical outlets at the base of the wall. Smoke was injected past the outlet using a Rosco 1900 fog machine. No pressure differential was imposed on the wall other than ambient weather conditions. The smoke was forced into the wall with an inline fan within the 4 inch smoke tube. When smoke was inject past the interior outlet at Gridline 1/C smoke was observed in the stud cavity above the unheated storage room, refer to Figure 2.9.

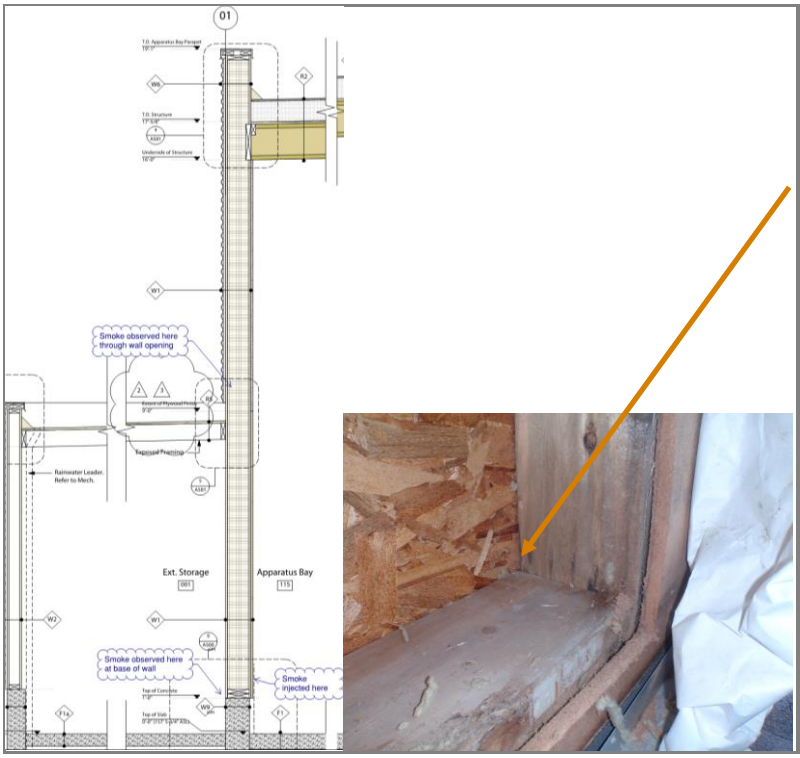


Figure 2.9

Small amount of smoke observed at the blocking in the stud wall above the storage roof during the smoke test at the interior outlet below.

View from the exterior opening above the unheated storage room.

→ Significant black staining/fungal growth within the stud cavity was observed at Exploratory Opening 1, refer to Figure 2.10 below in Section 2.3.

2.3 Exterior Exploratory Openings

During our site visit on May 01 2017, IWCD made 5 openings through the exterior cladding and water resistive barrier to view the condition of the Agepan Sheathing and the stud cavity. One opening above the unheated storage was already made prior to our site visit. The following observations were made at each opening.

2.3.1 Opening 1 (Previously made by IWCD)

Opening 1 was made by IWCD prior to our site visit and as a result of staining observed at the base of wall below the opening. IWCD indicated that wet insulation and studs were observed when the wall assembly was opened up.

Figure 2.10 Opening 1

Top of wall GL1/C

Opening made prior to site visit.

Heavy staining outboard edge of wall studs.

Fungal growth on roof ledger

Staining on outboard face of insulation.

2.3.2 Opening 2

This exploratory opening was made by IWCD during our site visit. The opening was made at the parapet height near the roof level interface. We observed moisture droplets on the face of the mineral wool insulation. The moisture content in the plywood sheathing on the inside face of the parapet was found to be 40% indicating the wood is saturated. The majority of the parapet plywood would be cold due to the uninsulated inside parapet face above the roof level.

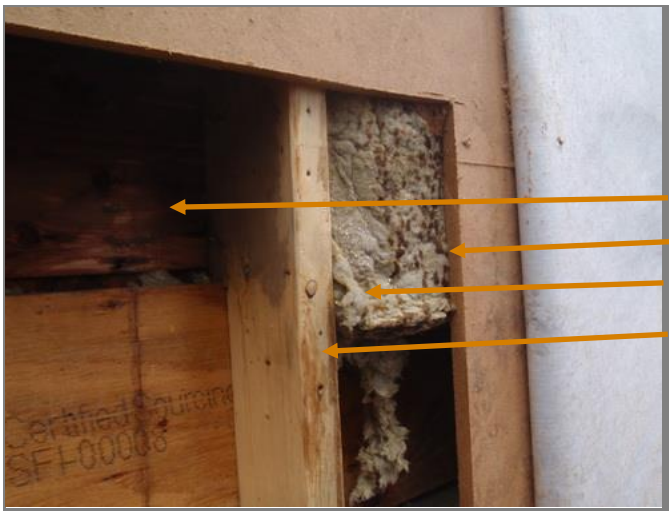


Figure 2.11 Opening 2
Top of wall GL 1/G
Moisture Content Readings
40% MC plywood at parapet
40% MC back side of Agepan
Wet insulation
25% MC outboard face of stud

2.3.3 Opening 3

This exploratory opening was made by IWCD during our site visit located directly below opening 2 at the base of the wall. We found that the insulation was dry at this location along with the other wood wall components. We observed staining on the backside of the Agepan sheathing.

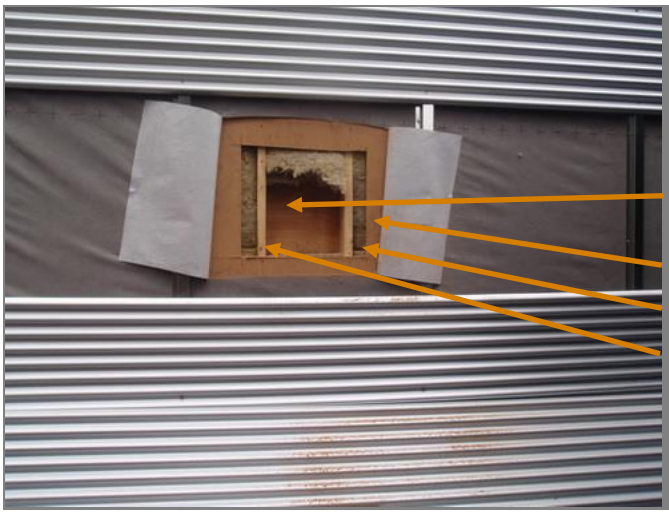


Figure 2.12 Opening 3
bottom of wall GL 1/G
Moisture Content Readings
10% MC plywood interior sheathing
20% MC back side of Agepan
dry insulation
17% MC outboard face of stud

2.3.4 Opening 4

This exploratory opening was made by IWCD during our site visit directly below opening 1 inside the unheated storage room. We found that the insulation was dry at this location along with the other wood wall components. We observed staining on the backside of the Agepan sheathing.

Figure 2.13 Opening 4
bottom of wall GL 1/D
Moisture Content Readings
10% MC OSB interior sheathing
20% MC back side of Agepan
dry insulation
17% MC outboard face of stud

2.3.5 Opening 5

Opening 5 was made by IWCD during our site visit above the level 2 roof deck. We found the face of the mineral wool insulation to be damp. The moisture content in the plywood sheathing on the inside face of the parapet was found to be 30%. Staining was observed on the plywood sheathing. The back side of the Agepan was also found to be wet and stained.

Figure 2.14 Opening 5
Top of wall GL 4/B
Moisture Content Readings
30% MC plywood at parapet
35% MC back side of Agepan
Damp insulation
22% MC outboard face of stud

2.3.6 Opening 6

This exploratory opening was made by IWCD during our site visit directly below opening 5 above the level 2 roof deck. We found that the insulation was dry at this location along with the other wood wall components. We observed staining on the backside of the Agepan sheathing.

Figure 2.15 Opening 6

Bottom of wall GL 4/B above roof deck.

Moisture Content Readings

19% MC plywood interior sheathing

20% MC back side of Agepan

dry insulation

2.4 Discussion and Recommendations

Our recommendations are based on a combination of factors including a review of design drawings and other available documentation, information collected at the building through visual observations and exploratory openings. The recommendations below are summarized to provide you with a general understanding of the repair scope recommendations.

During the investigation, RDH performed smoke testing of the wall assembly at specific locations to help identify potential discontinuities in the air barrier (also functioning as vapour retarder). Based on our observations it is clear that continuity of an effective air barrier using the interior OSB has not been achieved in the North wall of the Apparatus Bay during construction. Furthermore, we observed numerous unsealed penetrations in the Ampatop water resistive barrier.

The high moisture content found along the top half of the wall does not appear to be caused solely by the discontinuities in the air and vapour barrier. We understand that the construction of the Apparatus Bay occurred during the winter months and was exposed to inclement weather before being covered. In combination with the unheated Apparatus Bay, latent construction moisture in the stud cavity is condensing on cold surfaces, mainly the parapet and has not dried out and is collecting in the upper wall leading to staining and fungal growth on the wet wood materials.

Varying levels of staining and fungal growth on the in-board side of the Agepan was identified at all exploratory openings indicating there was moisture accumulation to some degree across the entire wall area. The moisture has now accumulated at the top of the wall condensing on the inboard side of the Agepan sheathing and parapet sheathing, refer to Figure 2.16.

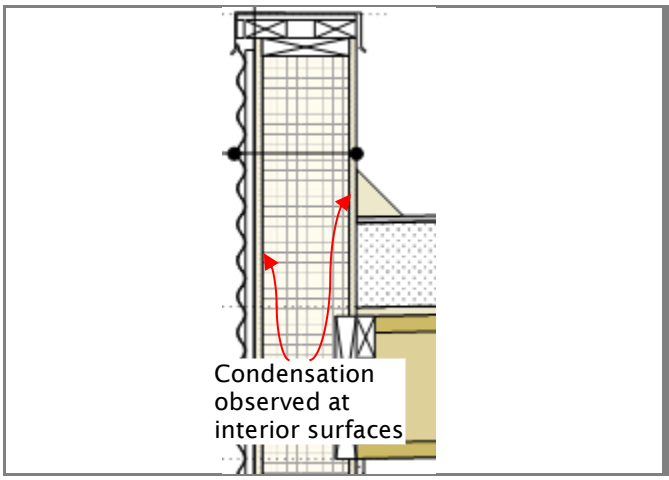


Figure 2.16

Typical locations at top of wall and parapet sheathing that were consistently found to have high moisture content.

If the construction moisture was to be dried out there is still be potential for air leakage into and through the wall due to deficiencies in the air barrier system. Uncontrolled air leakage from inside the Apparatus Bay into the wall cavity could lead to continued high moisture content in the wall assembly.

There are several existing conditions that should be addressed when developing a repair strategy. We have listed these recommendations below.

- → The wall needs to be dried out.
- → The fungal growth should be cleaned/removed from affected materials.
- → Provide a continuous air barrier system within the apparatus bay walls and interfaces to the adjacent assemblies such as foundation wall and adjacent fire hall walls. Including provisions to reduce convective looping into cold parapet spaces.
- → Review and provide appropriate vapour control strategy for the apparatus bay wall.

To address the problematic existing conditions as noted above and correct the deficiencies found during our site visit we recommend the following repair concepts be considered. We have prioritized the repair steps into phases.

Phase 1

The first phase of the repair process should be implemented immediately for the best chance to avoid the conditions in the walls worsening. The repair phase concepts are listed as follows:

- → Dry out the wall.
  - → At the Apparatus Bay walls remove at least the top 6 feet of cladding, Agepan sheathing, and insulation to dry out the interior stud cavity.
  - → Clean and treat all fungal growth from within the wall cavity and dispose or clean all Agepan sheathing with existing staining or fungal growth.
- → Correct air barrier discontinuities and provide vapour control.
  - → Seal penetrations through the interior wall finishes including outlets and fixtures. This can potentially be performed from the exterior side of the interior sheathing or at the interior of the Appartus bay space by sealing the sheathing .

- → Seal the joint between the interior wall finish and the concrete foundation (joint currently covered by a metal closure).
- → Install a vapour retarder paint on to the surface of the interior plywood and gypsum wall finish to achieve a wet cup vapour permeance of 60ng/(Pa·s·m^2) or less to reduce amount of moisture that is able to diffuse into the wall cavity given the expected operating conditions and humidity within the Apparatus Bay.

→ It would also be prudent to install moisture sensors within the wall to monitor the performance over time. Install sensors at the top and select locations at the bottom of the wall and connect to a centralized logging apparatus.

→ Add air-sealed horizontal blocking in the wall cavity to separate the parapet from the wall cavity.

→ Install passive vents into the parapet space venting into the rain screen cavity behind the metal cladding.

→ Ensure continuity of the wall air barrier in the ceiling space. This may require sealing the OSB interior sheathing joints from the interior by removing interior finishes, or from the exterior at the roof ledger area when the cladding is removed.

→ Re-install exterior wall sheathing. If the Agepan is damaged we recommend it be replaced with a more vapour open and moisture resistant exterior grade sheathing such as Densglass exterior gypsum sheathing.

→ Reinstate the sheathing membrane as the water resistive barrier. We suggest sealing the sheathing membrane to be airtight.

- → Tape all joints in the membrane.
- → Seal terminations and membrane transitions to other substrates.
- → Ensure continuity of the membrane and seal all penetrations.
- → Seal all joints in the unheated storage room roof ledger attached to the Apparatus Bay wall. Seal the ledger to the water resistive barrier sheathing membrane.

→ Re install the cladding and support framing.

→ We recommend that the interior humidity be monitored during operation of the building.

Phase 2

This phase should be considered if high moisture levels persist in the exterior walls of the Apparatus Bay.

→ Remove cladding to further investigate conditions. This may involve additional air leakage testing and smoke testing.

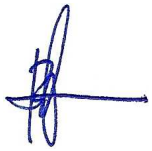
→ To control high humidity within the Apparatus Bay, consider integrating a humidistat control with the ambulance fume exhaust fan, or other means of mechanical ventilation. Make-up air should be provided at the same time.

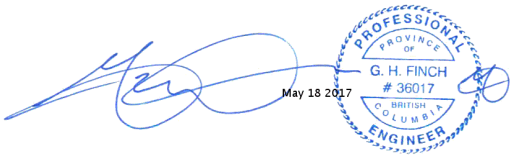
2.5 Next Steps

Additional detail and materials could be provided if desired. We would be happy to work with you to help develop alternative ways of addressing existing problems and assist you in making decisions with respect to specifics of the repair program. We are also available to undertake periodic field review of construction as the work proceeds as well as installing moisture sensors and equipment to monitor the ongoing performance of the wall.

If you wish to discuss any part of this report please do not hesitate to contact us.

Yours truly,





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