e) terminate in a drip offset not less than 5 mm outward from the outer face of the *building* element below.

In addition, there is no bottom flashing at the window sills in violation of the Alberta Building Code (figure 43).

Fig. 42: Head flashing for windows are simply caulked to the metal siding.
Fig. 43: There is no sill flashing in this window.

An illustration of a flashing, which is inserted upward behind the cladding and an end dam detail that complies with the Alberta Building Code is shown in figure 44.

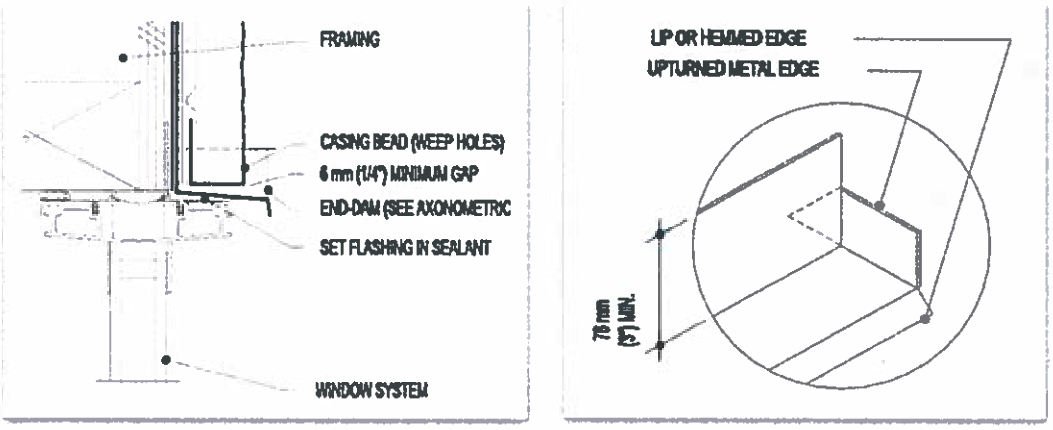


Fig. 44: End dam for window head. Note also that the flashing drip edge extends far away from the wall.

There are specific flashing installation requirements such as minimum projection beyond the cladding, minimum slope, end dams, etc. that are not adhered to at many locations. Article 9.21.4.10.1) of the Alberta Building Code, entitled Flashing, states:

> Junctions with adjacent materials shall be adequately flashed to shed water.

Article 9.20.13.7.1) of the Alberta Building Code, entitled Flashing Joints, states:

> Joints in flashing shall be made watertight.

Article 9.27.3.8.4) of the Alberta Building Code, entitled Flashing Installation, states:

> Flashing described in Sentences (1) and (3) shall
>
> a) extend not less than 50 mm upward inboard of the sheathing membrane or sheathing installed in lieu of the sheathing membrane (see Article 9.27.3.4.),
> b) have a slope of not less than 6% toward the exterior after the expected shrinkage of the *building* frame,
> c) terminate at each end with an end-dam
>   i) with a height in millimetres not less than 25 mm or 1/10 the value of the 1-in-5 driving rain wind pressure in Pa, and
>   ii) at the height defined in Subclause (c)(i), extending to the face of the adjacent cladding,
> d) lap not less than 10 mm vertically over the *building* element below, and
> e) terminate in a drip offset not less than 5 mm outward from the outer face of the *building* element below.

Penetrations such as outdoor electrical receptacles must be sealed to prevent water intrusion. However, the opening for the receptacle is only caulked and the caulking is deteriorating (figure 45). Both head and bottom flashing on the electrical outlet are required (see example in figure 46).

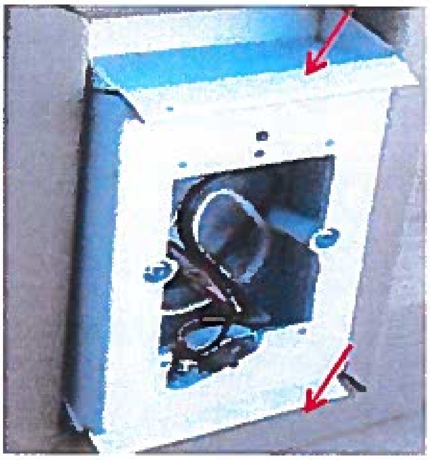
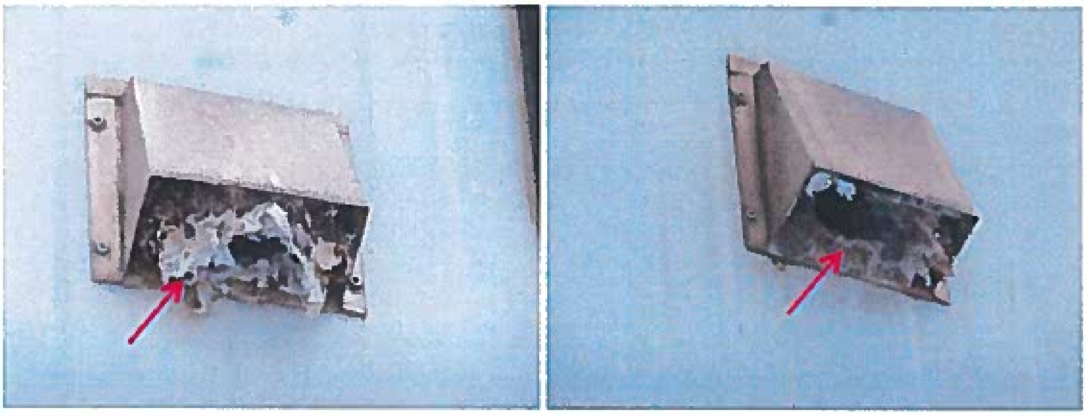



Fig. 45: Caulking cannot reliably prevent water intrusion at electrical outlet.
Fig. 46: Example of proper flashing installation above and below electrical outlet.

Penetrations such as dryer vent hoods must also be installed with proper flashing. These vent hoods are merely attached to the metal siding and they do not maintain a weather-tight seal (figures 47 and 48).

The accumulation of lint on these dryer vent hoods has constricted effective airflow. Back pressure can force the moist air into the building enclosure to cause interstitial condensation and damage within the wall. Cleaning the vents is part of proper maintenance.



Figs. 47 & 48: Clothes dryer exhaust hood is restricted by lint accumulation.

Due to differential movement between modules, the roofing membrane and the metal wall cladding have buckled (figure 49). These locations will tear any seal and waterproofing of the building enclosure. The Alberta Building Code requires that assemblies are watertight. Article 5.6.2.1.(1) of the Alberta Building Code, entitled Sealing and Drainage, states:

> (See Appendix A.)
> Except as provided in Sentence (2), materials, components, assemblies, joints in materials, junctions between components and junctions between assemblies exposed to precipitation shall be
>
> a) sealed to prevent ingress of precipitation, or
> b) drained to direct precipitation to the exterior.
>
> A-5.6.2.1. Sealing and Drainage
> Providing a surface-sealed, durable, watertight cover on the outside of a building is difficult. Where there is a likelihood of some penetration by precipitation into a component or assembly, drainage is generally required to direct the moisture to the exterior.

Fig. 49: Warping at connection between modules causes ruptures in the roofing membrane and metal siding to allow air and water leaks.
Fig. 50: Standing water on the roof is non-compliant to the Alberta Building Code.

4.3.3.3 Roof Defects

Water penetrations into the building are caused by defects in the design, lack of provision to accommodate building movements, or by improper installation of waterproofing on the roof. Standing water is seen throughout these buildings (figure 50) as shown elsewhere in this report.

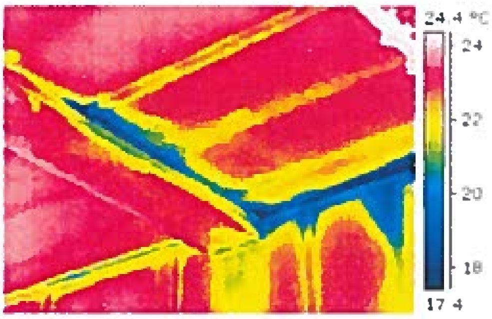
All roofs must slope toward a drain, scupper or eavestrough. There should be no standing water on the roof as is prevalent on these buildings. Article 9.26.3.1. of the Alberta Building Code, entitled Slope, states the following:

1) Except as provided in Sentences (2) and (3), the slopes on which roof coverings may be applied shall conform to Table 9.26.3.1.
2) Asphalt and gravel or coal tar and gravel roofs may be constructed with lower slopes than required in Sentence (1) when effective drainage is provided by roof drains located at the lowest points on the roofs.
3) Profiled metal roof cladding systems specifically designed for low-slope applications are permitted to be installed with lower slopes than required by Sentence (1), provided they are installed in conformance with the manufacturer's written recommendations.
4) Except where back-slope will not adversely affect adjacent supported or supporting constructions due to water ingress, roofs and constructions that effectively serve as roofs shall be constructed with sufficient slope away from
   a) exterior walls, and
   b) *guards* that are connected to the roof, or to a construction that effectively serves as a roof, by more than pickets or posts.

   (See A-9.26.1.1.(2), A-9.26.4.1. and A-9.27.3.8.(4) in Appendix A.)
5) The slope required by Sentence (4) shall be sufficient to maintain a positive slope
   a) after expected shrinkage of the *building* frame, where these surfaces are supported by exterior walls and exterior columns (see A-9.27.3.8.(4) in Appendix A), and
   b) once design loading is taken into consideration, where these surfaces are cantilevered from exterior walls.

In Table 9.26.3.1. of the Alberta Building Code, entitled Roofing Types and Slope Limits, that forms part of Sentence 9.26.3.1.(1), states that "Modified Bituminous Membranes, Cold application felt Asphalt or Coal-tar base roofing must have a minimum slope of 1:50." The roofs of these buildings with standing water do not conform to the Alberta Building Code.

Our thermographic scans also revealed many cold signatures along the junction beams where the modules are spliced together (figures 51 and 52). These cold signatures may indicate the presence of moisture. On the roof, these junctions are difficult to seal properly with roofing membrane. The membranes are often folded and thus gaps are created, which are prone to leaks (figures 53 and 54). A particularly difficult area to create a watertight roofing membrane is at the junctions (figures 55 and 56). Furthermore, differential movements between the modules from thermal expansion and contraction, as well as settlement and wind forces cause shifting at the junction that could tear the roof membrane.



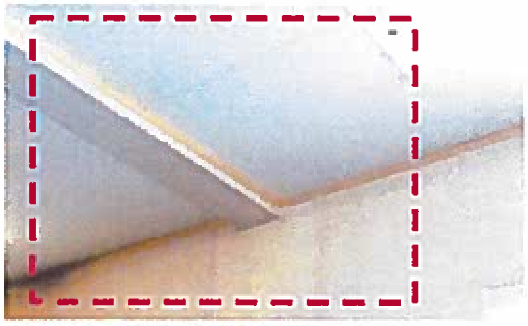
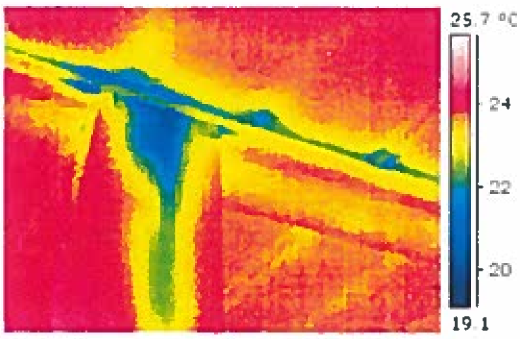


Fig. 51: Cold signatures along the junction beam and the wall-to-ceiling interface in the exercise room.



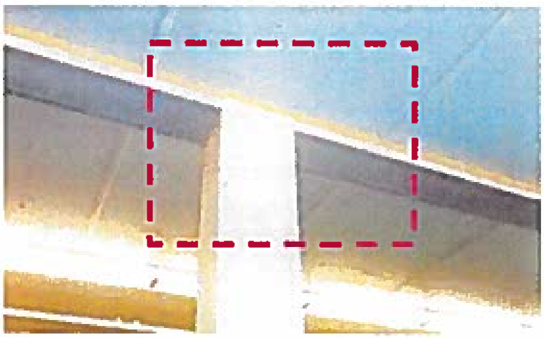


Fig. 52: Cold signature migrating down this column in the exercise room.

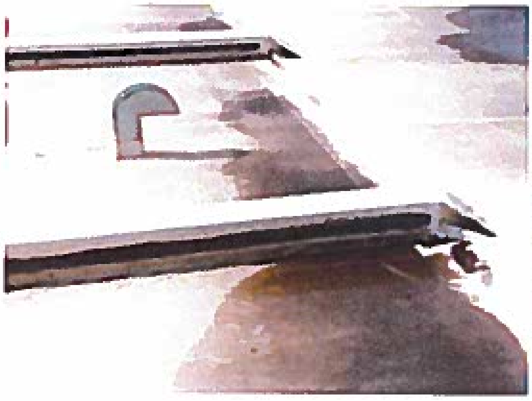



Fig. 53: Junctions between units are difficult to seal properly.
Fig. 54: Defects in the installation of the waterproofing have been patched.


Fig. 55: Folded roofing membrane at this junction is difficult to seal.
Fig. 56: Typical roof membrane junction between units. This detail may potentially cause roof leaks.

There are many roof penetrations through this waterproofing membrane (figure 57). Many of the roof penetrations for the pipes, wires and ducting rely on some type of sealant or caulking to attempt to maintain the integrity of the waterproofing (figure 58). Article 9.26.4.9. of the Alberta Building Code, entitled Roof Penetrations, states:

> 1) Where a pipe or duct penetrates a roof, the joint between the pipe or duct and the roof shall be flashed and be made watertight.

These penetrations may be the cause of cold signatures on the ceiling of the kitchen and other areas (figures 59 and 60).

Fig. 57: There are many penetrations through the waterproofing membrane.
Fig. 58: Most of the penetrations are simply sealed with caulking.

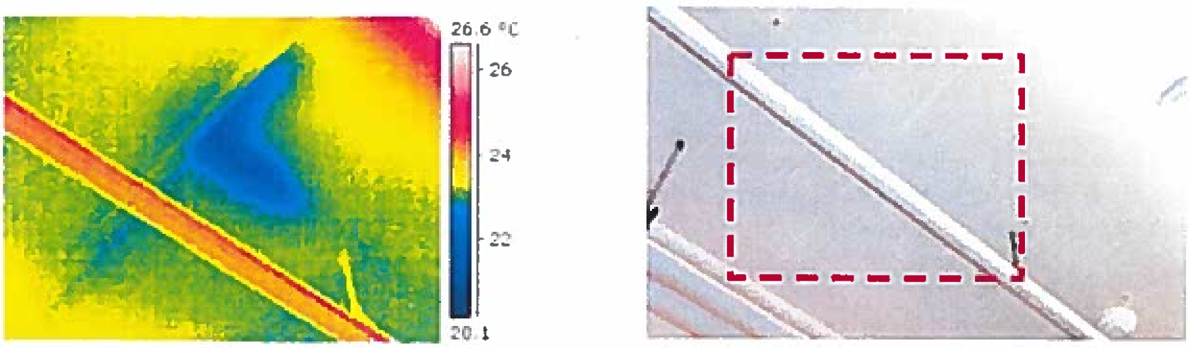


Fig. 59: Thermographic scan of the kitchen ceiling shows cold spots.

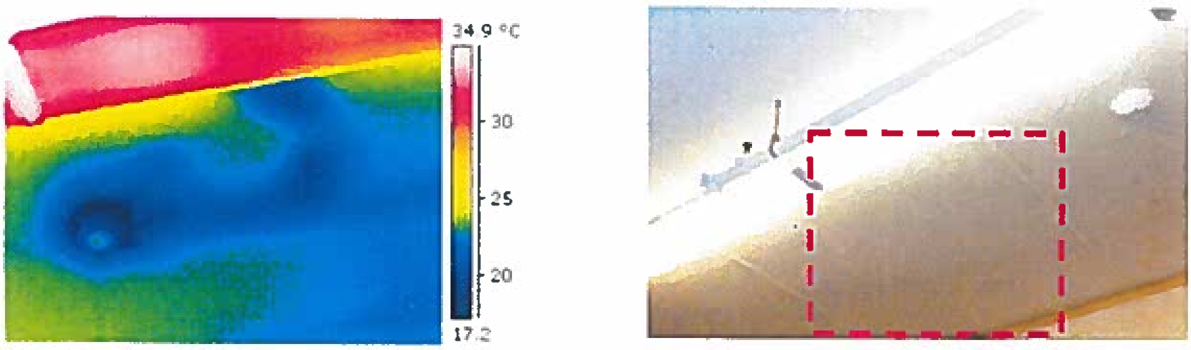


Fig. 60: More cold signatures on the kitchen ceiling.

On the roof, water accumulates at the junction between the wall of the raised lobby and the lower roof (figure 61). Wherever two modules are connected together with a raised roof parapet, it is difficult to seal the joint and this can be a source of the water leaks (figure 62). Possible faults in the roofing membrane were observed (figure 63).

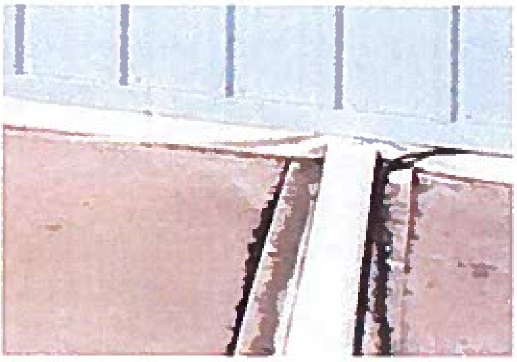


Fig. 61: Water accumulation at the junction between the lower roofs and the raised Front Lobby wall.
Fig. 62: Waterproofing this raised parapet junction is difficult.

Mud accumulating on the roof is caused by water ponding on the flat surface with no means of drainage (figure 64). Standing water is not permitted as all so-called flat roofs must slope to drain in accordance to the Alberta Building Code.

Article 5.6.2.2. of the Alberta Building Code, entitled Accumulation and Disposal, states:

1) Where water, snow or ice can accumulate on a *building*, provision shall be made to minimize the likelihood of hazardous conditions arising from such accumulation.
2) Where precipitation can accumulate on sloped or horizontal assemblies, provision shall be made for drainage conforming to the plumbing and drainage regulations made pursuant to the Safety Codes Act.

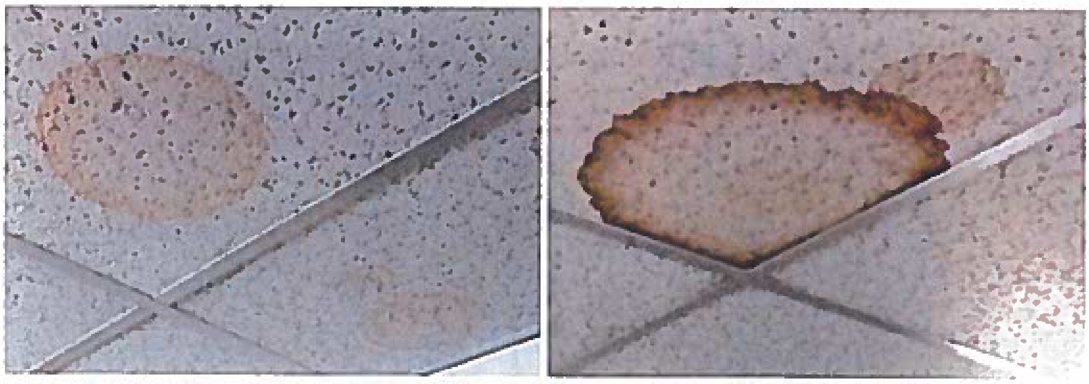
Fig. 63: Possible faults in the water-proof roofing membrane.
Fig. 64: Soil accumulation is the result of water ponding on the roof.

4.3.4 Water Intrusion

4.3.4.1 Water Staining on Ceilings

Despite the new roofing membrane, which was installed about 2 years ago, and recent replacement of all water stained ceiling tiles there are several new water stains on the ceilings of Wapasu Creek West, as well as some of the other buildings (figures 65, 66, 67 and 68). Some of the recent staining is caused by considerable amounts water entering from the roof (figure 69). Other stains are from leaks that occurred perhaps longer than one year ago without the ceiling tile being replaced (figures 70 and 71). It is obvious that these buildings have experienced water leaks for a long period of time. While most of the water stains have dried, several are still moist.

Figs. 65 & 66: Water staining on the ceiling of the corridors.



Figs. 67 & 68: Water staining spots on the ceiling.

Fig. 69: Considerable water has leaks onto ceiling tiles in this residential corridor.

Figs. 70 & 71: Older water stains on the ceiling.

Thermographic scans reveal evidence of moisture in the ceilings of these buildings. Leaks at the junction between the raised roof of the lobby and the lower portion of the building are discernible at the juncture between the front lobby and the main corridor (figures 72 and 73).

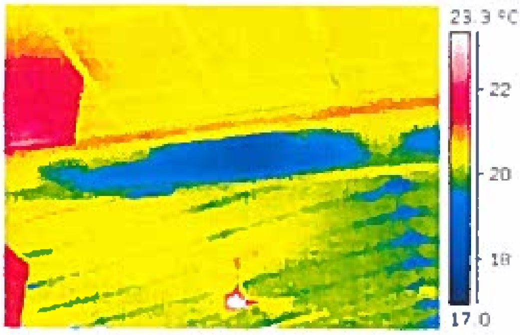
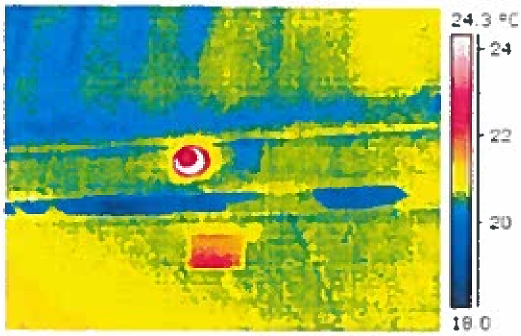


Fig. 72: Moisture above this beam in the front lobby.



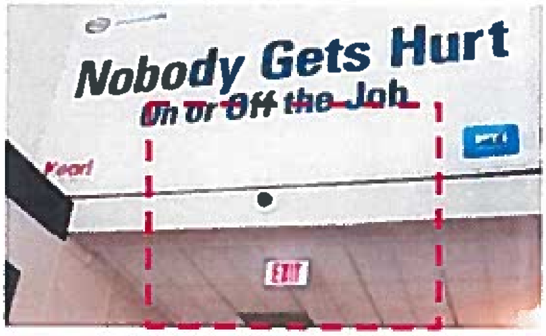


Fig. 73: Moisture along the same beam in the main corridor.

A bucket to catch the water had been placed under the drip and a caution sign was set next to it (figures 74 and 75). A bucket was also required in the front office of the lobby (figure 76). Roof leaks were discovered in additional areas of the corridors and towels were placed there to absorb the water (figure 77).

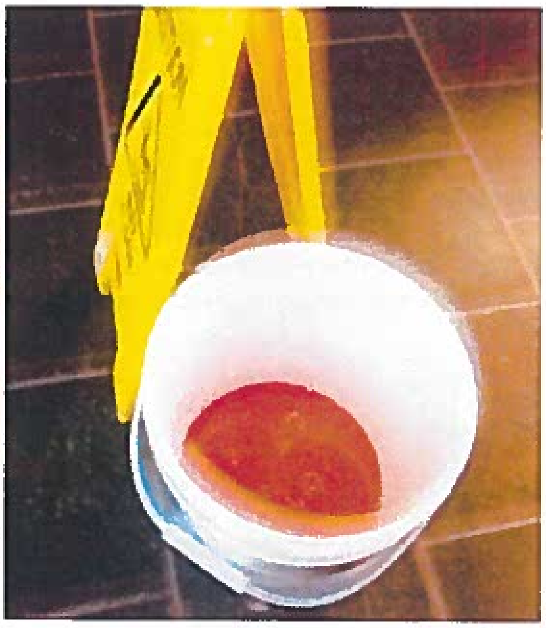
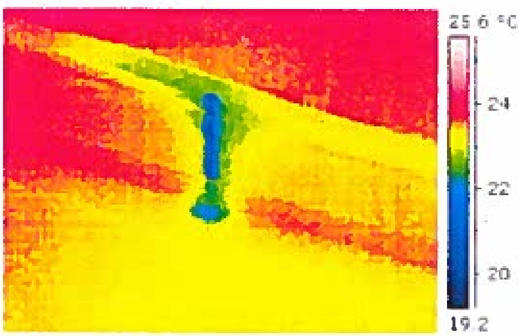


Fig. 74: Dripping water in the main corridor requires a bucket and caution sign.
Fig. 75: Water accumulating in the bucket.

Fig. 76: Bucket collects water dripping from a module junction beam in the front office.
Fig. 77: Towels soak up roof leaks at other locations.

Thermographic scans in the front office indicate that other areas of the beam that separates the two-storey lobby from the remainder of the building are exhibiting water accumulation that is beginning to drip down (figure 78). Although we could not open up these areas to verify the moisture in these anomalous cold signatures, a non-invasive moisture meter was used to verify that some of these areas are wet. Cold spots are showing up directly underneath the junction beam in the front office (figure 79). At one end of the beam, a cold signature is apparent and likely the result of water accumulation (figure 80).



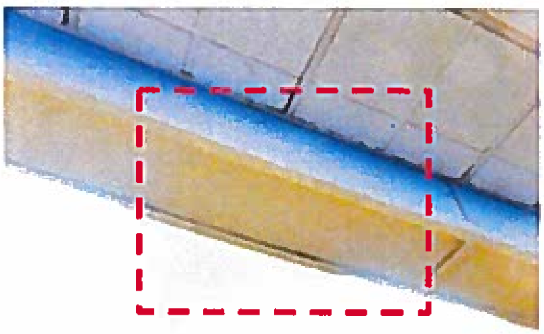


Fig. 78: This long vertical cold spot is likely water running down to the bottom of the beam.

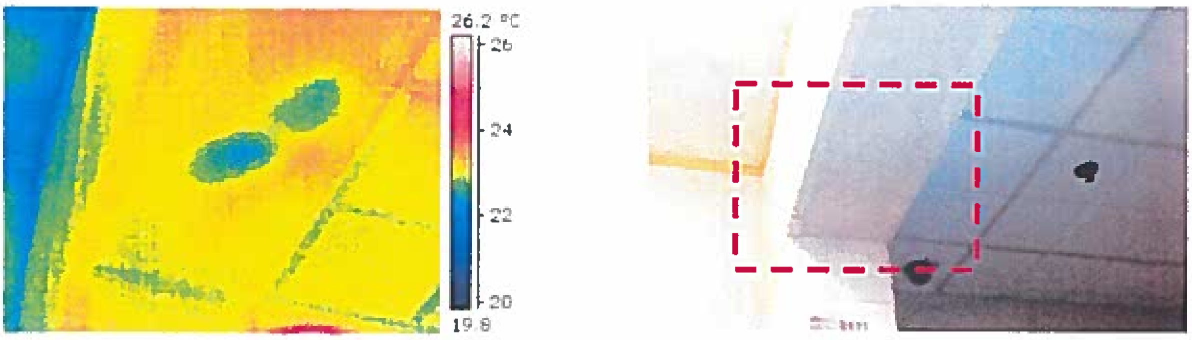


Fig. 79: Two cold spots on the underside of the beam due to moisture.

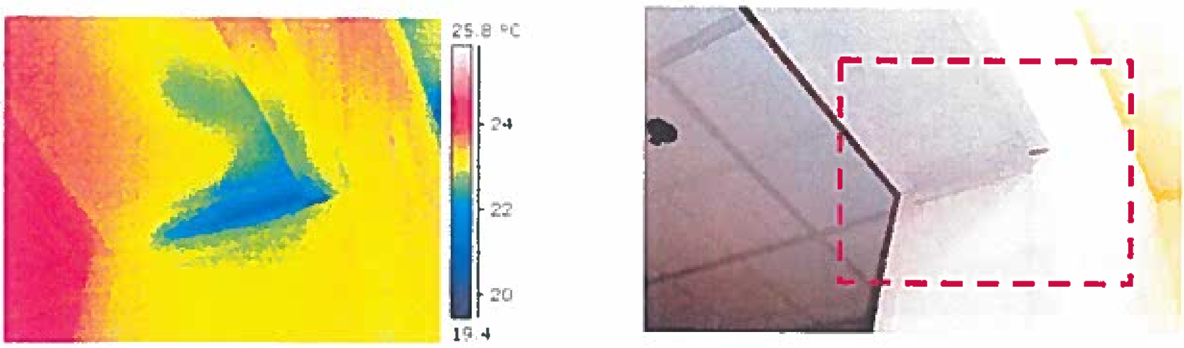


Fig. 80: The end of the beam is showing moisture accumulation.

Considerable areas with cold signatures were noted on the back ceiling of the front office (figure 81) and in one corner (figure 82). Visible water streaking on the wall at this location is evidence of water leaking down in the past (figure 83).

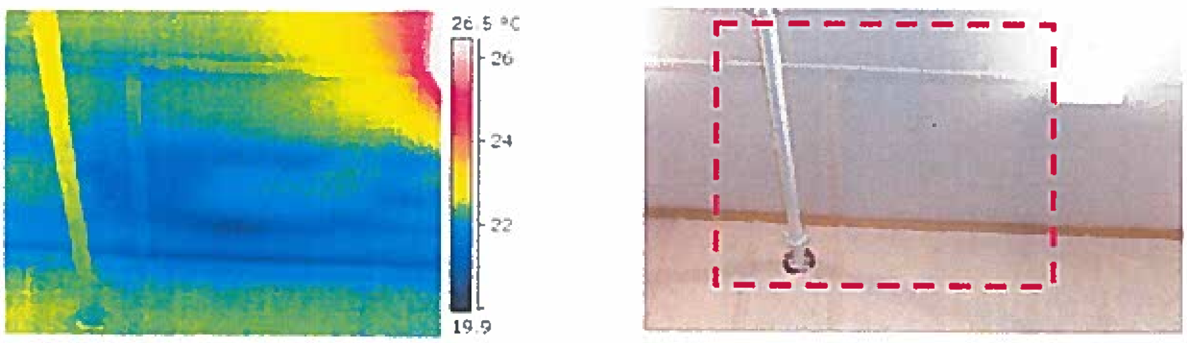


Fig. 81: Ceiling at rear wall of the front office.

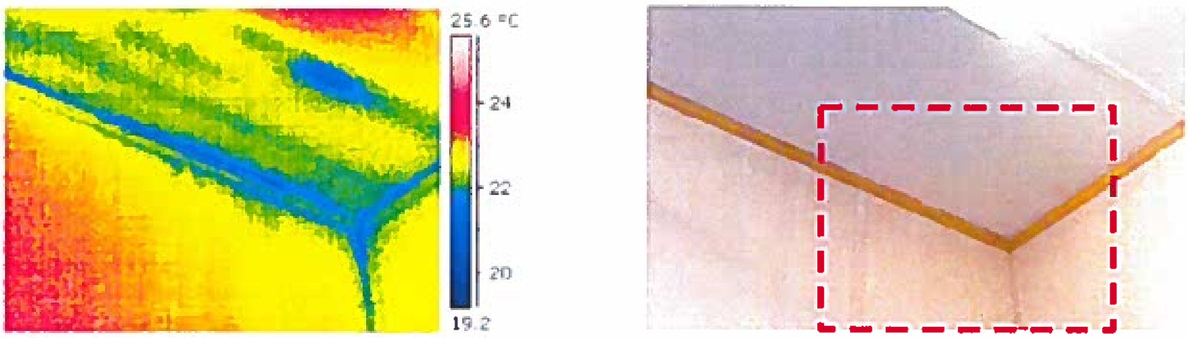


Fig. 82: Cold signatures found in the ceiling of the rear front office.

Fig. 83: Water streaks on the wall are evidence of past water leaks.

The security office adjacent to the front office is also showing signs of moisture in the ceiling (figure 84). A large cold spot is noted in another corner of this office (figure 85). The adjacent conference room also has evidence of cold spots (figure 86). As mentioned above, some of the cold signatures have been verified with a moisture meter. However, several areas are also moist to touch and others are beginning to show signs of water staining.

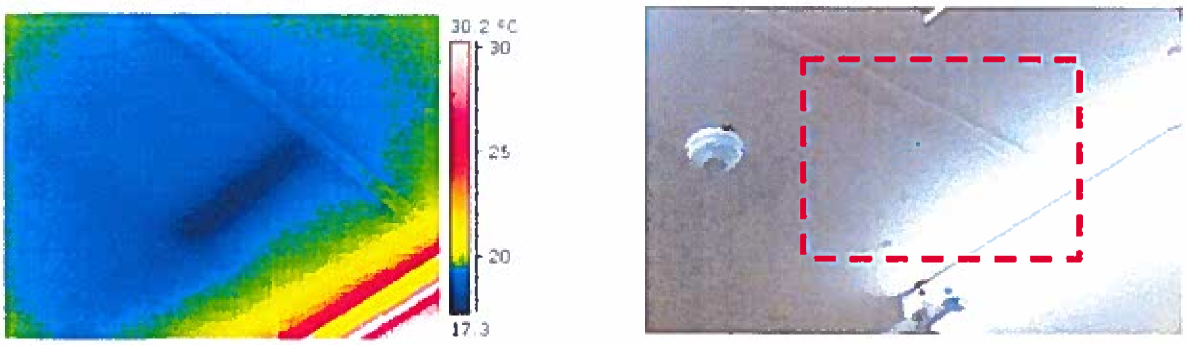


Fig. 84: Cold signature in the ceiling of the security office

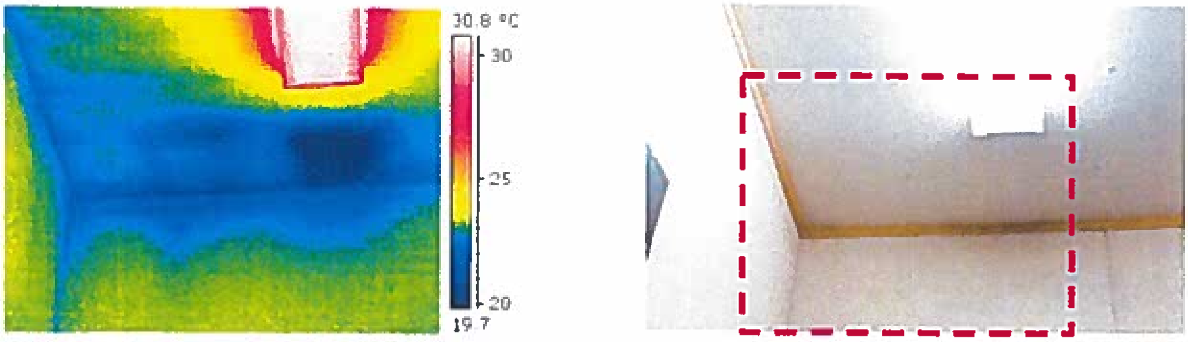


Fig. 85: Another cold signature in the corner of the security office

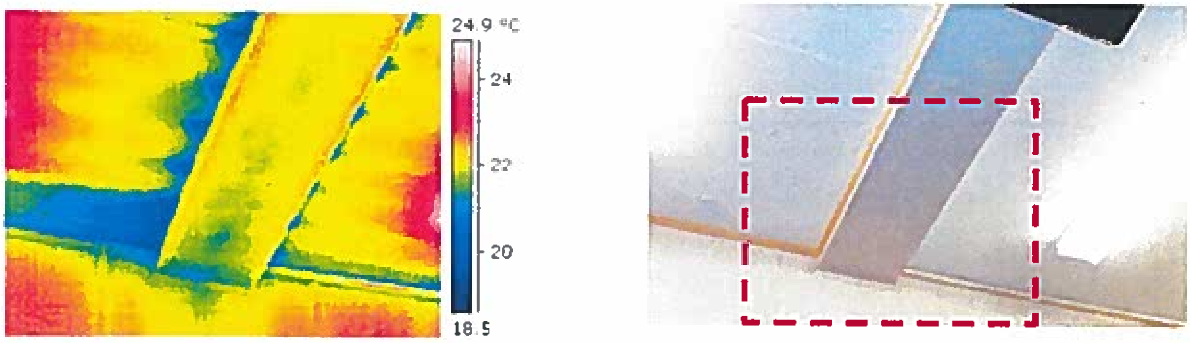


Fig. 86: Cold signatures in the ceiling of the Pahkismtahk (conference room).

Thermographic scans show many areas of the ceiling in other parts of the building with potential moisture that have not yet penetrated down onto the acoustic ceiling tiles (figure 87). It was reported that ceiling tiles in this building are frequently replaced due to water staining.

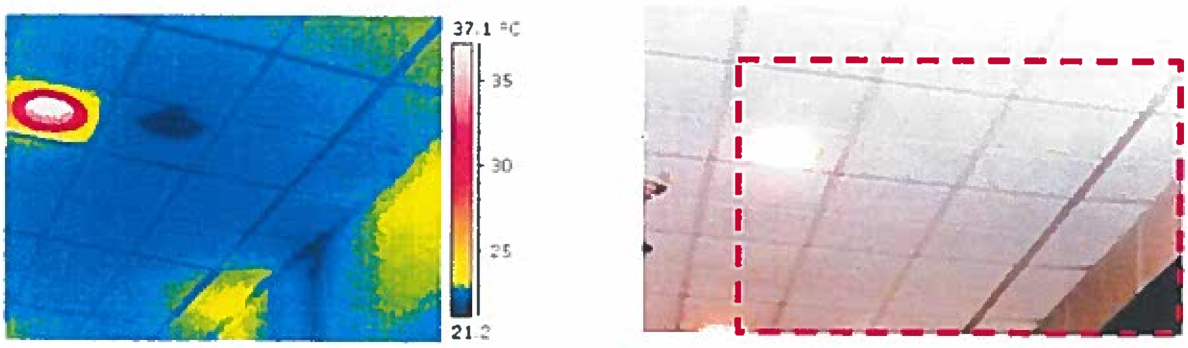
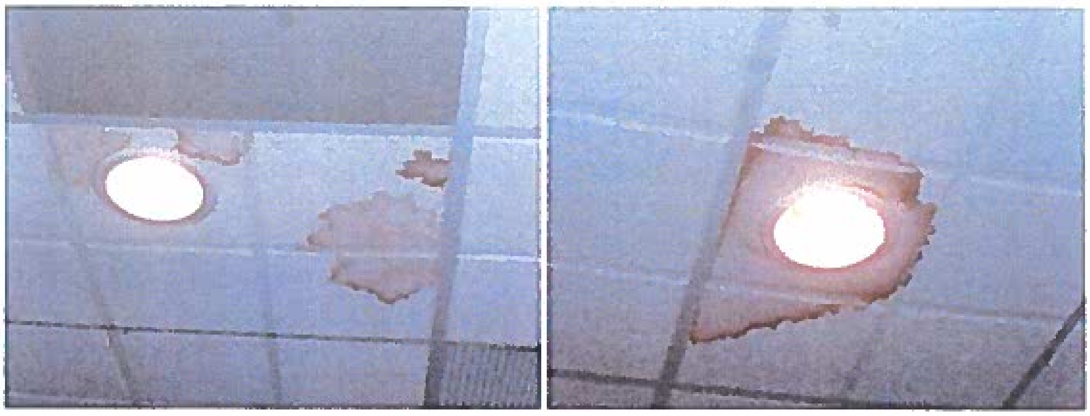


Fig. 87: A Water spot above this ceiling tile has not yet penetrated down.

Some water stains are at or very close to the ceiling lights (figures 88 and 89). Some of the water stains are near or on fluorescent lights (figures 90 and 91). Water on an electrical wire can cause an electrical short-circuit and potentially a fire. Water stains are also found around return air and supply air ceiling grilles (figures 92 and 93).



Figs. 88 & 89: Water staining near the lights can cause a short-circuit and fire.

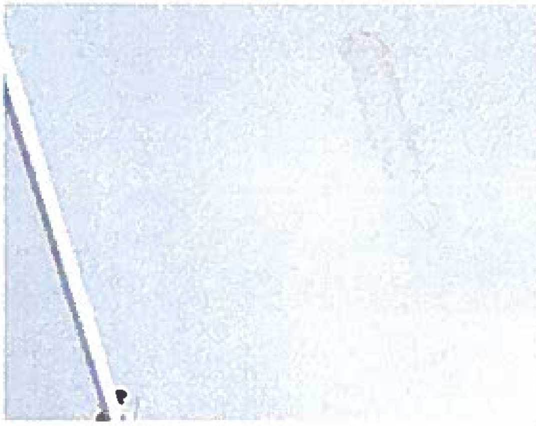
Figs. 90 & 91: Water staining close to electrical lights.


Fig. 92: Water stains around a return air grille.
Fig. 93: Water stains around a supply air registers in the ceiling.

There was a report of leaks from the sprinklers that may cause some of the water stains. However, although some stains are close to the sprinkler heads (figures 94 and 95), they are not necessarily caused by leaks in the sprinkler pipes.


Figs. 94 & 95: Water stains close to the sprinkler heads.

Even the sloped ceiling in the main lobby has evidence of water staining (figures 96 and 97). This may be the result of condensation in the attic due to inadequate attic ventilation.




Figs. 96 & 97: Water staining on the sloped ceiling of the main lobby.

4.3.4.2 Water Staining on Walls and Floors

As noted earlier, not only are water stains found on the ceiling, but they are also visible on some walls (figure 98) and floors (figure 99). The water can originate from the roof or from water penetration through walls. Due to building envelope deficiencies, the walls have defects that could be the source of some of these water leaks.

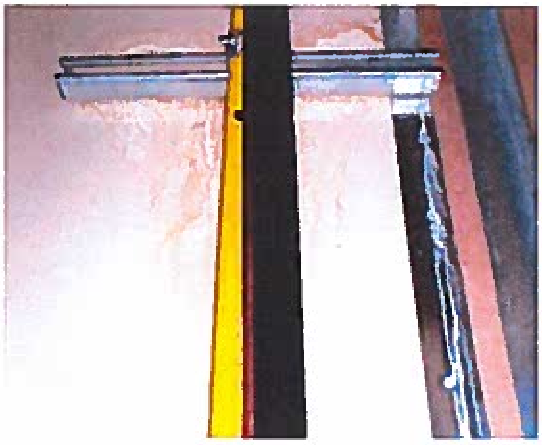



Fig. 98: Water staining on the walls.
Fig. 99: Water dripping down onto the floor and splashing or migrating to the adjacent wall.

4.3.5 Kitchen Hygiene

Dust is being drawn into the building, including into the kitchen, thus compromising hygiene, which can affect food safety. There is dust accumulating on the top of various equipment (figures 100 and 101).

Some of the dust is clearly visible and can be wiped off (figure 102). The top of walls and shelves as well as the contents are covered with a layer of dust (figure 103). Regular maintenance can remove the dust that is easily accessible, but hard to reach areas are less frequently cleaned.

Figs. 100 & 101: Dust on top of kitchen equipment.

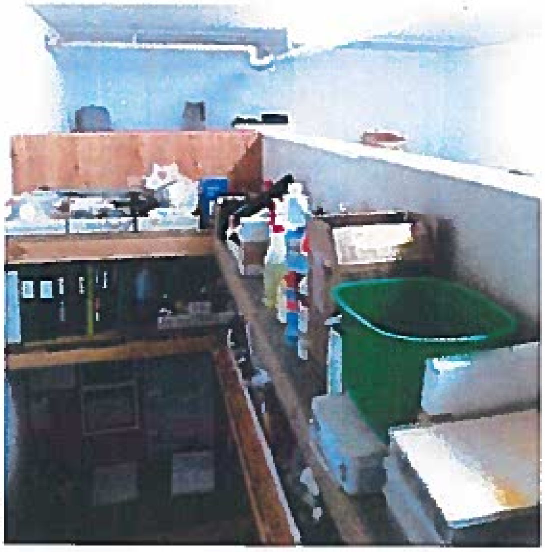


Fig. 102: Dust is clearly apparent on top of this kitchen unit.
Fig. 103: Dust is on top of this pony wall and also on the shelves.

The MUA supply grilles in the kitchen are visibly dirty (figures 104 and 105).


Figs. 104 and 105: Dirty air supply grilles in the Kitchen.

At Conklin Lodge, the kitchen staff has covered much of the stored goods with white cloth to keep the dust and insects off the stored food (figures 106, 107, 108 and 109).


Figs. 106 & 107: Kitchen staff cover packages of food.


Figs. 108 and 109: Insects are drawn into the kitchen as seen on top of these cover cloths and white plastic containers.

Food safety is a serious health concern and is also noted in article 10.5.1.8.1). of the Alberta Building Code, entitled Screens, states:

> A *building* used for eating, cooking or sleeping shall have screens over all doors, windows and other openings to the exterior to prevent the entrance of flies and other insects.

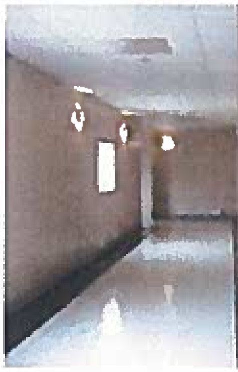
Section 9.32.3.13. of the Alberta Building Code entitled "Outdoor Intake and Exhaust Openings" states:

> 7) Air intake openings shall incorporate screens or grilles to protect against the entry of animals and insects.

4.3.6 Dust

Dust brought in from the outdoors on people's boots has been an ongoing problem. It was reported that at one time the dust in the air inside the buildings was so thick that visibility from one end of the corridor to the other was hindered. A few years ago building management put in place a 'boots off' policy at all of their lodges (figures 110, 111 and 112). Workers are now required to wash their boots at one of the boot washing machines located at the entrance or preferably to remove their boots and place them in a plastic bag that has been provided before entering the building (figure 113). The dust issue has improved, but it is not entirely solved. The 'boots off' policy is reported to be about 40% effective. Housekeeping staff must still vacuum the lobby entrance mats and wash the floors in the corridor several times per day to try to keep the dust at bay.

The actual content of the dust is unknown. It may contain silica, which is a health hazard (prolonged breathing of crystalline silica dust can cause silicosis and has been linked to lung cancer). Sand, rock and topsoil contain silica. The scale of industrial operations in the area that involve moving earth is large. Small respirable dust particles can also serve as vectors for other contaminants that might be attached. Diesel emissions contain fine particulates that can be drawn into the building through the air intakes or come into the building attached to other dust particles.



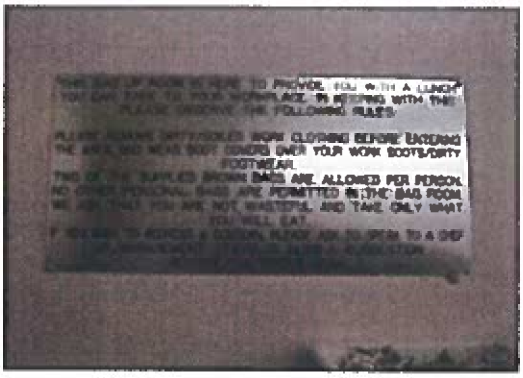


Fig. 110: Boots off sign posted.
Fig. 111: The second paragraph of this posted sign in the bag up room requests that dirty clothing and footwear be removed before entering.

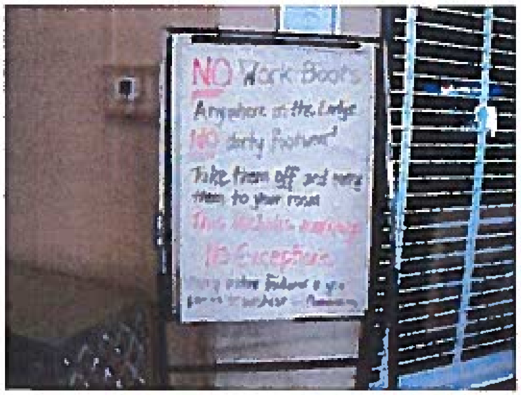


Fig. 112: No work boots posted sign.
Fig. 113: Boot washers located outside the door for use before entry.

There is dust throughout the building as can be seen in the dust build-up in the games room (figure 114). Air supply grilles to the room are very dusty as shown by the dust in the ceilings (figures 115 and 116). The return air grilles in the wall and ceiling are covered with dust (figure 117). Top of pipes and ceiling fans are also covered with dust (figures 118 and 119). Many of these locations are difficult to access and therefore receive less maintenance.

Fig. 114: Dust is visible on walls and columns inside this building.
Fig. 115: Dust on the ceiling is from the air supply.

Fig. 116: Visible dust on the ceilings emanates from the air supply to this room.
Fig. 117: This egg crate ceiling vent is covered with dust.

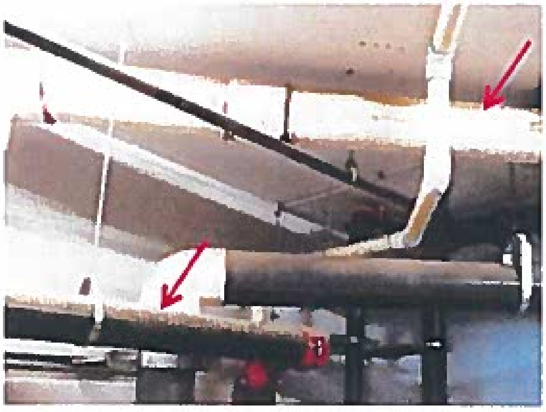
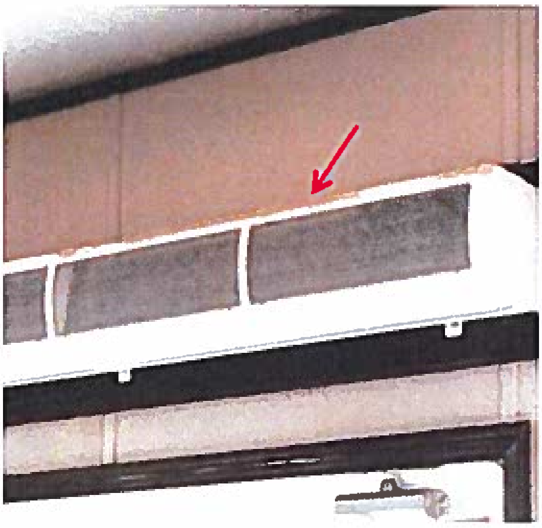


Fig. 118: Dust is found on top of pipes.
Fig. 119: Dust on ceiling fan.

Brown coloured dust can be clearly seen on top of the heater above the main entrance (figure 120). Dust is also visible on top of the ice-making machines in the wings (figure 121).



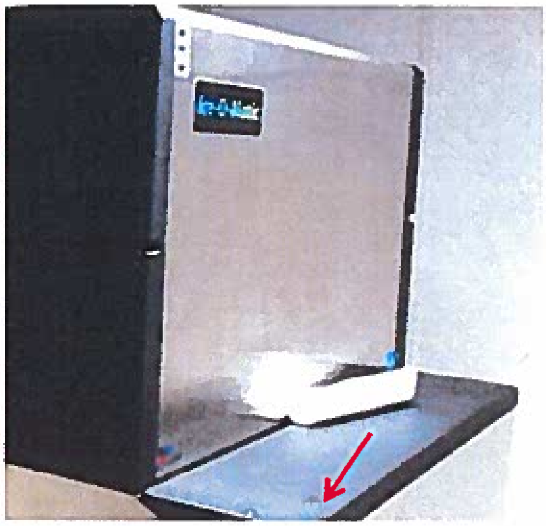


Fig. 120: Considerable dust on this space heater above the front entry door.
Fig. 121: Dust collecting on the ice-making machine in the residential wings.

4.4 Mechanical Systems Assessment

4.4.1 Furnaces

Each of the modules is heated by a natural gas fired forced air furnace. Some of the furnaces have chimneys (figure 122) while others are high efficiency models with PVC vents for flue gasses and drains for combustion condensate (figure 123). Some of the chimneys exhibit water leaks that are apparent in the flues (figure 124). Rust is clearly evident in this chimney flue. The water can rust through the metal chimney to allow flue gasses such as carbon monoxide into the building. Some of the space heaters also have water dripping down the metal chimney (figure 125).

Fig. 122: Furnace room in women's exercise room.
Fig. 123: Furnace room in the Lounge has a high efficiency furnace with no need for a chimney.

Fig. 124: Water leaking down the chimney of this furnace.
Fig. 125: Space heater chimney with water leaking down.

The furnace in the lounge is a combination of high efficiency heating and cooling unit. Water staining and rust on the bottom part of the furnace and the floor may be caused by water intrusion into the unit from the air intake duct (figure 126). The furnace room in the women's exercise room had experienced a water leak. Water may have leaked into the room through the conduit, which fitted the propane pipe and condenser lines to the roof (figure 127). Water leaked all the way down to the floor along the wall and mould grows on the drywall close to the floor (figure 128).

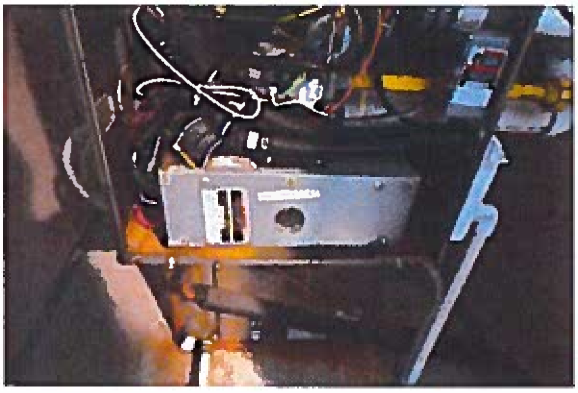


Fig. 126: Water stain and rust in the lounge furnace.
Fig. 127: Water leaked into the furnace room from through roof conduit.

Fig. 128: Mould grows on the drywall close to the floor.

Eight furnaces in Wing 47 were randomly selected and examined. Some of the furnaces were in fair condition and some were very dusty. There was dust and hair on the return air grille of some furnaces (figure 129). All furnaces were equipped with UV light on upstream airflow of the pleat filter to neutralize bacteria, viruses and mould particles (figure 130). The condition of the furnace filters was unknown, because we were denied access to examine them. All filters had been replaced on Feb. 14, 2015.

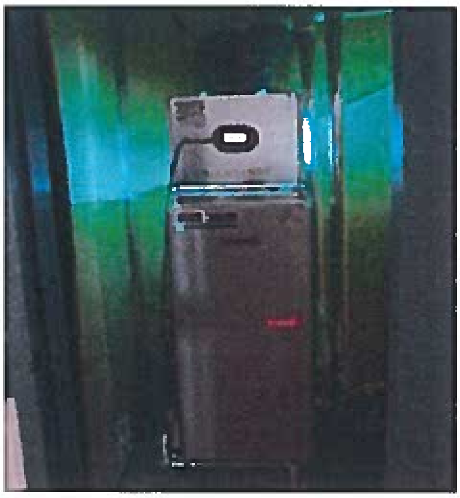


Fig. 129: Dust and hair on the return air grill on the furnace.
Fig. 130: Typical furnace in wing 47 with UV light.

In wing 45 the furnaces were without UV light. The configuration of the furnace rooms is different than wing 47: some consist of one furnace (figure 131) and some have two furnaces (figure 132), each furnace serving one guest room. In general, the floors in all furnace rooms were dirty and dusty (figure 133).

Fig. 131: The furnace without UV light in wing 45.
Fig. 132: Two furnaces share one furnace room in wing 45.
Fig. 133 : Dirty and dusty furnace room floor.

All pleated filters were replaced on March 03, 2015 regardless of their previous replacing schedule, which was taped on the furnace room door. Figure 134 shows the filter was replaced on September 28. Another furnace filter was replaced on December 5 (figure 135).

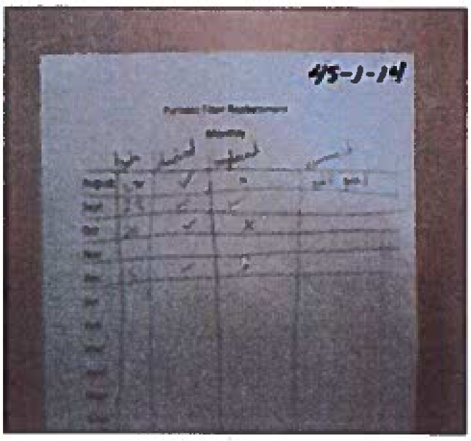


Figure 134: Furnace log show filter was replaced on Sept. 28th.
Figure 135: Furnace log show filter was replaced on Dec. 5th.

4.4.2 Air Intake

All natural gas fired furnaces require combustion air and an outdoor air supply for ventilation. The outdoor air is drawn in from an air intake hood installed on the wall outside of the furnace room. Due to snow drifting and shovelling of the pathways, snow is piled up against the wall where the air intake hood is located. Some air intake hoods are completely covered with snow (figures 136 and 137).

Fig. 136: The air intake hood at the back of photo is blocked with snow.
Fig. 137: Fresh air intake for this furnace is completely covered with snow.
Fig. 138: This damper air intake is completely blocked by snow.

Some of the vents with dampers are also blocked by snow, thus preventing any outside air to be drawn into the building (figure 138). This lack of air supply can compromise the efficiency of the furnace, or cause chimney backdrafting due to absence of combustion air (figure 139). Carbon monoxide build-up can occur due to negative air pressure differential caused by exhaust fans or wind flow and direction.


Fig. 139: Combustion air discharged onto the floor of the furnace room.
Fig. 140: Condensate is allowed to drain through a hole in the floor down into the crawlspace.

Combustion condensate from the furnace drains away through a hole in the floor (figures 140 and 141). The hole allows the condensate to discharge directly into the crawl space. High efficiency furnaces have considerably more condensate and those are also discharged directly down into the crawl space (figure 142). This water adds to the moisture in the crawl space increasing the potential for mould growth. The gaps around the floor penetration allow contaminated crawl space air to migrate up into the conditioned building through stack effect.


Fig. 141: Condensate drains down this hole in the floor of the furnace room.
Fig. 142: This high efficiency furnace has considerably more condensate, which is also discharged into the floor of the crawl space.

4.4.3 Ducting

There were considerable amounts of debris, grease, dust, food particles, etc. in the kitchen ductwork (figures 143 and 144). The debris is unsanitary as microorganism can grow inside these ducts (figure 145). Insects and rodents will find ample food in these ducts and may be nesting in them. Periodic maintenance is required to clean these ducts, but floor ducts are notorious for accumulating spills and debris. These air registers should be positioned on walls instead of the floor.

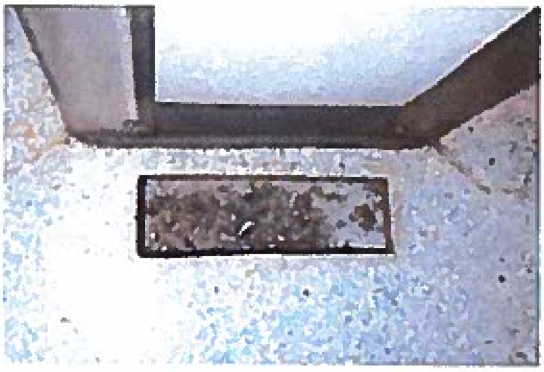


Fig. 143: Very dirty ducting inside the floor register.


Fig. 144: Dirty ducting underneath this floor register.
Fig. 145: Close-up of the debris in the ducting.

4.4.4 Rooftop Units

There are thirteen make-up air (MUAs) units located on the roof of Wapasu Creek West (figure 146). There are two types of MUA - one type only heats the incoming air as needed (figure 147), the other type is also equipped with an air conditioner coil so that it can either heat or cool the intake air (figure 148).

Fig. 146: Overview of the roof equipment

Fig. 147: Make-up air (MUA) unit for tempering the air intake
Fig. 148: MUA for tempering or cooling the air intake

The rooftop make-up air units are manufactured by Engineered Air, each drawing between 2,000 and 9,000 CFM (cubic foot per minute) into the building, mainly into the kitchen area. That equates to drawing 26,000 to 117,000 cubic feet of air from the surrounding area every minute through the thirteen units. With this suction power, ambient air in the immediate vicinity is drawn into the building complex including vehicle emissions from the loading docks, buses and other vehicles driving or idling nearby.

The filters being used in the MUA units are Minimum Efficiency Reporting Value Eight (MERV8) deep loading panel filters (figure 149). MERV8 filters will trap particle sizes between 3 to 10 microns such as mould spores at an efficiency of 70% to 85%. MERV8 filters will not trap PM2.5 particulates, diesel particulates, or smoke from forest fires.

According to the information from the maintenance technician, the filters in the MUA are replaced once every month in winter and once every two weeks after all the snow has melted. The replacement date was not marked on any filters. Most of the filters were very dirty and dusty (figure 150).

Fig. 149: Typical placement of the panel filters in a make-up air unit
Fig. 150: Dirty filter from a make-up air unit

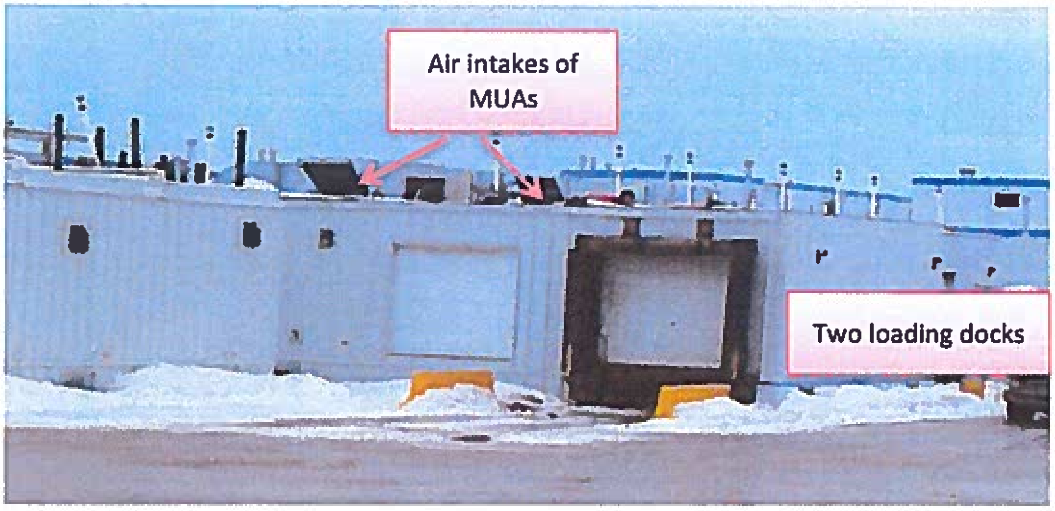


Fig. 151: MUA air intake located close to loading docks.

Two MUA units are located within twenty feet from two loading docks near the kitchen (figure 151). Another MUA was installed on the roof close to the roadway where the buses congregate to pick up or drop off personnel. We observed delivery trucks idling adjacent to the front lobby where the MUA unit air intake was about thirty feet away (figure 152). Another delivery truck was idling in front of the flight centre near several MUA units (figure 153).

Fig. 152: Delivery truck idling near air intake of MUA

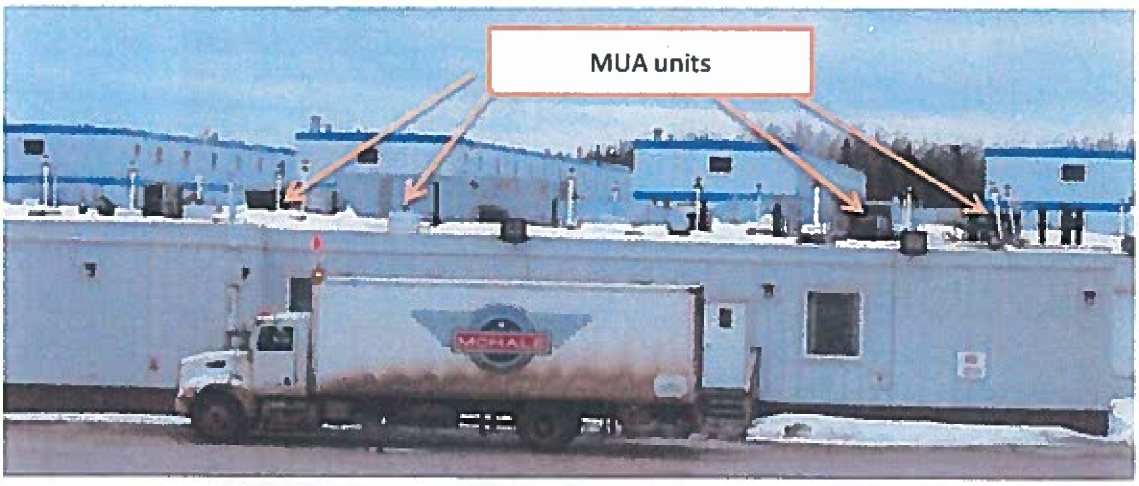


Fig. 153: Delivery truck idling near MUA unit

Section 9.32.3.13. of the Alberta Building Code entitled "Outdoor Intake and Exhaust Openings" states:

1) Intake openings shall be located so as to avoid contamination of the ventilation air from other local sources such as automobile exhaust and exhaust from the building or adjacent buildings.

4.4.5 Air Filtration

Vehicle traffic and wind will stir up dry exposed dirt on the ground. During our examination, the ambient air was not particularly dusty because the ground was moist due to spring melt. Considerably more airborne dust is experienced in summer months as reported by the workers. Nevertheless, even under conditions with little dust in the air, we examined the roof top units and found them to be very dusty. The air filters are clogged with dust (figure 154). It is apparent that significant dust had bypassed the filter to enter into the rooftop units and subsequently into the conditioned space below (figure 155). Some of the direct-fired units serving the kitchen are very dusty (figures 156 and 157). The dust enters the air intake of the direct-fired units, passes through the filters, burns in the flames, and then releases soot and other by-products of combustion directly into the building.


Fig. 154: Large amount of dust in the ambient air clogs up the air filters on the rooftop units.
Fig. 155: Considerable amount of dust is drawn into the forced air units.

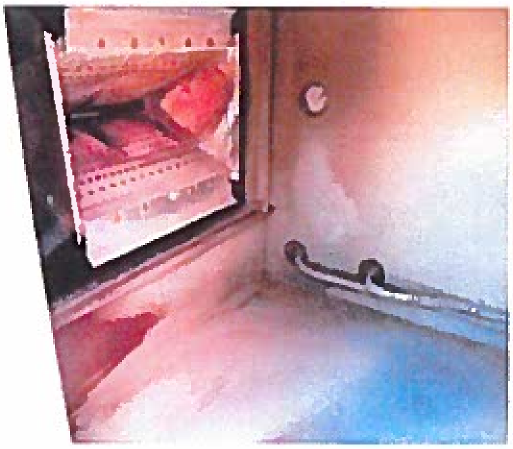
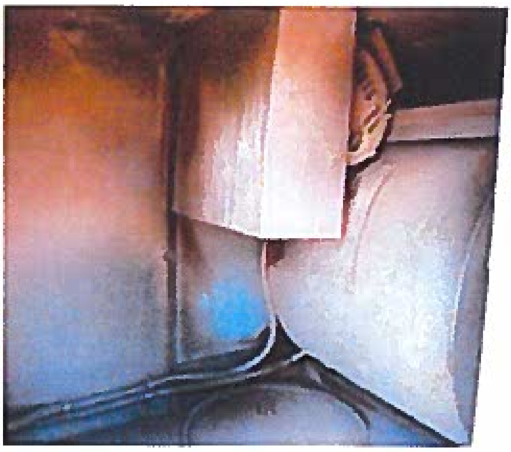



Fig. 156: Dust is drawn into these direct-fired units.
Fig. 157: Considerable dust is found inside all of the furnace units.