REPORT FOR:

Bonivital Pool; 1215 Archibald Street
Building Condition Assessment

Submitted to: City of Winnipeg
Planning, Property, and Development Department
Accommodation Services

Attention: Mr. Lou Chubenko

Date: April 4, 2019

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Our File No. 2018-0222

Crosier Kilgour & Partners Ltd.™

CONSULTING STRUCTURAL ENGINEERS

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Executive Summary

At the request of the City of Winnipeg Planning Property & Development Department, a structural, building envelope, and mechanical systems assessment of the Bonivital Pool was completed by Crosier Kilgour & Partners and Epp Siepman personnel.

Short term priorities include structural repairs and tile replacement on the pool deck and tanks, repairs to exterior pavement, repairs to interior CMU walls, installation of roof fall protection, recovering the out-building roof membrane, replacement of the heat recovery unit, and repairs to the steam finned tubes and air handling units.

Medium term priorities include crawlspace remediation, replacement of the tile floor within the change rooms, exterior masonry repairs, window replacement, entrance door replacement, and replacement of the D/X mechanical unit.

Long term priorities include re-cladding of the building exterior and inspection of mechanical units.

A long term consideration includes replacement of the existing slab-on-grade within the basement.

Category	Estimate
Total Short Term Repairs (within 1 year)	$1,155,500
Total Medium Term Repairs (Year 1 to 5)	$889,500
Total Long Term Repairs (Year 5 to 10)	$1,261,500
Total Long Considerations / Recommended Improvements	$125,000
Total of All Recommendations	**$3,431,500**

1. Introduction

At the request of the City of Winnipeg Planning Property & Development Department, a structural, building envelope, and mechanical systems assessment of the Bonivital Pool was completed by Crosier Kilgour & Partners and Epp Siepman personnel. The purpose of the investigation was to provide an opinion as to the current condition of the structure, cladding, windows and roofing, identify areas of distress, and provide recommendations aimed at extending the service life of the structure and building envelope components.

The following report details the review methods utilized, problem background and provides a summary of our observations and findings, as well as opinions regarding the condition of the structure and building envelope. Recommended repairs and estimates of budget construction costs are also provided where appropriate.

1.1 Limitations

Our assessment is based on a visual examination of representative portions of the building under review which were easily visible, exposed and could be examined. We cannot warrant any different conditions that may exist, but which are covered by finishes, or other materials, or not accessible at the time of the site visit. It should be further acknowledged that our foundation evaluation is based on the present condition only and that we cannot guarantee that future foundation movements will not occur due to movements in the subsoil

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1.2 Scope of Investigation

The intent of this project is to complete a non-destructive condition assessment of the structure and building envelope, and provide recommendations for immediate, short and long-term repairs.

The investigation included, a review of available documentation such as original construction drawings, engineering reports, roofing reports, maintenance reports, and discussions with personnel familiar with the structures.

A visual review of representative portions of the building structure, envelope, and roof(s) which were exposed and readily accessible including common public areas such as entrance foyer, corridors, stairwells, and representative non-public areas such as accessible crawlspaces, and mechanical rooms.

The results of our investigation are summarized in this final report will includes recommendations, and a Class 4 (-30% to +60%) estimate of probable construction costs for the property.

1.3 Priority of Recommendations

All recommendations for building systems or components identified in the following sections have been assigned a priority based on the following criteria for the purposes of scheduling and budgeting in accordance with the following:

- Required Repairs (within 3 months) – Repairs necessary to address specific safety issues. Repairs required within 3 months.
- Short Term Recommendations (within 1 year) – High priority for repairs/maintenance including code and regulatory issues.
- Medium Term (Year 1 to 5) – Repairs required to address ongoing or low-risk deterioration, replacement of end of service-life building components.
- Long Term (Year 5 to 10) – Repairs required to address ongoing or low-risk deterioration, replacement of end of service-life building components.
- Long Term Considerations/Recommended Improvements (not time critical) – Optional work including recommended improvements presented for future consideration and planning.
- Maintenance (ongoing) – Repairs required to address ongoing, or routine maintenance.

1.4 Opinion of Probable Construction Costs

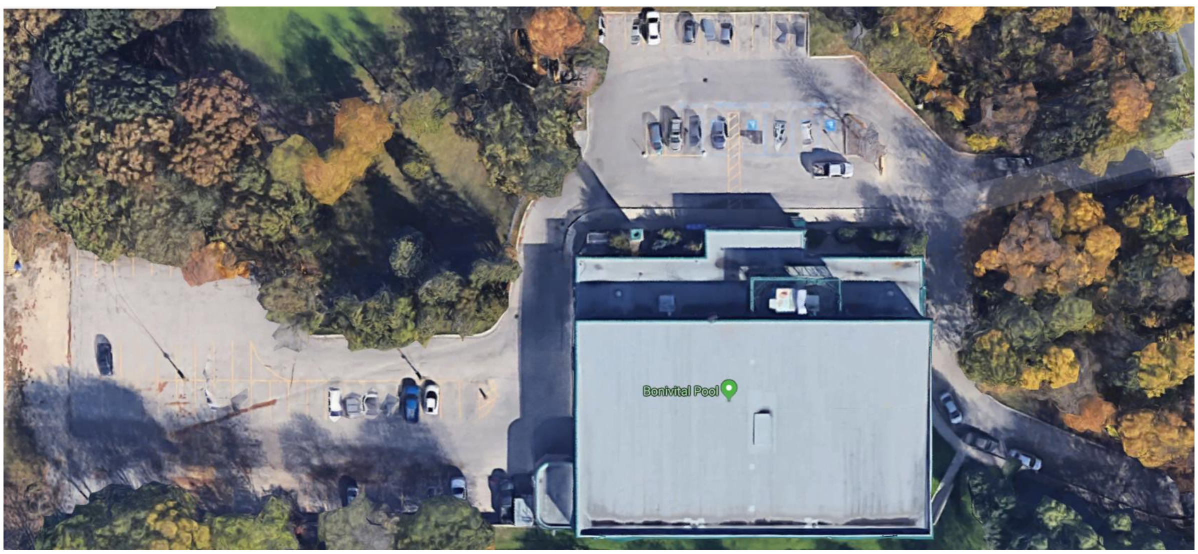
Accurate estimation of construction costs for remediation projects is difficult to provide because of the inherent number of variables associated with working on an existing structure. Hidden conditions inevitably exist which can result in increases in the overall cost of repairs. Based on the level of investigation and available information, the budget is considered a Class 4 (-30% to +60%) estimate in accordance with the city of Winnipeg budget classification system. The cost estimate is a preliminary estimate used in developing long term capital plans and for preliminary discussion of proposed capital projects.

2. Property Description

The following description is based on a review of the existing architectural and structural drawings, and visual observations made during the site reviews. A satellite image of the site is shown in Figure 1 below. The following drawings were available for review:

- Architectural drawings A3, A4, A6through A8 by Hans Peter Langes Architect and dated 1974.
- Structural drawings S1 through S4 by Burgoyne & Thomassen Consulting Engineers and dated 1974.
- Building Envelope drawings B104, B108 through B109 by Wardrop Engineers Inc. and dated 1996.

Figure 1: Site Plan



2.1 General

The Bonivital Archibald Pool (Building number PI-02) is an indoor recreational facility located at 1215 Archibald Street, Winnipeg Manitoba. According to information supplied by the City of Winnipeg, the facility has a total floor area of 38,871 square feet, was constructed in 1974 and comprises a one-story building with basement and crawl space. The main floor of the building contains two swimming pools, a sauna, whirlpool, two spectator rooms, reception/lobby, lifeguard, staff and administrative offices and associated change-rooms, locker-rooms, showers and washrooms. The lower roof finish and perimeter drainage were replaced in summer of 2005 and the building's brickwork façade and windows were replaced in 1999.

2.2 Building Structure

The Bonivital pool is a single storey structure with a partial basement and crawlspace. The high roof over the pool consists 1-1/2" – 22 gauge steel decking supported on 54" long span steel joists spaced at approximately 6'-3" on-centre. The high roof joists span in the north-south direction and are supported on W16x36 steel beams supported on steel columns.

The low roof is constructed of a 1-1/2” – 22 gauge steel decking supported on 20” short span steel joists spaced at approximately 3’-9” on-centre. The roof joists span in the north-south direction and are supported on W16x31 steel beams on the south end and an 8” concrete masonry unit (CMU) wall on the north end which also forms the exterior building wall.

The main floor structure in the common spaces at the north side of the building consists of 8” precast, prestressed hollowcore floor slabs spanning in the north-south direction and are supported on a 12” x 24” cast-in-place concrete beam on the south end and a 12” cast-in-place concrete foundation wall at the north end.

The pool deck and tanks are constructed of conventionally reinforced cast-in-place concrete. The pool decks are combination of one-way and two-way spanning 6” thick concrete slabs. In general, the aprons around the pool tanks are one-way slabs spanning between the pool tank wall, adjacent pool tank, exterior foundation wall, or interior the 12” x 24” concrete beam which also supports the hollowcore floor panels that frame the common areas. The southwest pool deck is a two-way spanning, 6” slab supported on concrete columns.

Pool Tank ‘A’ (deep pool) is constructed of an 8” thick conventionally reinforced two-way spanning concrete slab. The slab is supported directly on the concrete pile foundation. The tank walls consist of 10” thick cast-in-place concrete walls.

Pool Tank ‘B’ (shallow pool) is constructed of an 8” thick conventionally reinforced one-way spanning concrete slab. The slab is supported on 24” x 18” concrete beams spanning in the north-south direction and supported directly on the concrete pile foundation. The tank walls consist of 10” thick cast-in-place concrete walls.

The lower level includes occupied spaces at the northwest corner for mechanical and electrical services, as well as storage and staff rooms. The basement floor slab consists of a 5” slab-on-grade supported directly on “undisturbed levelled clay”.

The remaining basement areas is unfinished crawlspace. Drawings do not indicate if a vapour retarder was included in the original design however evidence of a polyethylene vapour retarder was observed during the site visits.

The building is founded on a deep foundation system consisting of cast-in-place concrete friction piles of varying sizes and depths.

2.3 Building Envelope and Cladding

The building envelope retrofit included the installation of 4” face brick, air space, rigid insulation, air barrier membrane and existing concrete block back-up approximately 5 feet to 8 feet up from the ground level and prefinished metal cladding at the higher levels.

The prefinished metal cladding at higher levels is a durable material and utilizes concealed fasteners for improved aesthetics and for water-tightness. Based on the existing 1997 building envelope retrofit drawings, the prefinished horizontal metal cladding was mounted on an existing back-up masonry wall with galvanized girt system, with 2” of rigid insulation, air barrier membrane installed on the face of the masonry back-up. T

2.4 Roofing

Bonivital pool roof footprint is approximately 20,300 square feet and comprises of three roof facets. The roof system on all three facets are a typical insulated SBS modified bitumen 2-ply membrane system. The existing roof assemblies are approximately 20 years old and the overall condition is good. The assembly installed on all three facets comprises of SBS base and granulated cap membrane, gypsum support panel over 3” rigid insulation, air vapor barrier membrane, and gypsum exterior grade support panel on existing steel deck.

- Upper pool roof = 15,700 square feet total area
- Entrance roof = 4,400 square feet total area
- Out building roof = 200 square feet total area

2.5 Mechanical Systems

Two low pressure steam boilers (Photograph 2.5-1) are the main heating source for the pool systems, domestic hot water, and HVAC systems. Mechanical condensate pumps are located within the basement mechanical room.

2.5.1 Pool Systems

The steam heats the deep and shallow pool water systems via two steel shell-and-tube heat exchangers. Two primary pool pumps draw the pool water from an open filter tank, through the heat exchangers, and to the pools. The pumps are base-mounted centrifugal pumps. All control valves (Photograph 2.5.1-1) are pneumatically controlled.

Photograph 2.5.1-1: One of two low pressure steam boilers

Photograph 2.5.1-2: Control valves serving steam-water and steam-glycol heat exchangers

2.5.2 Domestic Hot Water

The domestic hot water is generated via a steam to hot water tube-and-tank heat exchanger (Photograph 2.5.2-1). Distribution to the domestic hot water system is from the basement mechanical room and is complete with a recirculation system.

Photograph 2.5.2-1: Tube and tank heat exchanger for domestic hot water

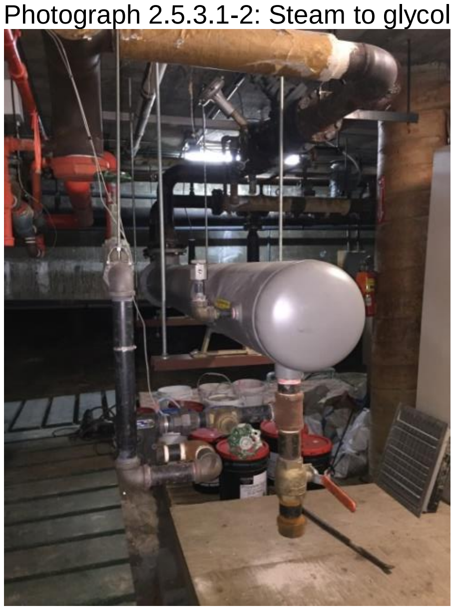
2.5.3 HVAC Systems

.1 Pool Deck Unit, AHU-1

AHU-1 (Photograph 2.5.3.1-1) is responsible for zone control of the pool deck area. The heating coil of AHU-1 is a glycol coil (undergoing replacement at time of site review) which is heated via a steam-to-glycol shell-and-tube heat exchanger (Photograph 2.5.3.1-2). The pool is served by AHU-1 supply grilles around the east, south and west exposures. The north side wall is served by steam fed fin tube radiators. A roof top heat recovery ventilation (HRV) unit uses pool exhaust air to pre-heat outside air which mixes with return air prior to entering AHU-1.

Photograph 2.5.3.1-1: AHU-1 serving pool deck; glycol loop down for repairs

Photograph 2.5.3.1-2: Steam to glycol heat exchanger serving AHU-1



.2 Administration Unit, AHU-2

AHU-2 (Photograph 2.5.3.2-1) is responsible for zone control of the administration area (lobby area) as well as the men's and women's locker rooms. The heating coil of AHU-2 is a glycol coil which is heated via a steam-to-glycol shell and tube heat exchanger (Photograph 2.5.1-1) that was recently replaced. The women's locker room receives zone control via a dedicated steam fed re-heat coil (Photograph 2.5.3.2-2) downstream of AHU-2 as well as a steam fed fin tube radiator. A dedicated re-heat coil for the men's locker room was deemed unnecessary because it is situated right on top of the boiler mechanical room, so sufficient heat is conducted through the floor.

Photograph 2.5.3.2-1: AHU-2 serving administration unit, men and women locker rooms

Photograph 2.5.3.2-2: Steam fed re-heat coil in AHU-2 dedicated for zone control of women's locker room

.3 Combustion Air Unit, AHU-3

AHU-3 (Photograph 2.5.3.3-1) is responsible for supplying combustion air to the boilers. The heating coil of AHU-3 is a glycol coil which is heated via the same steam-to-glycol shell and tube heat exchanger that serves AHU-2. The glycol coil and the ducting downstream of the unit were all recently replaced. However, the glycol circulation pump, the unit fan and upstream ducting are all original.

Photograph 2.5.3.3-1: AHU-3 unit supplying combustion air to boilers

.4 D/X Roof Top Units

Two D/X rooftop cooling-only units serve the observation area (west side) and the office space (east side) only during the summer months to meet the cooling and ventilation demands. During the winter months, however, the roof top units are incapable of heating the outside air, and therefore, they do not operate during these months. The heating demand is rather provided via floor mounted steam fed fan coils (Photograph 2.5.3.4-1). Air is exhausted via a supply grill in each of the rooms

Photograph 2.5.3.4-1: Observation area (west) served by D/x cooling unit and steam fed fan coil. Office space (east) is served similarly.

3. Summary of Findings

The following sections summarizes the significant findings, recommendations, and estimates of probable construction costs.

3.1 Site

3.1.1 Pavement and Sidewalks

.1 Varying degrees of cracking and movement in the concrete sidewalks and deterioration of concrete curbs was observed. Localized repairs are required to address tripping hazards and existing deficiencies.

Photograph 3.1.1.1-1: Partial view of sidewalk cracking and movement.

Recommendation 3.1.1.1-1: Complete localized repairs to existing sidewalks and curbs to address potential tripping hazards and deterioration. Repairs will range from localized patches to full depth replacement.

Estimated Cost: $10,000

Priority: Short Term, recommended within 1 year.

3.1.2 Grading

.1 A cursory review of the existing grading surrounding the building did not reveal any obvious deficiencies.

3.2 Structural

3.2.1 Basement/Crawlspace

.1 A crawlspace is located below the pool deck. Access to the crawlspace is provided by way of a man door off the mechanical room. The existing vapour retarder is discontinuous and in poor condition (Photograph 3.2.2.1-1). A wood walkway is provided as a walking surface in select areas (Photograph 3.2.2.1-2). The walkway is in good condition.

Photograph 3.2.1.1-1: Partial view of crawlspace showing typical ground cover.

Photograph 3.2.1.1-2: Wood walkway between pool basins.

<u>Recommendation 3.2.1.1-1</u>: The crawlspace does not have a functioning vapour barrier. Remediation of the crawlspace is required including grading of the existing soil to direct water away from structural members, installation of a new drainage system and sump pits (if required, see mechanical), and installation of a vapour retarder and sand cover. Installation of new sub-surface drainage, vapour barrier, and sand cover is recommended within 5 years.

Estimated Cost: $375,000

Priority: Medium Term, recommended within 1 to 5 years.

.2 There is evidence of heaving of the basement floor slab in the mechanical room. Cracking is occurring as a result of the heaving and site personnel indicated that the conditions have been present for some time. Since the slab is grade-supported, the cracking is considered a functional/aesthetics issue rather than a structural problem.

Movement in the slab-on-grade is causing cracking in the concrete masonry unit (CMU) wall above the electrical room door (Photograph 3.2.1.2-1). The conditions are likely caused by heaving of the slab-on-grade. Repairs to the CMU wall is recommended in the short term.

Photograph 3.2.1.2-1: Cracking in CMU wall.

Recommendation 3.2.1.2-1: To address cracking in the CMU wall, localized removal and rebuilding of the wall will be required. Installation of a soft joint at the top of the wall and around penetrations is also recommended to allow for future movement.

Estimated Cost: $15,000

Priority: Short Term, recommended within 1 year.

Recommendation 3.2.1.2-2: Removal of and replacement of the slab-on-grade may be considered as a way of addressing the heaving. Repairs would consist of removing the existing 5” slab, excavation of the existing subgrade, installation of new compacted granular fill, and installation of a new 5” concrete slab. Existing partition walls, equipment, and fixtures would have to be removed in areas of repair. This option would have the added benefit of addressing existing cracks observed in the slab.

Estimated Cost: $125,000
Note: Cost presented are for slab replaced only and does not include soft costs for temporary removal and relocation of existing mechanical equipment, partitions, or other building components affected by the work.

Priority: Long Term Considerations/Recommended Improvements (not time critical)

3.2.2 Swimming Pools and Pool Deck

.1 Delamination of the underside of the concrete pool tanks was observed at numerous locations from within the crawlspace. Photographs 3.2.2.1-1 and 3.2.2.1-2 show typical delamination of the slab soffit. The delamination is a result of corrosion of the embedded reinforcing steel. Efflorescence is also visible which is caused by water seepage through cracks in the concrete.

Photograph 3.2.2.1-1: Soffit delamination and spalling at pool tank drain.

Photograph 3.2.2.1-2: Typical concrete deterioration.

Efflorescence and corrosion staining were observed along the existing construction joints in the pool walls (Photograph to 3.2.2.1-3). The conditions a caused by water seepage through the joint.

Photograph 3.2.2.1-3: Typical concrete deterioration.

A hammer sounding survey was completed on the pool basins and revealed the following:

- Pool Tank A (Deep Pool): Total Area = 3,465 sq.ft. Area of slab soffit delamination = 290 sq.ft. (8.4%).
- Pool B (Shallow Pool): Total Area = 3,066 sq.ft. Area of slab soffit delamination = 218 sq.ft. (7.1%). Area of wall delamination – 19 sq.ft.
- Pool Deck Soffit Delamination = 55 sq.ft.

A limited structural analysis was completed and determined the impact of the deterioration. The analysis indicates that there is no immediate concern for structural safety.

Overall, the deterioration of the concrete is directly related to water seepage through the concrete pool walls. It also indicates that the existing tile is not providing an effective waterproof barrier.

Subsequent to the site visits, it was reported that water was observed seeping through existing cracks during filling of the pool tanks.

Recommendation 3.2.2.1-1: Structural concrete repairs are required to address existing deterioration. Given the extent of leakage and the fact that the pool water contains chlorine which enhances corrosion, the likelihood of a rapid increase in corrosion and delamination is very high. Repairs are therefore required in the short term to address existing deterioration. Repairs will include removal of all loose concrete down to a sound substrate, exposing all corroding reinforcing steel, sandblasting existing concrete and reinforcing steel, and infilling with a proprietary concrete repair material.

Estimated Cost: $250,000

Priority: Short Term, recommended within 1 year.

.2 A visual inspection with localized chain drag soundings was completed on the top surface of the pool basins and pool decks while they were drained. Localized areas of debonding of the tile was observed within the pool tanks. Evidence of previous repairs was also visible.

Evidence of rust staining was visible through the tile with the deep end of Pool Tank A. The cause of the rust staining could not be determined but may be related to corrosion of the embedded reinforcing steel.

Chain drag soundings of the pool deck south of Pool Tank A indicate that the tile is extensively bonded.

Recommendation 3.2.2.2-1: As noted in 3.2.2.1-1, delamination of the concrete pool tanks is a result of water seepage through the pool slabs and walls indicating that the existing tile is not providing an effective waterproof barrier. In order to address the root cause of the concrete deterioration and extend the service life of the repairs, it is recommended that the existing tile be removed and replaced with a new pool lining and tile finish. Repairs are recommended in 2019 to coincide with the structural concrete repairs. Deferral of tile repairs will significantly shorten the service-life of the structural repairs.

Estimated Cost: $700,000

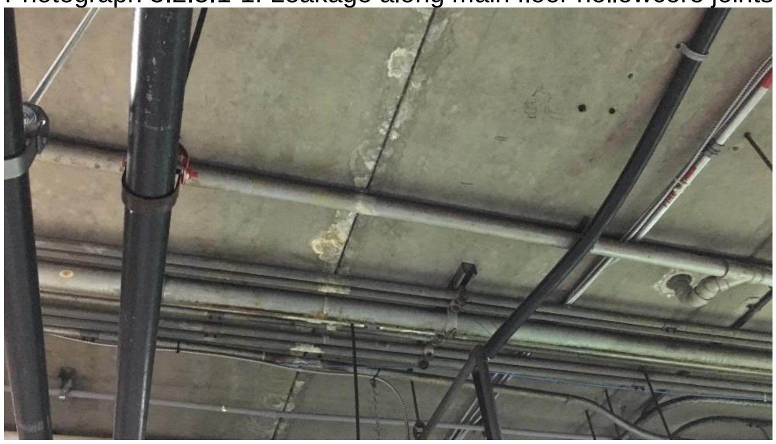
Priority: Short Term, recommended within 1 year.

.3 The hot tub was not part of the original construction. The existing slab was cut and removed to permit installation. No evidence of structural damage or deterioration was observed.

3.2.3 Main Floor Structure and Common Areas

.1 Evidence of leakage was visible along existing main floor hollowcore joints (Photographs 3.2.3.1-1 and 3.2.3.1-2) and plumbing penetrations (Photograph 3.2.3.1-3). The areas correspond to the location of the change rooms and shower areas. In general, greater instances of leakage was observed below the men's change room compared to the women's change room. Evidence of previous injection repairs was visible but has not been successful. The conditions suggest water is penetrating the tile and waterproofing. The conditions suggest that the existing tile flooring is not providing an effective waterproof barrier.

Photograph 3.2.3.1-1: Leakage along main floor hollowcore joints.



Photograph 3.2.3.1-2: Leakage along main floor hollowcore joints.

Photograph 3.2.3.1-3: Leakage at pipe penetrations.

Recommendation 3.2.3.1-1: Evidence of leakage was observed through the main floor structure below the change rooms. Removal of the existing tile is recommended followed by the installation of a waterproofing membrane and new tile is recommended. Replacement of the tile is recommended in 2019. Deferral of tile repairs will shorten the service-life of the hollowcore floor panels.

Estimated Cost: $80,000

Priority: Medium Term, recommended within 1 to 5 years.

.2 Water staining was observed on the ceiling tile in staff room. Site personnel indicated the leak was caused by a drain line and has since been fixed. Related to a drain line.

.3 The existing interior stairs are in good condition. No repairs required.

.4 Men's and Women's Change Room. Surfaces are generally covered with finishes. No obvious signs of deterioration or distress visible.

.5 Common areas. Surfaces are generally covered with finishes. No obvious signs of deterioration or distress visible.

.6 Pool Surfaces are generally covered with finishes. No obvious signs of deterioration or distress visible.

3.2.4 Building Superstructure

.1 The steel roof joists and metal roof deck are visible along the north wall. Minor surface corrosion visible (Photograph 3.2.4.1-1). Similar conditions were observed within the pool storage room at the west end of the building.

Photograph 3.2.4.1-1: Partial view of roof framing. Step cracking in northwest corner also visible (yellow arrow).

Recommendation 3.2.4.1-1: Minor surface corrosion was visible on structural framing. Removal of corrosion and repainting will be required periodically throughout the life of the structure. Consideration should be given to the environmental conditions when selecting materials. Painting is considered normal maintenance.

Estimated Cost: N/A – Non-capital Expense

Priority: Maintenance.

.2 Step cracking was observed in the CMU wall at the northwest corner of the pool area (Photograph 3.2.4.1-1). Similar step cracking was observed in the south elevation CMU wall (Photograph 3.2.4.2-1). The cause of the step cracking could not be readily determined.

Photograph 3.2.4.2-1: Step cracking in south wall.

Recommendation 3.2.4.2-1: Localized masonry joint repairs are recommended to address cracks in the mortar joints.

Estimated Cost: $15,000

Priority: Medium Term, recommended within 1 to 5 years.

3.2.5 Roof (Exterior)

.1 Access to the roof is provided by way of fixed access ladders. The ladders are in reasonable condition. Minor surface corrosion was visible.

Recommendation 3.2.5.1-1: Periodic repainting will be required to address corrosion. Painting is considered normal maintenance.

Estimated Cost: N/A – Non-capital expense.

Priority: Maintenance.

.2 No fall protection is provided for Workers accessing the roof for the purpose of maintaining existing equipment. Based on the path of travel required to access an existing mechanical unit a Worker would likely need to move within 2 metres of the north elevation roof edge which is unprotected. Installation of fall protection consisting of a surface mounted, non-penetrating guardrail is recommended.

Photograph 3.2.5.2-1: North Low Roof showing area without fall protection.

Recommendation 3.2.5.2-1: Install fall protection consisting of a surface mounted, non-penetrating guardrail along portions of north elevation roof edge.

Estimated Cost: $25,000

Priority: Short Term, recommended within 1 year.

.3 The structural framing around the mechanical unit appears to be in condition. Minor surface corrosion was visible.

Recommendation 3.2.5.3-1: Periodic repainting will be required to address corrosion.

Estimated Cost: N/A – Non-capital expense.

Priority: Maintenance.

3.3 Building Envelope

3.3.1 Walls and Cladding

.1 Localized mortar joint deterioration and efflorescence build-up was evident at the southwest corner of the building addition along the West side of the building (Photograph 3.3.1.4-2). Localized cracking and debonding of mortar at joint interface between brick and granite cladding at the North elevation was also observed.

.2 Typical sealant deterioration/debonding at all existing masonry control joints was observed through-out the entire building. Insufficient sealant throat thickness was noted at localized areas. Thermographic scan confirmed the anomalies at the brick masonry ties, control joints and at the foundation wall/brick wall joint interface.

.3 The existing prefinished metal cladding is dark green in colour with a wide horizonal batten profile approximately 300mm on centre. The metal cladding appears to be in good condition. However, thermal anomalies caused by air leakage was observed at the metal cladding control joints, at cladding supporting steel girts and at cladding/brick wall interface.

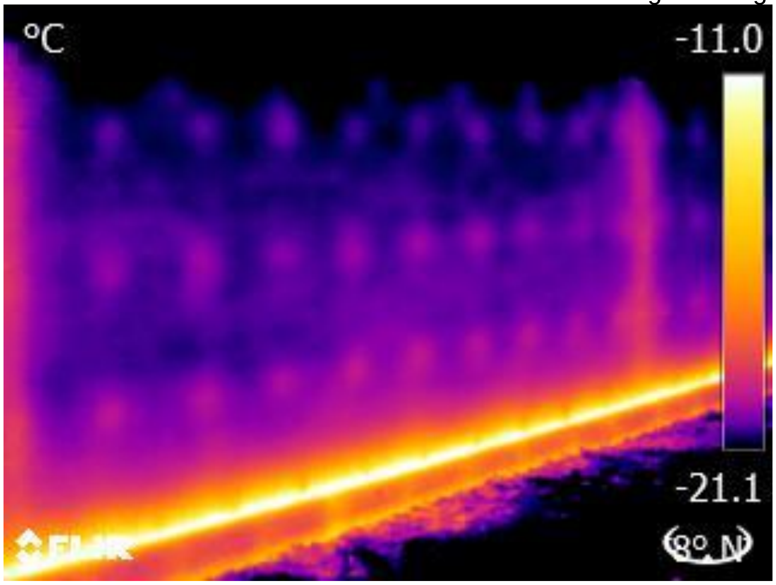
.4 The underlying insulation and vapour barrier system were concealed from view. However, based on the existing drawing (1997 building envelope retrofit), the original exterior masonry back-up walls have air-barrier membrane and 2” rigid insulation. The condition of the air-barrier membrane and insulation could not be confirmed but based on the thermographic scan, anomalies were noted at the several locations. Upgrading the exterior wall assembly should be considered

Photograph 3.3.1.4-1: General view of existing metal cladding and brick masonry control joint where thermal anomalies were observed during thermographic scanning.

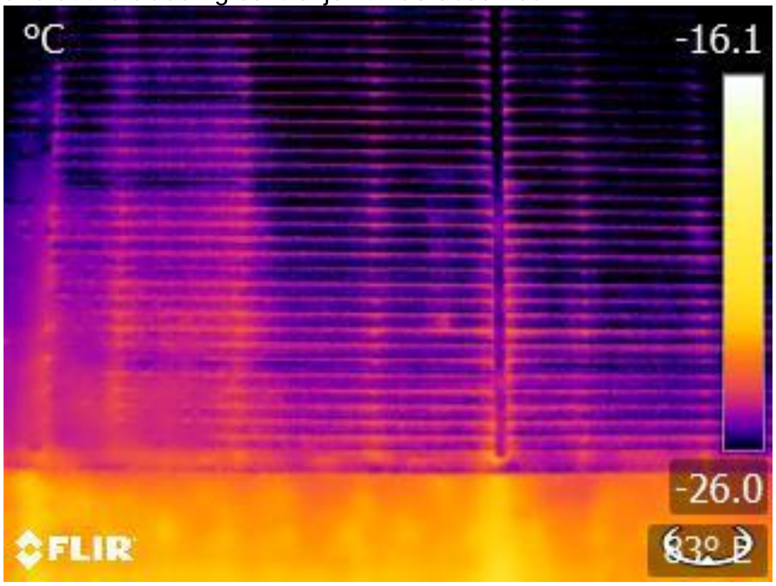
Photograph 3.3.1.4-2: Localized brick mortar joint deterioration with efflorescence build-up at brick cladding (West Elevation).

Photograph 3.3.1.4-3: Typical cracking and debonding of existing sealant at brick masonry control joint where thermal anomaly was observed during thermographic scanning.

Photograph 3.3.1.4-4: Heat transfer at brick masonry ties, at control joints and along the foundation wall/brick wall interface was observed during thermographic scanning.



Photograph 3.3.1.4-5: Heat transfer through steel girts supporting the metal cladding and at the cladding control joint was observed.



<u>Recommendation 3.3.1.1-1</u>: Repointing of localized deteriorated/cracked brick and granite mortar joint is anticipated as original mortar joint work becomes aged and breaks down due to exposure to the elements. Assume 20% of the existing mortar joint.

Estimated Cost: $75,000

Priority: Medium Term, recommended within 1 to 5 years.

Recommendation 3.3.1.1-2: Removal of existing caulking and re-caulking of all existing brick masonry control joints.

Estimated Cost: $45,000

Priority: Medium Term, recommended within 1 to 5 years.

Recommendation 3.3.1.1-3: Removal and replacement of existing metal cladding and brick veneer to upgrade vapour permeable air-barrier membrane and insulation.

Estimated Cost: $1,250,000

Priority: Long Term Considerations/Recommended Improvements (not time critical)

3.3.2 Glazing

.1 The clerestory windows on the north elevation are aluminum framed interior glazed ribbon windows consisting of triple pane argon filled sealed units with PVC spacers. Glass thickness could not be determined. Individual ribbon units consist of four glazing panels separated by a horizontal rail and vertical mullion. Individual ribbon units are installed in banks of two, vertically butt jointed together at the center and separated by structural framing on either end of the bank, for a total of eight glazing panels per bank. All windows are fixed and have no operable components. The sealed glazing units are dated 1997, 22 years old, and as such are nearing their expected service life of 25 years.

Photograph 3.3.2.1-1: Partial view of east end of north elevation showing first two banks of ribbon windows separated by structural framing.

Photograph 3.3.2.1-2: Partial view of bank of ribbon window, showing center butt joint between individual ribbon units, and end structural framing separating banks.

All sealed units exhibited evidence of seal failure including fogging, condensation, streaking, and accumulation of desiccant residue on interior surfaces of lites. Four of the 62 sealed clerestory units underwent frost point testing, which confirmed failed seals in all instances.

Photograph 3.3.2.1-3: Partial view of west end of north elevation showing condensation and fogging within each sealed unit.

Photograph 3.3.2.1-4: Typical example of a failed sealed glazing unit, exhibiting condensation between the lites.

No visible cracks were observed in any of the sealed units. Generally, the exterior gaskets were intact; however, environmental exposure degradation, such as minor cracking and stiffening of the gasket, was observed. Displacement of glazing sealant from behind the gaskets was noted, generally at horizontal to vertical frame connection points.

Photograph 3.3.2.1-5: Typical example of glazing sealant displacement.

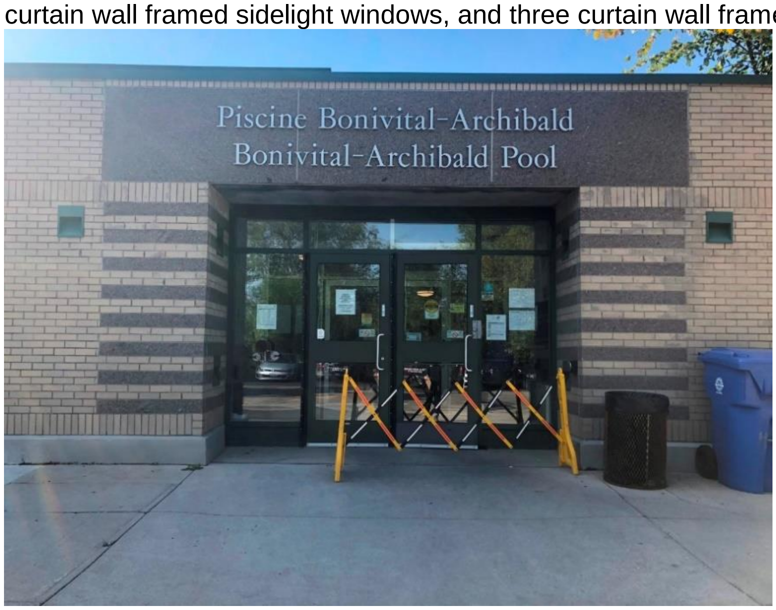
Recommendation 3.3.2.1-1: Existing aluminum ribbon windows are near the end of their expected service life and exhibiting sealed unit failure. Short term replacement is recommended to increase thermal performance, visibility, and occupant comfort. It is recommended that associated flashing and sealant replacement and repairs be conducted simultaneously to increase the performance and durability of the window tie in to the overall envelope system.

Estimated Cost: $230,000

Priority: Medium Term, recommended within 1 to 5 years.

.2 The north elevation entrance consists of glazed aluminum doors complete with curtain wall framed exterior glazed sidelights and transoms. Both door and window glazing consist of dual pane 6mm interior and exterior lite, clear glass, argon filled sealed units with 10mm metal spacers. All windows are fixed and have no operable components. Doors bear Kawneer manufacturer label. The sealed glazing units are dated 1997, 22 years old, and as such are nearing their expected service life of 25 years.

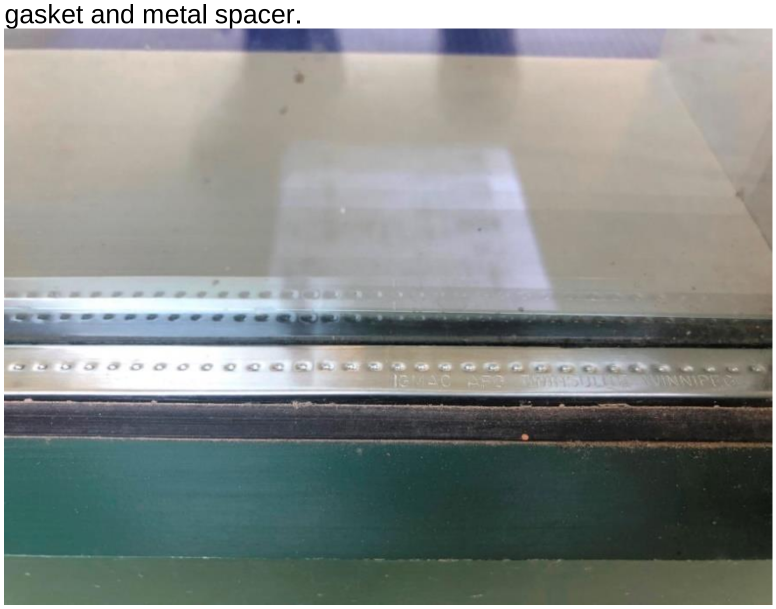
Photograph 3.3.2.2-1: North elevation entrance consisting of two aluminum doors, two curtain wall framed sidelight windows, and three curtain wall framed transom windows.



Though the sealed units did not exhibit visible evidence of seal failure, frost point testing of one of the five window units revealed seal failure.

No visible cracks were observed in any of the sealed units. Being situated below the entrance canopy and somewhat protected from the elements, the exterior gaskets of these units were intact.

Photograph 3.3.2.2-2: Typical example of north elevation entrance window exterior gasket and metal spacer.



Recommendation 3.2.2.2-1: Existing aluminum doors and associated curtain wall framed entrance windows are near the end of their expected service life and exhibiting sealed unit failure. Short term replacement is recommended to increase thermal performance, visibility, and occupant comfort. It is recommended that associated flashing and sealant replacement and repairs be conducted simultaneously to increase the performance and durability of the window tie in to the overall envelope system.

Estimated Cost: $22,000

Priority: Medium Term, recommended within 1 to 5 years.

3.3.3 Roofing

.1 Overall, our observations of the existing upper pool roof system the condition is good and is performing as intended. Photograph 3.3.3.1-1. Drainage on the pool roof is satisfactory and sloped adequately to the interior drains. We observed minor blisters throughout the roof area, however the importance factor of minor blistering is insignificant to the membrane's performance. Photograph 3.3.3.1-2. The presence of minor blisters or wrinkles is often attributed to the materials installation methods used, and in most cases does not have a negative impact on the longevity of the roofing system.

Recommendation 3.3.3.1-1: Annual maintenance required.

Estimated Cost: N/A – Non-capital expense.

Priority: Annually, 12 months

Photograph 3.3.3.1-1: showing upper roof.

Photograph 3.3.3.1-2: View of minor blister.

.2 Our observations of the existing entrance roof system the condition is good and is performing as intended. Photograph 3.3.3.2-1. Drainage on the pool roof is satisfactory to the interior drains. This roof facet houses multiple roof penetrations and mechanical equipment stands. Overall the membrane flashings are in good order including, pedestals, curbs, vents, and pitch pockets. Photograph 3.3.3.2-2. The staining on the existing granulated cap membrane is due to the metal work performed during construction. This type of deficiency will have no effect to the membrane, although remains aesthetically unpleasing.

Recommendation 3.3.3.2-1: Annual maintenance required.

Estimated Cost: N/A – Non-capital expense.

Priority: Annually, 12 months.

Photograph 3.3.3.2-1: showing entrance roof.

Photograph 3.3.3.2-2: View roof penetrations and pedestal.

.3 The out-building's roof cover is in poor shape and observing the major wrinkling and degranulation of the existing granulated cap membrane we recommend remediation actions in the short term. Photograph 3.3.3.3-1. Currently the entire roof cover shows defects to the application of the granulated cap membrane. Typically defects of major wrinkling and granule loss the importance factor is high and corrective actions are recommended. Photograph 3.3.3.3-2.

Recommendation 3.3.3.3-1: Roof recover with 2-ply SBS modified bitumen membrane.

Estimated Cost: $18,000

Priority: Short Term, recommended within 1 year.

Photograph 3.3.3.3-1: showing entrance roof.

Photograph 3.3.3.3-2: View roof penetrations and pedestal.

3.4 Mechanical

3.4.1 HVAC

.1 The HRV serving the Pool Deck unit (AHU-1) is past published life expectancy and the fan is showing signs of deterioration and rust (Photograph 3.4.1.1-1). The unit is still functional, but performance effectiveness is unknown, though can be assumed to be somewhat less than original design.

Photograph 3.4.1.1-1 Rooftop HRV Fan deterioration

Recommendation 3.4.1.1-1: Replace pool area heat recovery unit with heat recovery unit suitable for use pool environment, installed in in same roof top location as the existing unit. The new unit shall be capable of providing minimum ventilation and exhaust requirements to comply with current code. Proposed unit does not include mechanical cooling or dehumidification. Consideration should be given during design to requirement or benefits to adding mechanical dehumidification to manage humidity levels within the pool deck area.

Estimated Cost: $100,000

Priority: Short Term, recommended within 1 year.

Recommendation 3.4.1.1-2: If replacement of the pool area heat recovery unit is not planned for near future, the fans and belts should be serviced, and the recovery coil cleaned to optimize operation in the interim.

Estimated Cost: $15,000

Priority: Short Term, recommended within 1 year.

.2 The high level windows on the north side of the pool area exhibited signs of seal failure with significant condensation, fogging, and streaking (Photographs 3.4.1.2-1 and -2).

Photograph 3.4.1.2-1: Condensation, fogging of pool north side windows

Photograph 3.4.1.2-2: Condensation, fogging of pool north side windows

Recommendation 3.4.1.2-1: Condensation in a high humidity pool environment is difficult to manage during the winter months due to the extreme temperature differential between indoors and ambient. Recommissioning, servicing and/or replacing the steam finned tube along the high level glazing on the north side of the pool area can help eliminate or minimize the condensation (Photograph 3.4.1.2-1).

Estimated Cost: $17,000

Priority: Short Term, recommended within 1 year.

Photograph 3.4.1.2-2 Fin tube radiators serving pool north side walls

.3 It is advised to re-balance air supply and exhaust of the pool area and the adjacent spaces (change rooms and administration area) in such a way to ensure that the pool area is negatively pressured relative to the lobby area in order to prevent migration of pool humidity to these spaces. The change rooms should be maintained with negative pressure relative to the administration area and pool area as well.

Recommendation 3.4.1.3-1: Rebalance supply air delivery, introduction of fresh air, return and exhaust of pool heat recovery unit, AHU-1 and AHU-2 to maintain negative pressurization of pool area relative to adjacent spaces. Re-balance change room exhaust fans to maintain negative pressure relative to administration and pool areas.

Estimated Cost: $5,500

Priority: Short Term, recommended within 1 year.

.4 If structural resolves that sump pit(s)/pump(s) are required to serve additional or remediated weeping tile systems in the crawl space (Recommendation 3.2.1.1-1), a duplex sump pump is recommended per required location.

Recommendation 3.4.1.4-1: Crawlspace sump pits.

Estimated Cost: $12,000
Note that cost is subject to some variability based on required length of discharge piping.

Priority: Medium Term, within 1 to 5 years.

.5 The roof top D/X units serving the office and observation areas are only ventilating the spaces during the summer months, and therefore, the air being supplied in the winter months is not providing any ventilation to the spaces which does not meet current ventilation code requirements. The units are also nearing the end of their useable service life.

Photograph 3.4.1.5-1:D/X rooftop unit serving office space- east side

Photograph 3.4.3.1.5-2: D/X rooftop unit serving observation area - west side

Recommendation 3.4.1.5-1: The units should be replaced with alternatives that are capable of conditioning the outside air during the winter months so as to provide adequate fresh air ventilation to the spaces served throughout the entire year.

Estimated Cost: $20,000

Priority: Medium Term, recommended within 1 to 5 years.

.6 The shell and tube heat exchangers serving the pool water systems and administration unit/combustion air units are original and nearing the end of their useable service life.

Photograph 3.4.1.6-1: Shell-and-tube heat exchangers serving pool water systems (1 & 2), AHU-2 and AHU-3 (3)

Recommendation 3.4.1.6-1: Heat exchangers should be inspected for fouling and replacement considered

Estimated Cost of pool system heat exchangers: $10,000

Estimated Cost of air handler heat exchanger: $5,500

Priority: Medium Term, recommended within 1 to 5 years.

.7 The circulation pumps for glycol loops serving the administration and combustion air units are past published life expectancy but still functioning reliably.

Recommendation 3.4.1.7-1: The circulation pumps should be inspected to ensure proper flow is being supplied to the air handlers, and replacement is to be considered if deemed necessary.

Estimated Cost: $6,000

Long Term, recommended within 5 to 10 years.

.8 The exhaust fans serving the change rooms are nearing their useable service life but are still functioning reliably
3.2.4.1
Recommendation 3.4.1.8-1: Consider inspecting the exhaust fans to ensure that air is being exchanged in a satisfactory manner and replace if deemed necessary.

Estimated Cost of replacement: $5,500

Long Term Considerations/Recommended Improvements (not time critical)

4. Summary of Recommendations

The following table summarizes our estimate of probable construction costs by category. All costs presented are in 2019 dollars and are before taxes, contingencies, and consulting fees.

Category	Section	Recommendation	Description	Estimate
Short Term	Site	3.1.1.1-1	Sidewalk and curb repairs	$10,000
	Structural	3.2.1.2-1	Interior CMU wall repairs	$15,000
		3.2.2.1-1	Pool tank concrete repairs	$250,000
		3.2.2.2-1	Pool deck/tank tile replacement	$700,000
		3.2.5.2-1	Roof fall protection	$25,000
	Building Envelope	3.3.3.3-1	Recover out building roof	$18,000
	Mechanical	3.4.1.1-1	Replace pool heat recovery unit	$100,000
		3.4.1.1-2	Service existing heat recover unit	$15,000
		3.4.1.2-1	Steam finned tube repairs at high glazing	$17,000
		3.4.1.3-1	Rebalance AHU-1 and AHU-2	$5,500
Total Short Term Repairs (within 1 year)				**$1,155,500**
Medium Term	Structural	3.2.1.1-1	Crawlspace remediation	$375,000
		3.2.3.1-1	Changing room tile replacement	$80,000
		3.2.4.2-1	Interior CMU wall repairs	$15,000
	Building Envelope	3.3.1.1-1	Exterior masonry repairs	$75,000
		3.3.1.1-2	Exterior masonry control joint repairs	$45,000
		3.3.2.1-1	Ribbon window replacement	$230,000
		3.2.2.2-1	Entrance door replacement	$22,000
	Mechanical	3.4.1.4-1	Install crawlspace sump pits	$12,000
		3.4.1.5-1	Replace D/X rooftop unit	$20,000
		3.4.1.6-1	Inspect heat exchangers	$15,500
Total Medium Term Repairs (Year 1 to 5)				**$889,500**
Long Term	Building Envelope	3.3.1.1-3	Building cladding replacement	$1,250,000
	Mechanical	3.4.1.7-1	Inspect circulation pumps	$6,000
		3.4.1.8-1	Inspect exhaust fans	$5,500
Total Long Term Repairs (Year 5 to 10)				**$1,261,500**
Long Term Considerations/ Recommended Improvement	Structural	3.2.1.2-2	Basement slab-on-grade replacement	$125,000
Total Long Considerations / Recommended Improvements				**$125,000**
Total of All Recommendations				**$3,431,500**

5. Closure

At the request of the City of Winnipeg Planning Property & Development Department, a structural, building envelope, and mechanical systems assessment of the Bonivital Pool was completed by Crosier Kilgour & Partners and Epp Siepman personnel. The purpose of the investigation was to provide an opinion as to the current condition of the structure, cladding, windows and roofing, identify areas of distress, and provide recommendations for immediate, short and long-term repairs.

We trust that this report provides the information you require. Upon your review, please contact our office at your convenience to discuss this report in further detail.

Structural
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Appendix A

Thermographic Report

THERMOGRAPHIC SURVEY FOR:

1215 Archibald Street; Winnipeg, Manitoba
Bonivital Pool

Submitted to:	City of Winnipeg Planning, Property, and Development Department Accommodation Services
Attention:	Mr. Lou Chubenko
Date:	April 4, 2019
Submitted by:	Crosier Kilgour & Partners Ltd. 300-275 Carlton Street Winnipeg, Manitoba R3C 5R6 Phone: 204.943.7501 Fax: 204.943.7507 Website: www.ckpeng.com
Contact:	Tom Berthin
Our File No.	2018-0222

Crosier Kilgour & Partners Ltd.™

CONSULTING STRUCTURAL ENGINEERS

Table of Contents

1. Disclaimer and Limitations

This report has been prepared for the sole benefit of the City of Winnipeg. This report may not be reviewed, referred to or relied upon by any other person or entity without the prior written permission of Crosier Kilgour & Partners Ltd. and the City of Winnipeg.

While Infrared cameras can detect minute temperature variations on materials surfaces, there are numerous factors that can affect the readings. These factors musts be understood and accounted for when interpreting the images. Factors include but are not limited to:

- Wind
- Solar loading
- Positive/negative indoor air pressure
- Adjacent buildings or structures
- Surface moisture
- Reflections
- Low emissivity materials

2. Equipment

Infrared Scanner:	Calibrated radiometric FLIR T440 thermal imaging camera. The camera is equipped with a standard 25° wide (viewing angle) lens. For select images, the thermal camera was fitted with a 45° wide angle lens. All thermal images were recorded to an internal Compact Flash memory card.
Visible Light Camera:	Integrated visible light camera in FLIR T440 thermal imaging camera.
Temperature / Relative Humidity:	Kestrel 3000 handheld weather station.

3. Satellite Image

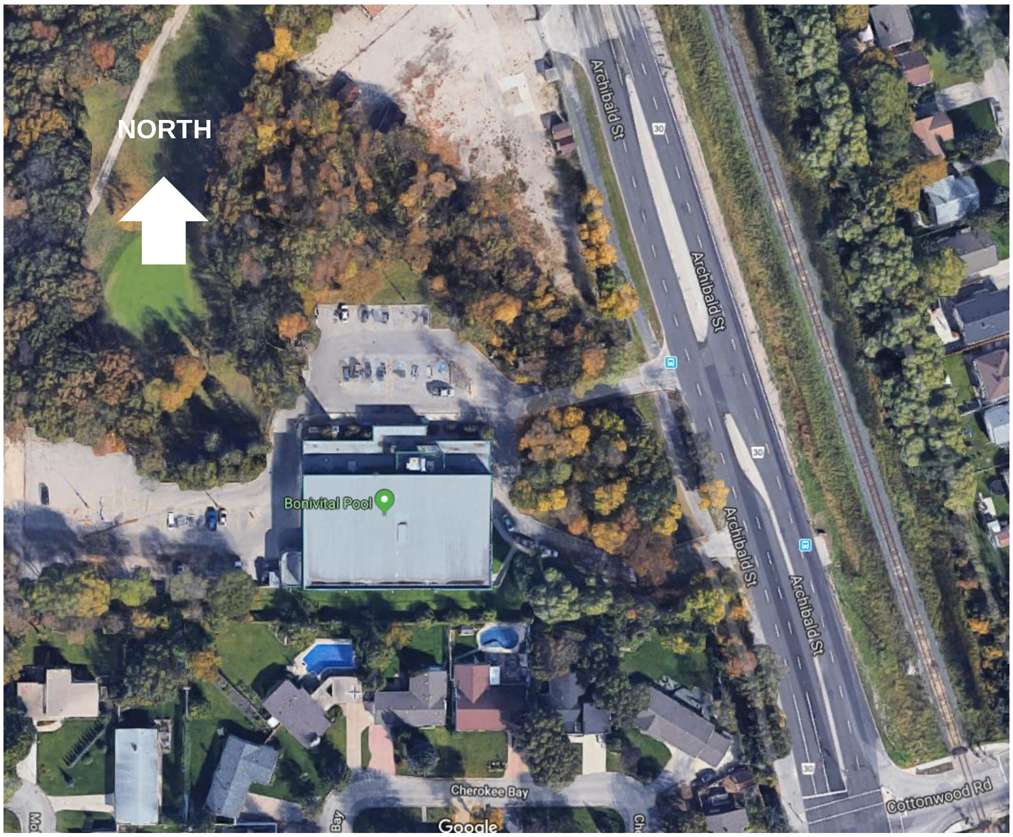


Figure 1: Satellite image of Bonivital Pool – 1215 Archibald Street, Winnipeg, Manitoba.

4. Background Information

A thermographic scan of Bonivital Pool located at 1215 Archibald Street, Winnipeg, Manitoba was completed by Tom Berthin, a Certified Level I Thermographer on November 27, 2018. The scan was an initial screening of the building envelope as part of ongoing facility management activities.

The scan started at approximately 6:00 a.m. to minimize the effects of solar loading on the cladding. The temperature at the time of the scan was -18° Celsius and the humidity was approximately 80%. The sky was clear with the wind from the west north-west at 14 km/hr. The building mechanical systems were in normal winter operating (heating) mode. A copy of the weather data from Environment Canada has been included in Section 6 of this report.

The thermographic scan uses infrared sensing photographic equipment to "observe" and record variations in the temperature of the exterior of the building. Thermal patterns created by such things as air leakage, thermal bridging, missing insulation or moisture within the wall assembly can be identified.

Thermal anomalies caused by air leakage are typically random in appearance. These anomalies can appear as intense bright spots where a concentrated air leak occurs. Alternately, they can appear as plumes, fingers or irregular shapes where the leakage is more disbursed. Air leakage was identified at several locations such as:

- Masonry control joints. Figure 2 shows a typical example of air leakage at masonry control joints.
- Exhaust vent discharge. Figure 3 shows a typical example of air leakage at exhaust vent discharge. Air leakage at these locations is a controlled air leakage.
- Vertical intersection of masonry and siding cladding. Figure 4 shows a typical example of air leakage at the vertical intersection of masonry and siding cladding. This condition was observed at one location on the South-West elevation only.
- Doors. Figure 5 shows a typical example of air leakage at doors.

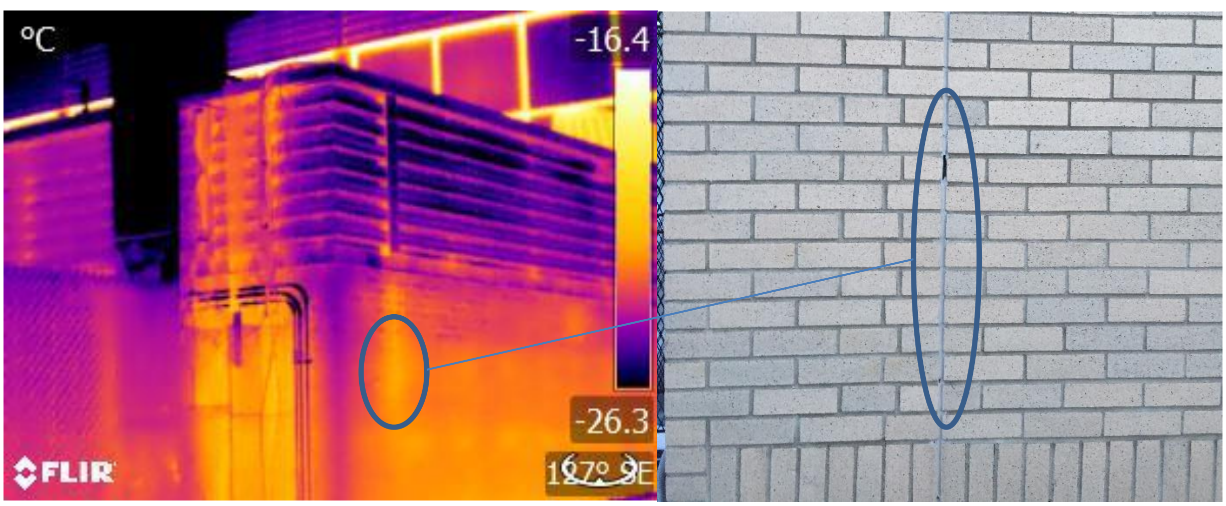


Figure 2: Air leakage at masonry control joint at West elevation (refer to Photograph #17). Air leakage at masonry control joints is a result of discontinuous and debonded sealant at the joints. The sealant at many of the control joints is debonded or discontinuous. Warm, moist air from within the pool building leaking through the control joints will cause condensation when in contact with cold outdoor air or colder building materials. The condensation created can cause deterioration of the masonry over the long term.

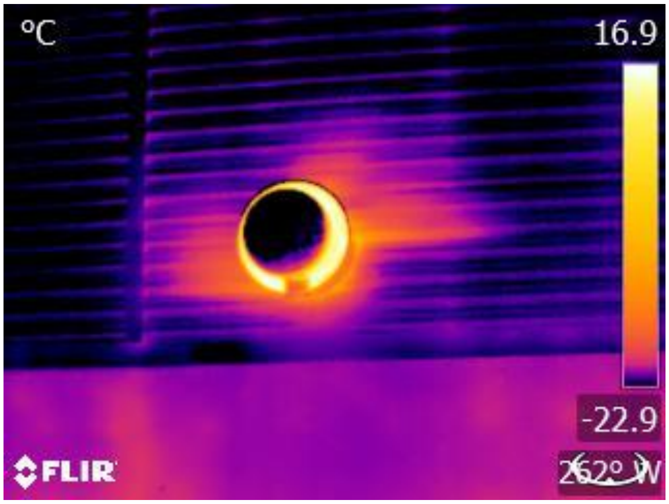


Figure 3: Air leakage at exhaust vent (refer to Photograph #55). Air leakage at this location is a controlled air leakage caused by mechanical exhaust fans.

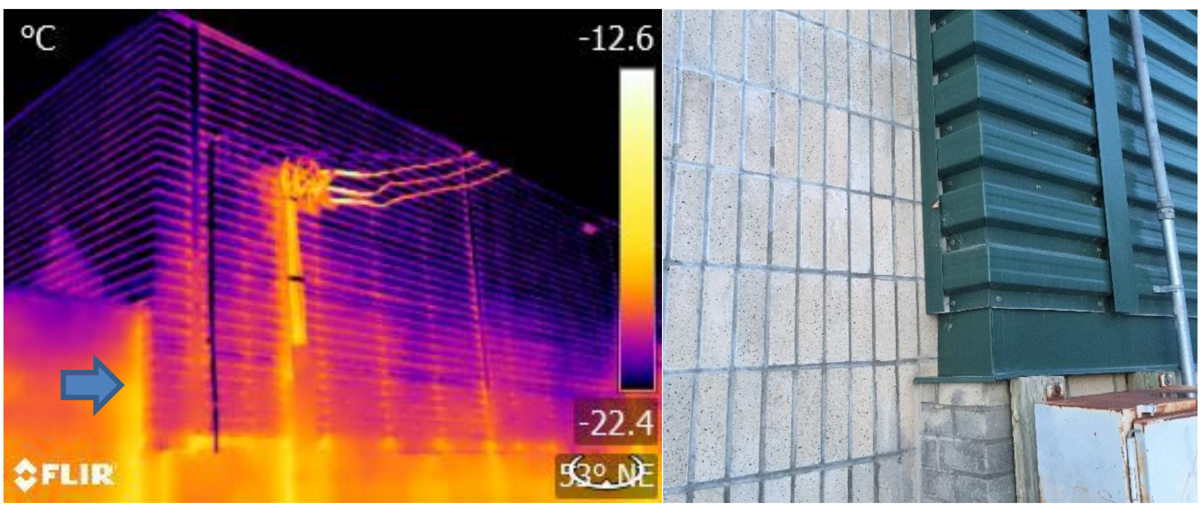


Figure 4: Air leakage vertical intersection of siding and brick cladding. South elevation at West end (refer to Photograph #31). Air leakage at this location is typically a result of discontinuous air barrier at the intersection of the cladding materials. Warm, moist air from within the pool building leaking through this location will create condensation when in contact with cold outdoor air or colder building materials. The condensation created can cause deterioration of the masonry over the long term.

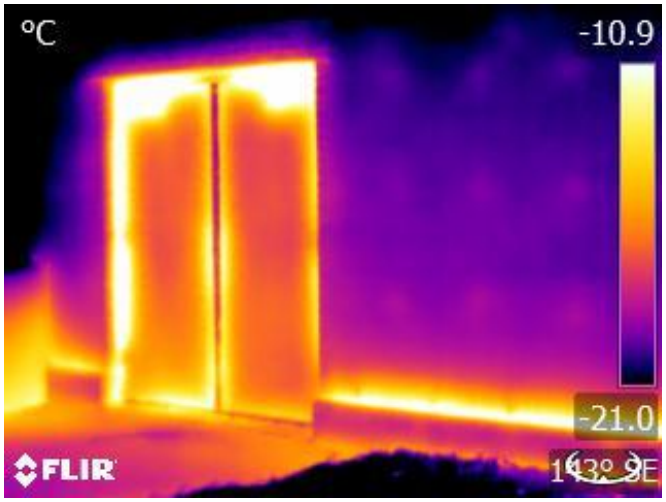


Figure 5: Air leakage at doors (refer to Photograph #51). Air leakage at doors is typically the result of worn gaskets and weather-stripping on door frames. Warm, moist air from within the pool building leaking through this location will create condensation when in contact with cold outdoor air or colder building materials. The condensation created can cause corrosion of the metal doors and frames.

Thermal bridging occurs at locations where members of the wall assembly span between the warm interior and cold exterior surfaces. These bridges create a more direct path for heat flow and cause elevated temperatures on the exterior surface of the cladding during colder weather. The thermal anomalies created by these members are usually linear and relatively uniform in appearance.

Thermal bridging was observed at various typical locations around the building such as:

- Window frames. Figure 6 shows an example of thermal bridging at window frames. The metal window frames are heated by the interior space. This heat is conducted through the metal window frame. Thermal bridge at metal frames is common for all metal frames and other than heat loss and energy efficiency losses, this condition is not anticipated to cause significant deterioration of building materials.
- Intersection of inside wall corners. Figure 7 shows a typical example of this condition. Thermal bridging at corners is typical in a building of masonry construction. The mass of masonry intersecting at a corner creates a conduit for heat to flow from warm interior to cold exterior. Other than heat loss and energy efficiency losses, this condition is not anticipated to cause significant deterioration of building materials
- Metal siding control joints and supporting girts. Figure 8 shows an example of this condition. Heat from the interior is conducted from the wall and through the metal girts supporting the siding. Similarly, heat is transferred through the siding at the control joint flashing. This condition is not anticipated to impact the long-term durability of the building.
- Masonry wall ties. Figure 9 shows an example of this condition. Similar to the siding support girts, heat is transferred across the wall though the structural ties that bond the clay brick veneer to the interior concrete block wall. This condition is common for this type of wall system and is not anticipated to impact the long-term durability of the building.
- Foundation wall at intersection with grade. Figure 9 also shows an example of this condition. Heat from the interior is conducted through the foundation wall. This condition is not anticipated to impact the long-term durability of the building.

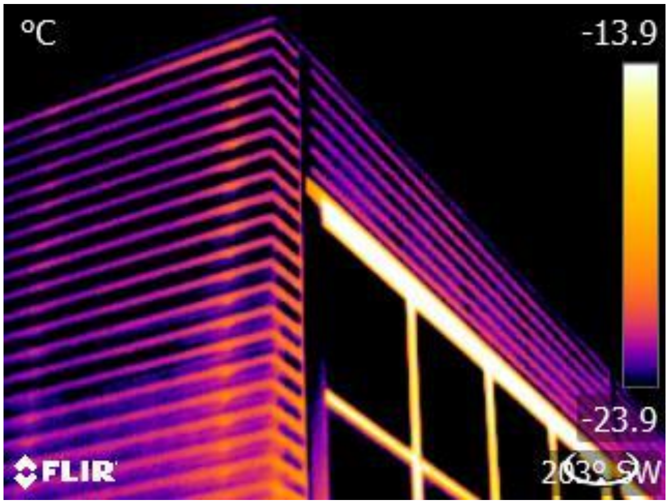


Figure 6: Thermal bridge at window frames at North elevation (refer to Photograph #65).

Figure 7: Thermal bridge at inside corner of North elevation wall intersection at entrance (refer to Photograph #5). Direct path for heat flow from mass of masonry at the corner causes elevated temperatures on the exterior surface during colder weather.

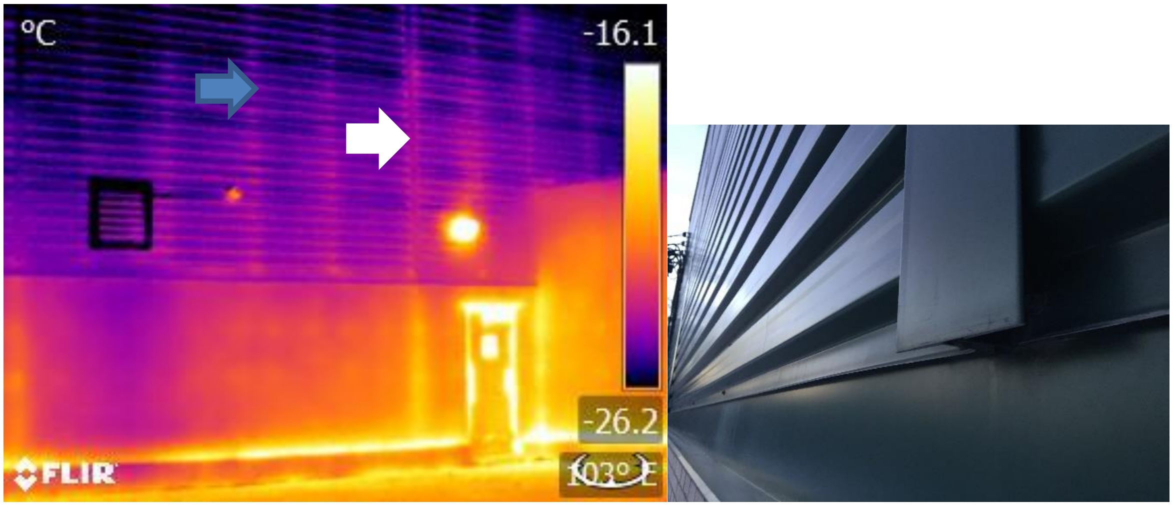


Figure 8: Metal siding control joints and supporting girts at West elevation (refer to Photograph #27). Heat transfer through steel girts supporting the siding (blue arrow) and at siding control joints (white arrow) and photograph to right).

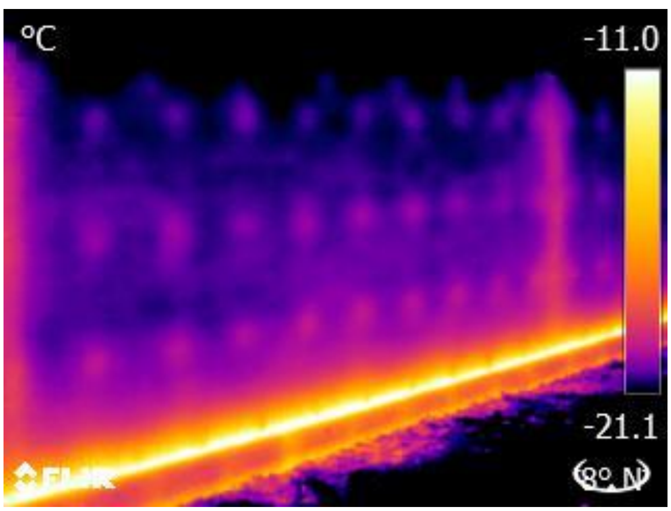


Figure 9: Masonry wall ties and foundation wall at grade at East elevation (refer to Photograph #57). Heat transfer through wall at ties supporting the clay brick veneer. Also, heat transfer through the foundation wall at grade.

A thermal anomaly was observed at the intersection of the clay brick veneer and the foundation wall. Figure 10 shows an example of this condition. The cause of the heat transfer is not known and could be caused by thermal bridge through the mortar. The thermal anomaly could also be cause by air leakage through the mortar joint between the clay brick veneer and the foundation wall. If warm moist air from within the pool area leaks through the intersection between the brick veneer and the top of the foundation wall, condensation will form when it meets a cold surface. The condensation will cause deterioration to the concrete foundation wall and brick. Investigation of this condition is hampered as exterior insulation; cement board and metal flashing are installed over the foundation wall. Intrusive investigations will be required to review the condition of the foundation wall. Further review is recommended to assess if air leakage is occurring at this location.

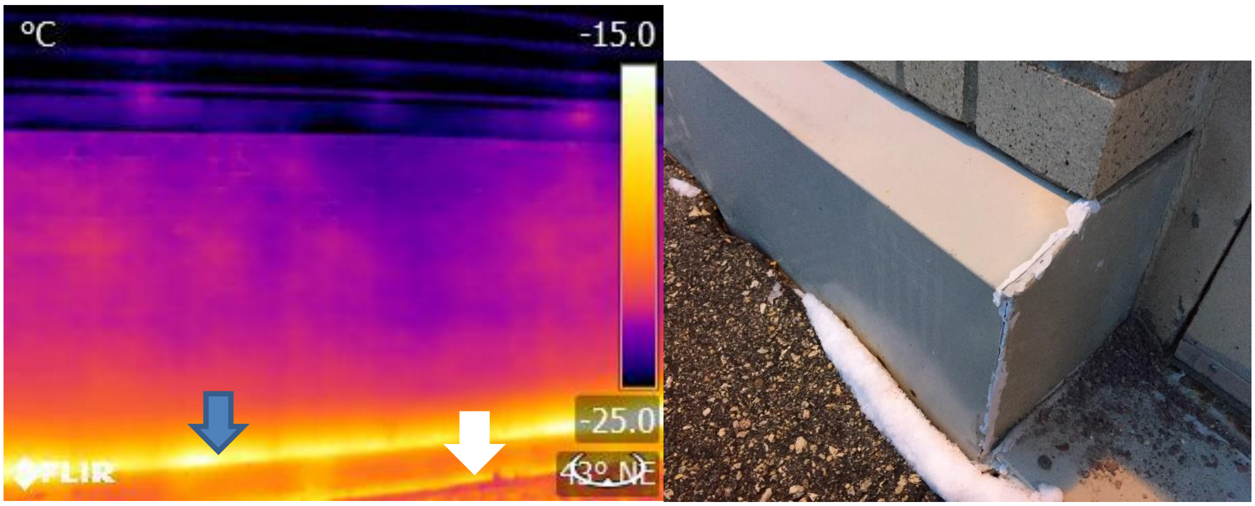


Figure 10: Thermal anomaly at the intersection of the brick cladding and foundation wall (blue arrow). Note that this thermal anomaly is located at the intersection of the top of the foundation wall and brick cladding and not at the intersection of the foundation wall and grade (white arrow). Also note that insulation and metal flashing is installed outboard of the foundation wall below the brick cladding.

Generally, the thermographic scan did not identify significant deficiencies in the building envelope.
Maintenance replacement of weather stripping and gaskets will address air leakage at doors.
Maintenance replacement of sealant at masonry control joints will address air leakage at masonry control joints.

A follow-up review of the condition at the intersection of the brick masonry veneer and foundation all is recommended. The review should include intrusive investigations to observe the condition of the concrete foundation wall and air leakage testing of the building envelope.

We trust this report provides the information you require at this time. Should you have questions or if you require additional clarification, please call.

Prepared by:

Tom Berthin
Certified Level I Thermographer

Reviewed by:

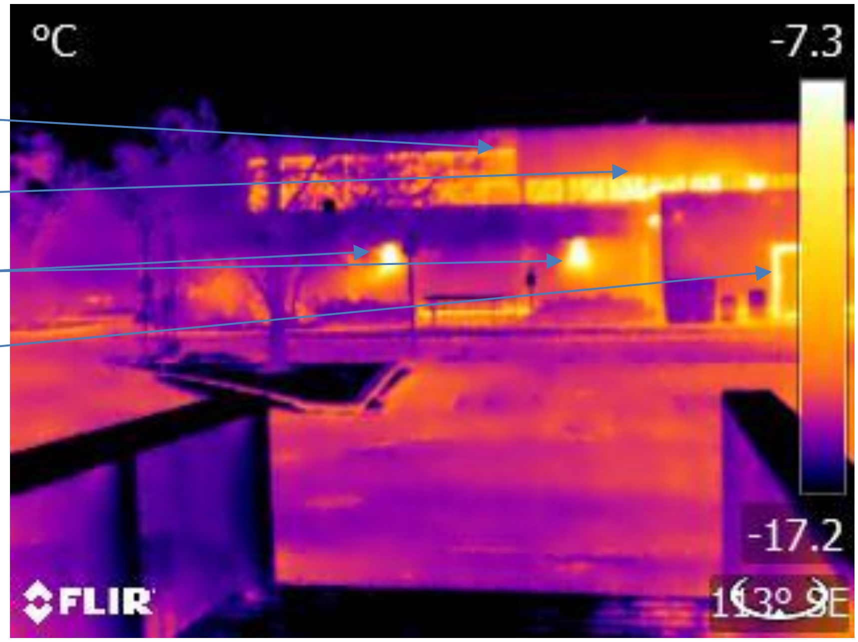
Chris Richter, C.E.T.
Certified Level III Thermographer

5. Thermographic Scan

Photograph #1:

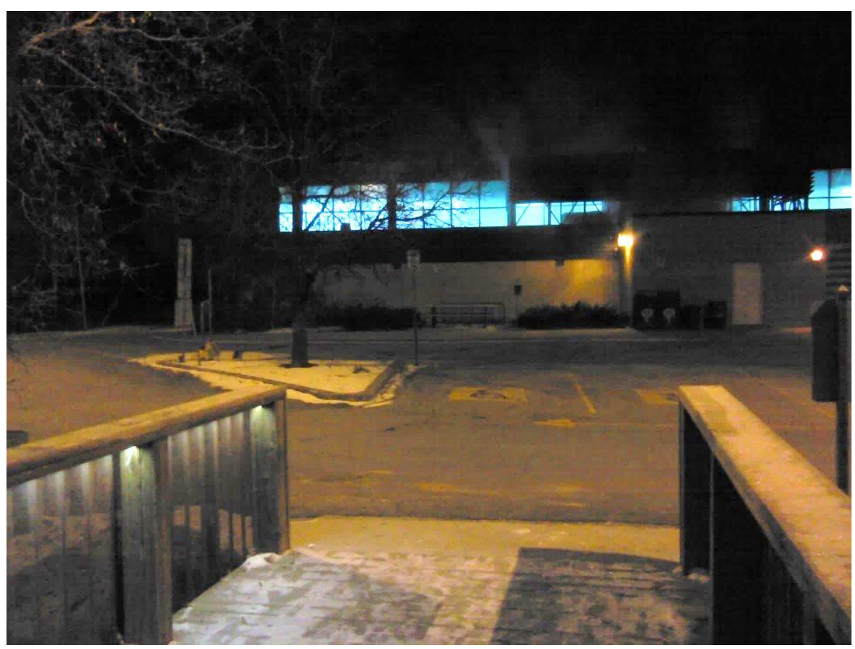
North elevation.
Note:

- Thermal bridge at window frames.
- Thermal anomaly caused by discharge of roof-top air handling unit.
- Thermal anomaly caused by air discharge at exhaust vents.
- Air leakage around door.



Photograph #2:

North elevation.

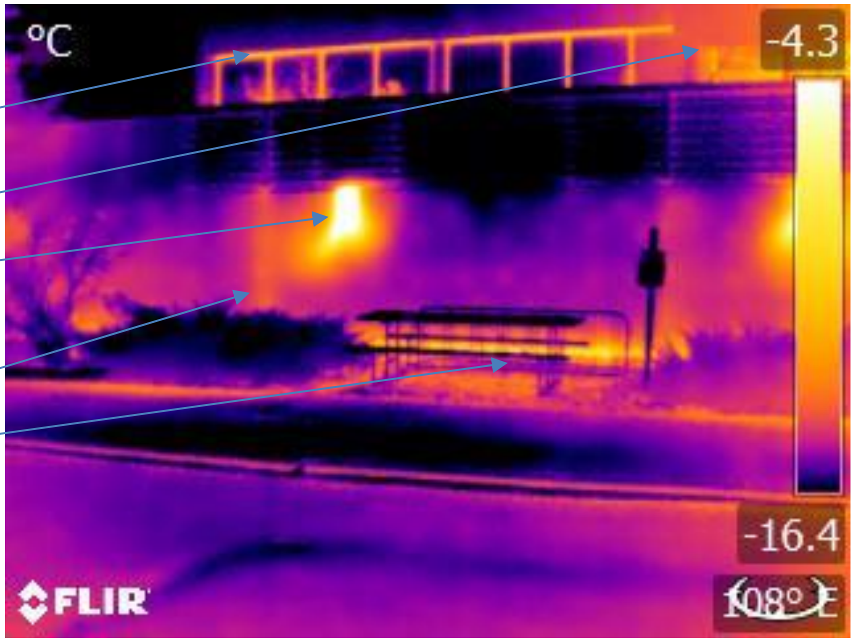


Photograph #3:

North elevation.

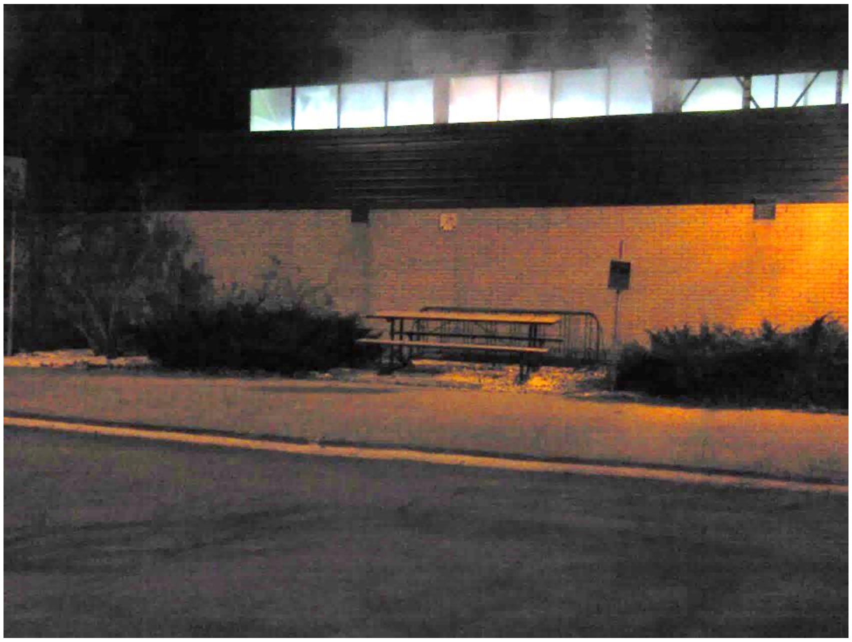
Note:

- Thermal bridge at window frames.
- Thermal anomaly caused by discharge of roof-top air handling unit.
- Thermal anomaly caused by air discharge at exhaust vents.
- Thermal bridge at masonry control joint.
- Thermal anomaly at foundation wall.



Photograph #4:

North elevation.



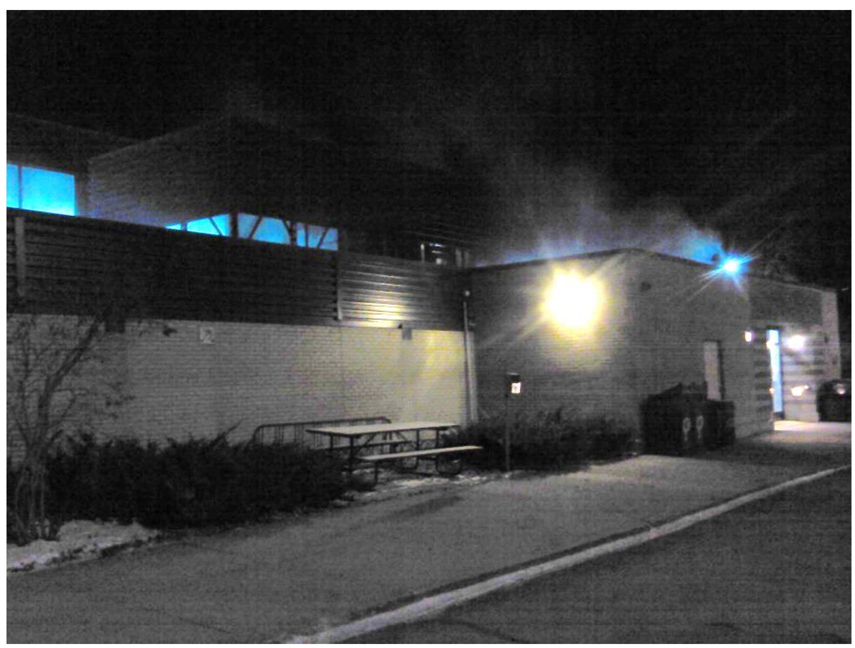
Photograph #5:

North elevation, east of entrance.
Note:

- Thermal anomaly caused by discharge of roof-top air handling unit.
- Thermal anomaly at light fixture.
- Thermal bridge at inside corner walls.
- Thermal anomaly at exhaust vent.
- Thermal bridge at masonry control joint.
- Thermal bridge at masonry wall ties.

Photograph #6:

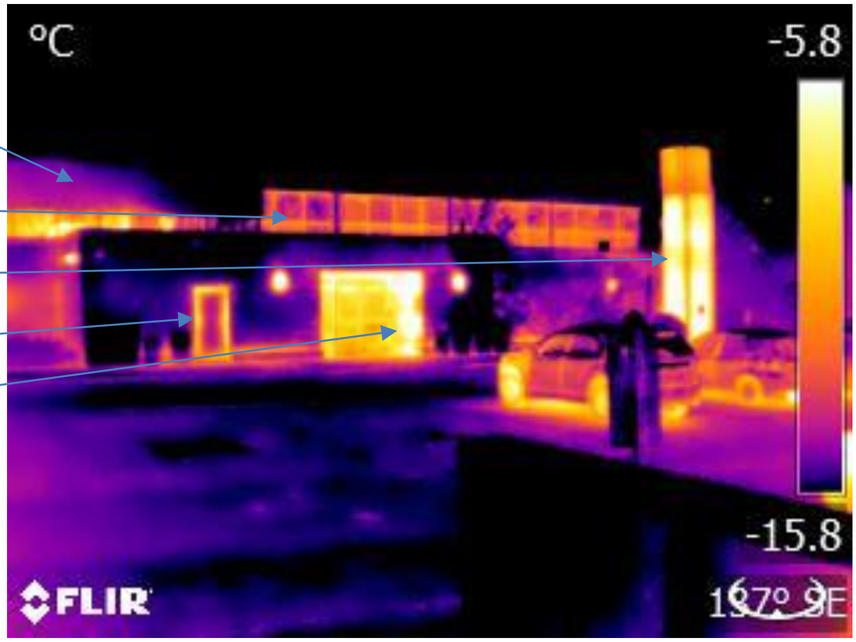
North elevation, east of entrance.



Photograph #7:

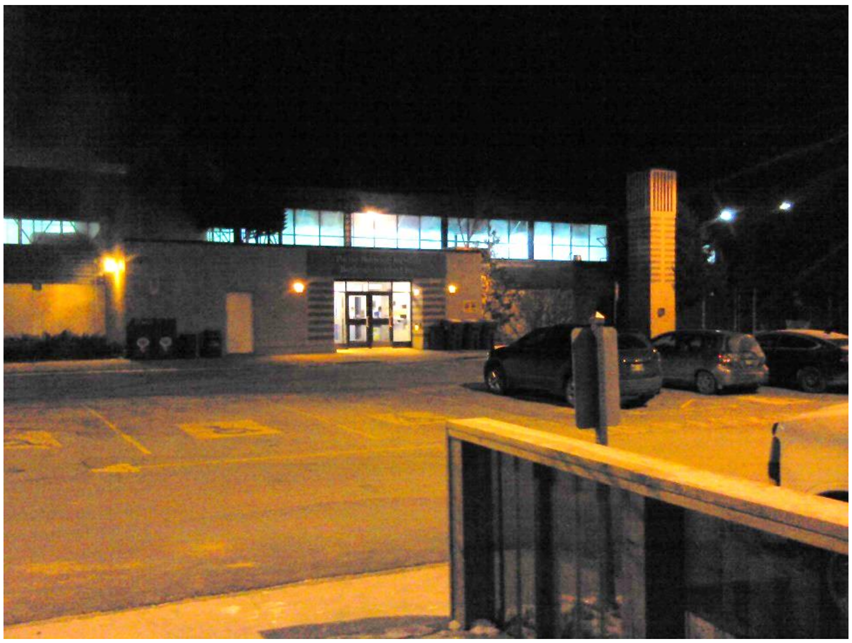
North elevation, west end.
Note:

- Thermal anomaly caused by discharge of roof-top air handling unit.
- Thermal bridge at window frames.
- Thermal anomaly at chimney.
- Air leakage at door.
- Thermal anomaly in door alcove caused by light fixtures.



Photograph #8:

North elevation, west end.

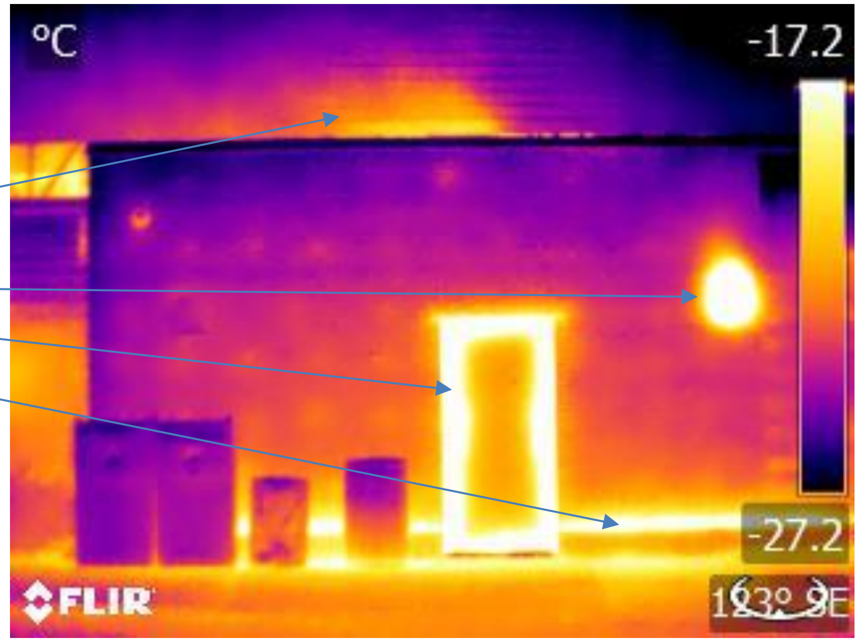


Photograph #9:

North elevation. Close-up of service door, east of main entrance.

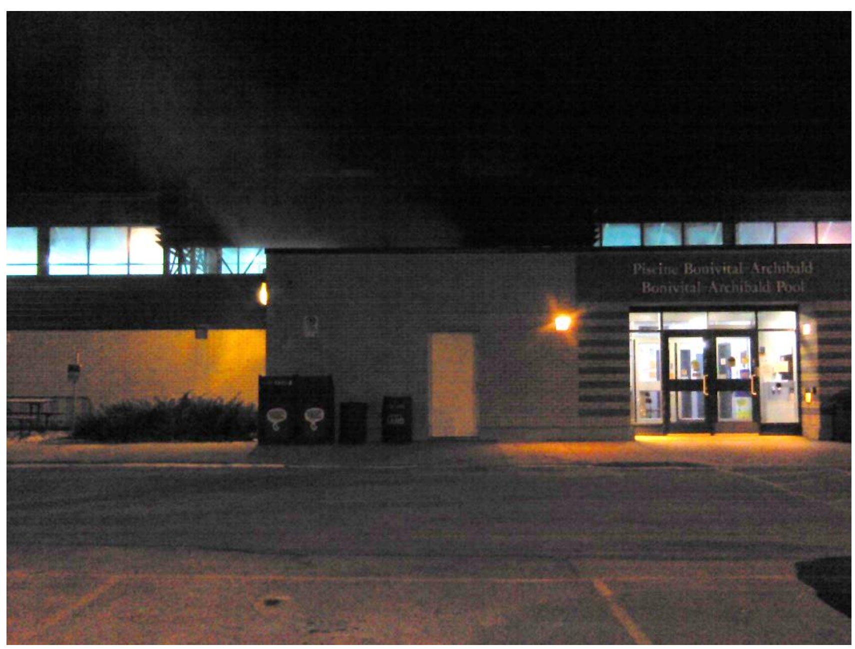
Note:

- Thermal anomaly caused by discharge of roof-top air handling unit.
- Thermal anomaly at light fixture.
- Air leakage at door.
- Thermal anomlay at intersection of foundation wall and brick cladding.



Photograph #10:

North elevation. Close-up of service door, east of main entrance.

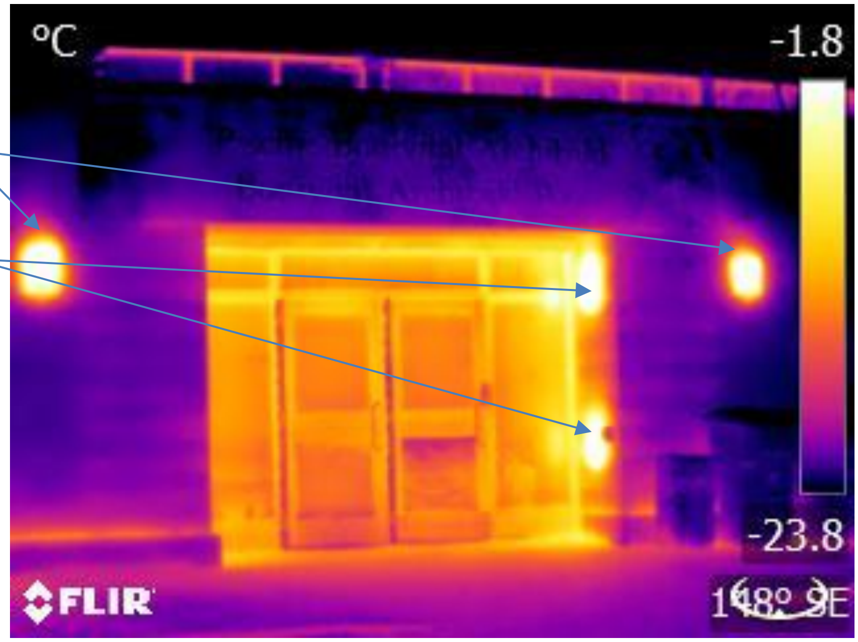


Photograph #11:

North elevation at Main Entrance.

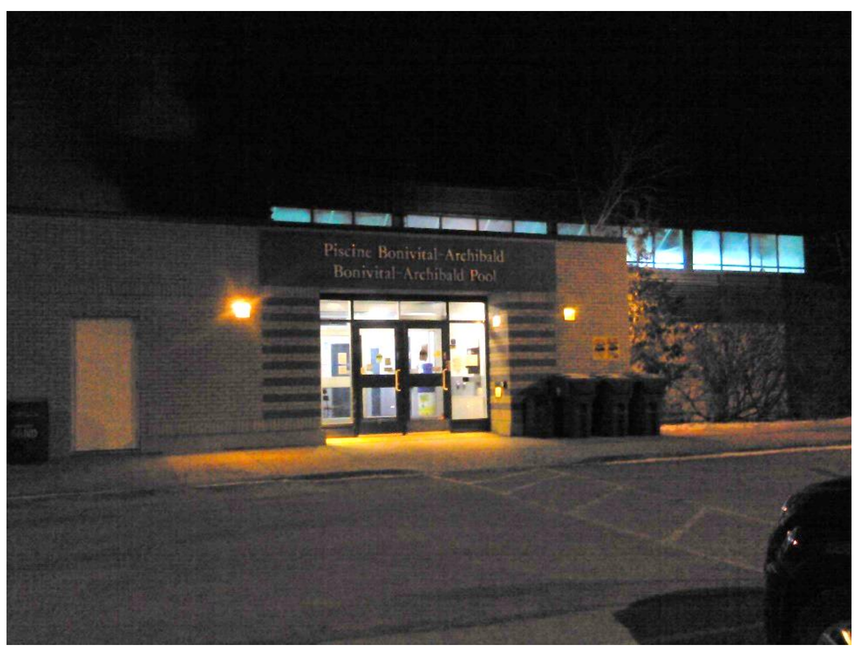
Note:

- Thermal anomaly caused by light fixture.
- Thermal anomaly caused by light fixture and intensified by stagnant air within entrance alcove.



Photograph #12:

North elevation at Main Entrance.

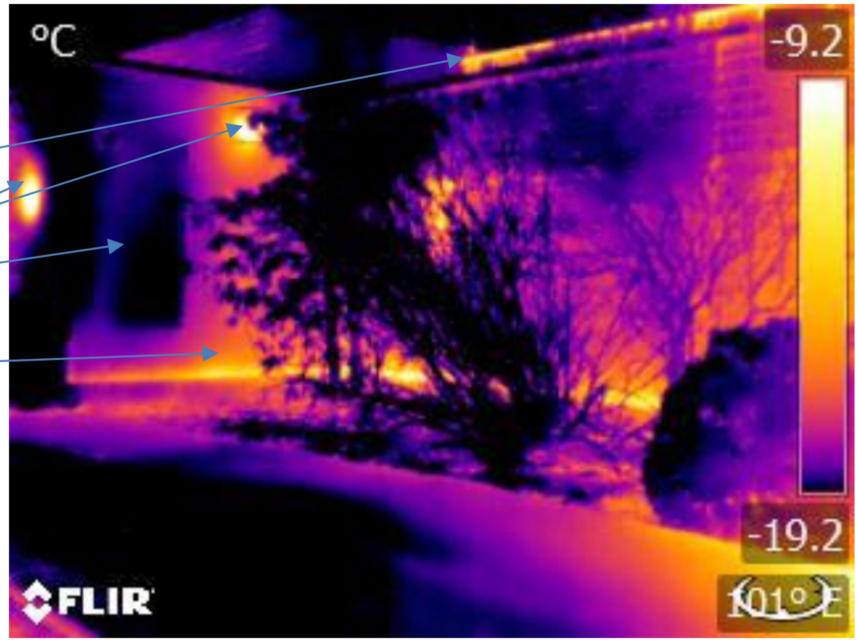


Photograph #13:

North elevation, west of entrance.

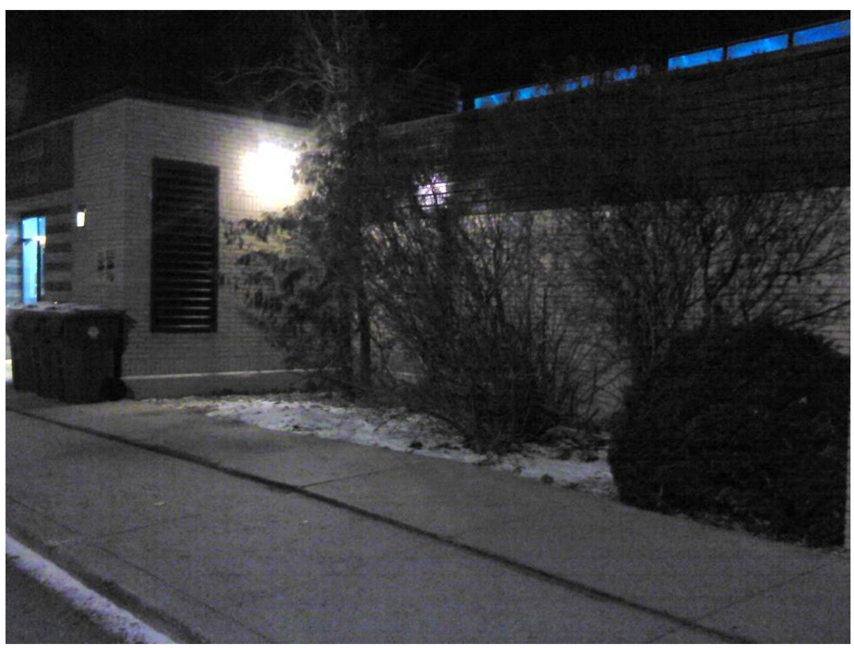
Note:

- Thermal bridge at window frames.
- Thermal anomaly at light fixtures.
- Thermal anomaly at intake grille.
- Thermal anomaly at intersection of foundation wall and masonry cladding.



Photograph #14:

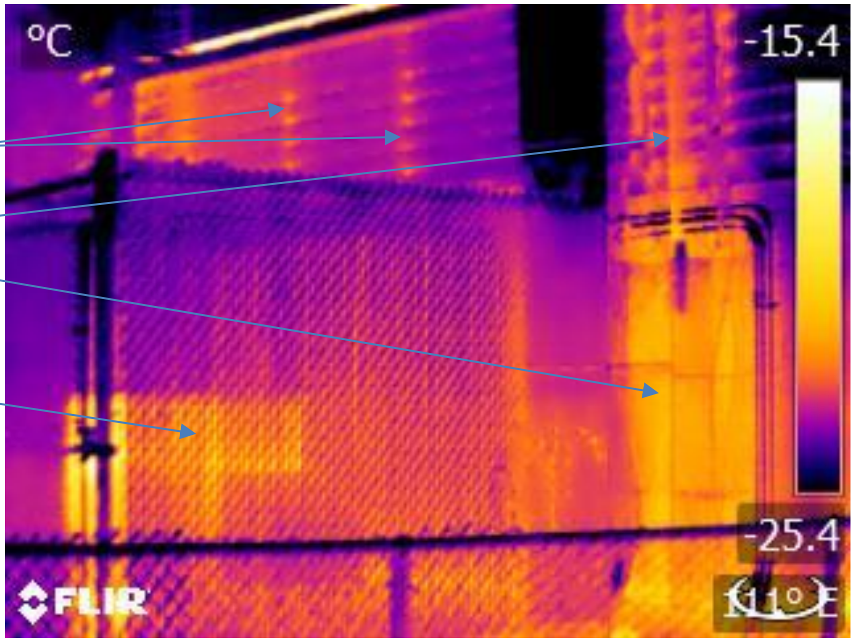
North elevation, west of entrance.



Photograph #15:

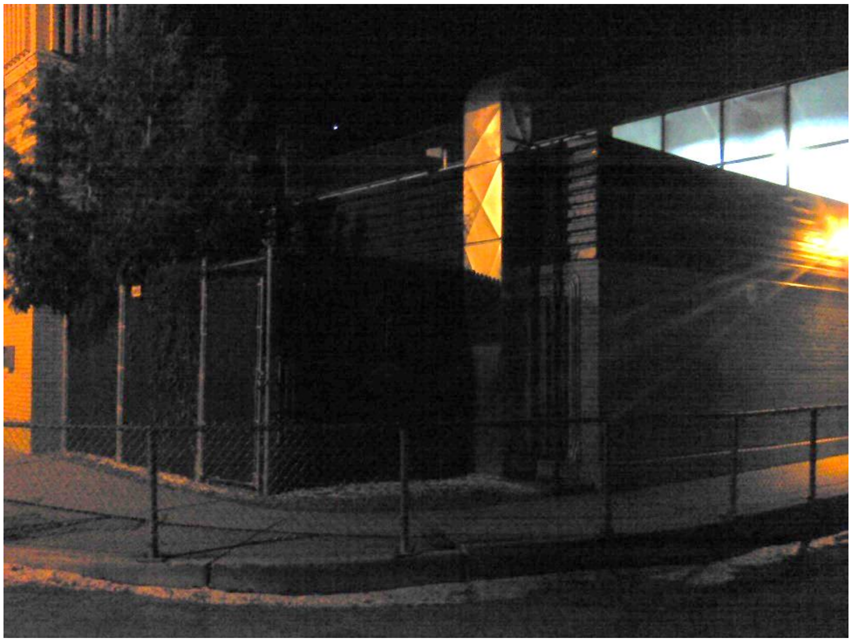
North elevation, west corner at mechanical compound.
Note:

- Thermal bridge at metal siding fasteners.
- Thermal anomaly at electrical conduit.
- Thermal anomaly at ductwork due to reflectivity of metal ductwork.
- Thermal anomaly at transformer (behind slatted fence).



Photograph #16:

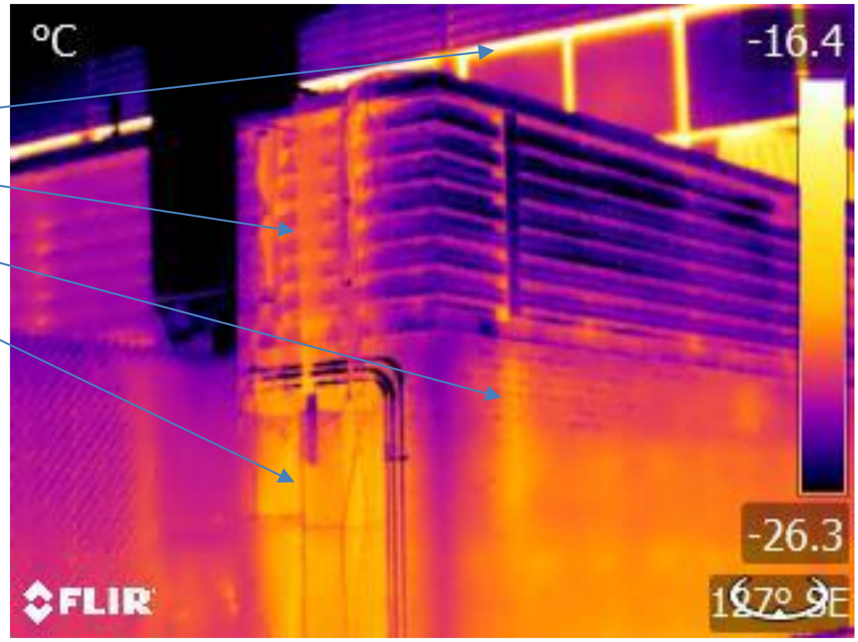
North elevation, west corner at mechanical compound.



Photograph #17:

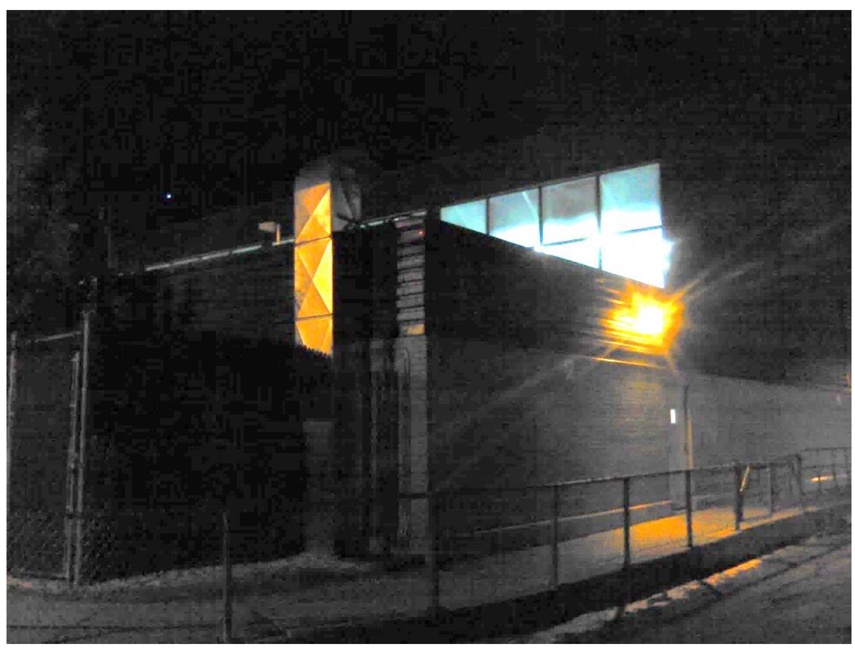
North-West corner.
Note:

- Thermal bridge at windows.
- Thermal anomaly at electrical conduit.
- air leakage at masonry cladding control joint
- Thermal anomaly at metal ductwork caused by reflectivity of metal.



Photograph #18:

North-West corner.



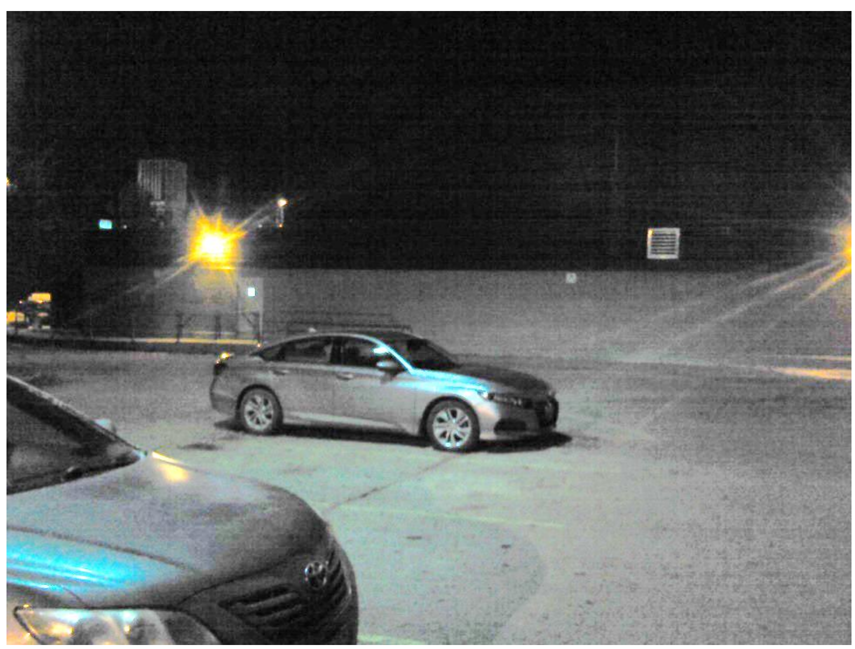
Photograph #19:

West elevation, north half.
Note:

- Thermal anomaly at chimney.
- Thermal bridge at siding control joint.
- Air leakage at masonry cladding control joints.
- Thermal anomaly at intersection of foundation wall and masonry cladding.

Photograph #20:

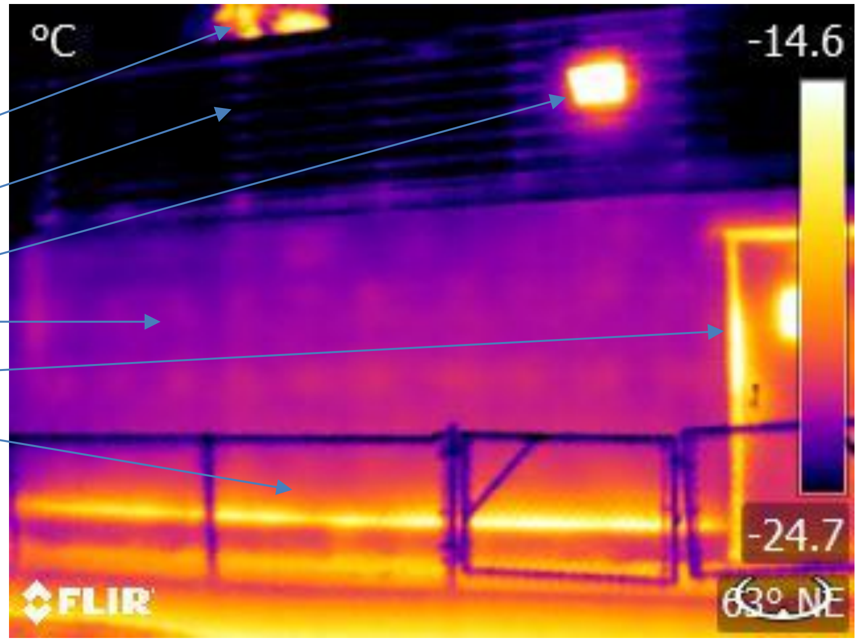
West elevation, north half.



Photograph #21:

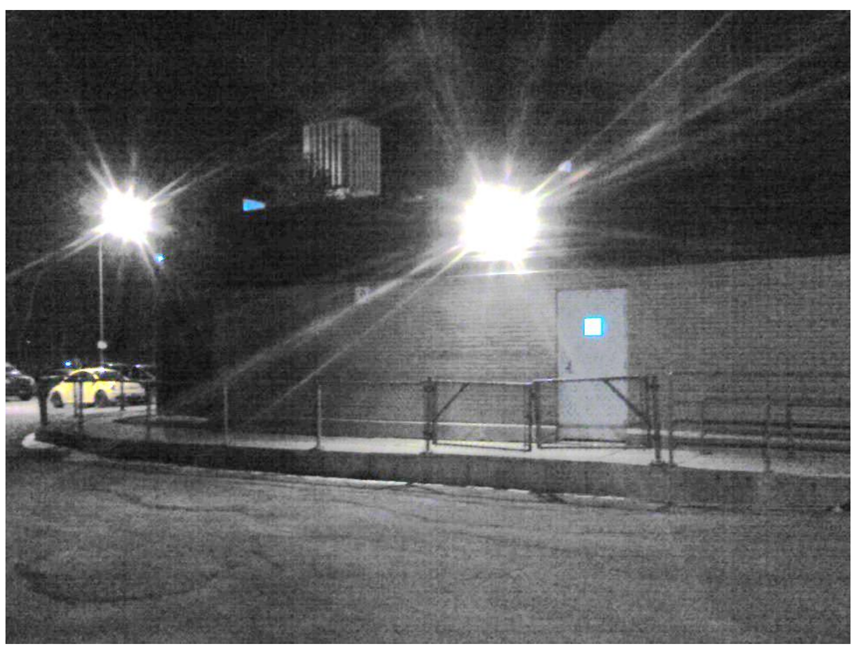
West elevation, close-up view at north service door.
Note:

- Thermal anomaly at chimney.
- Thermal bridge at siding control joints.
- Thermal anomaly at light fixture.
- Thermal bridge at masonry wall tiles.
- Air leakage around door.
- Thermal anomaly at intersection of brick cladding and foundation wall.



Photograph #22:

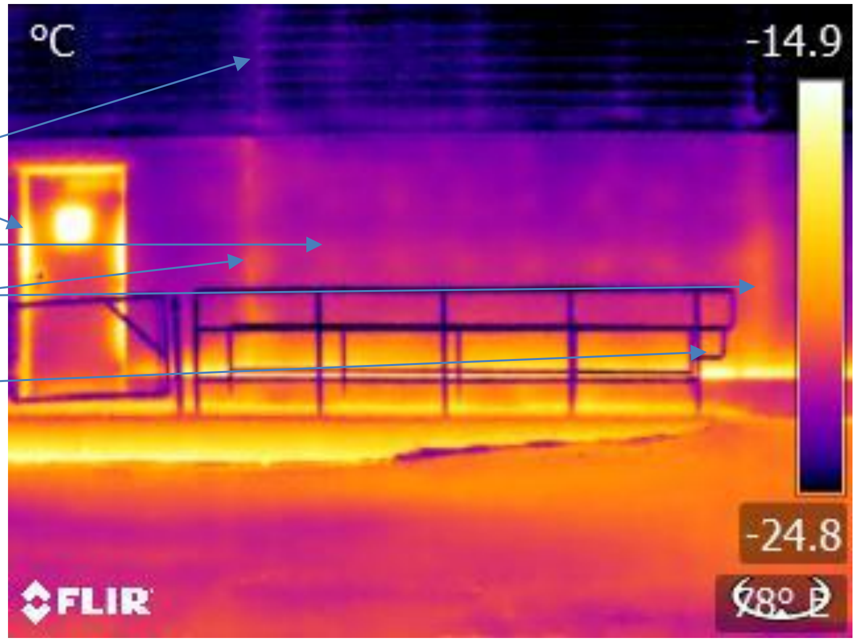
West elevation, close-up view at north service door.



<u>Photograph #23:</u>

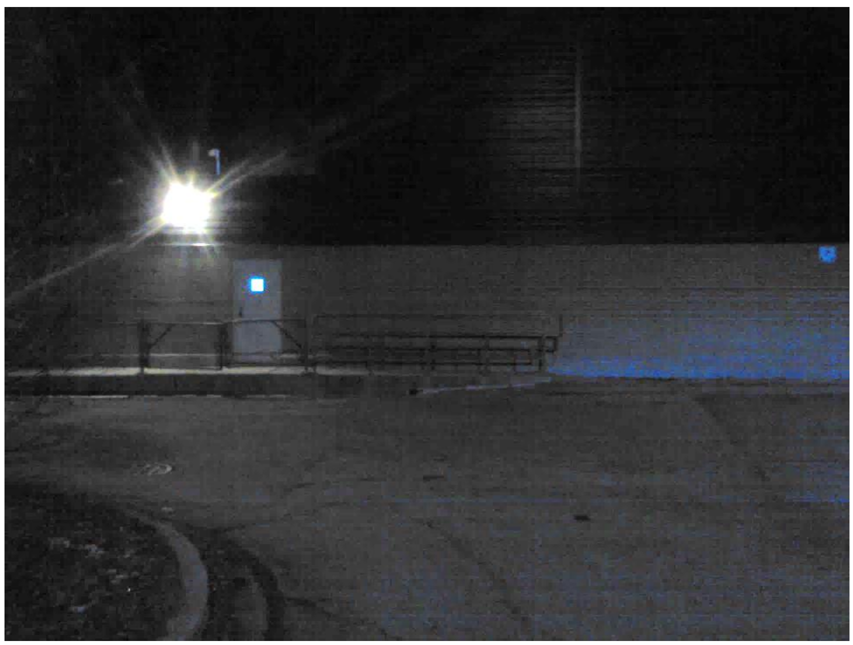
West elevation, south of north service door.
Note:

- Thermal bridge at siding control joints.
- Air leakage at door.
- Thermal bridge at masonry wall ties.
- Air leakage at masonry control joints.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



<u>Photograph #24:</u>

West elevation, south of north service door.



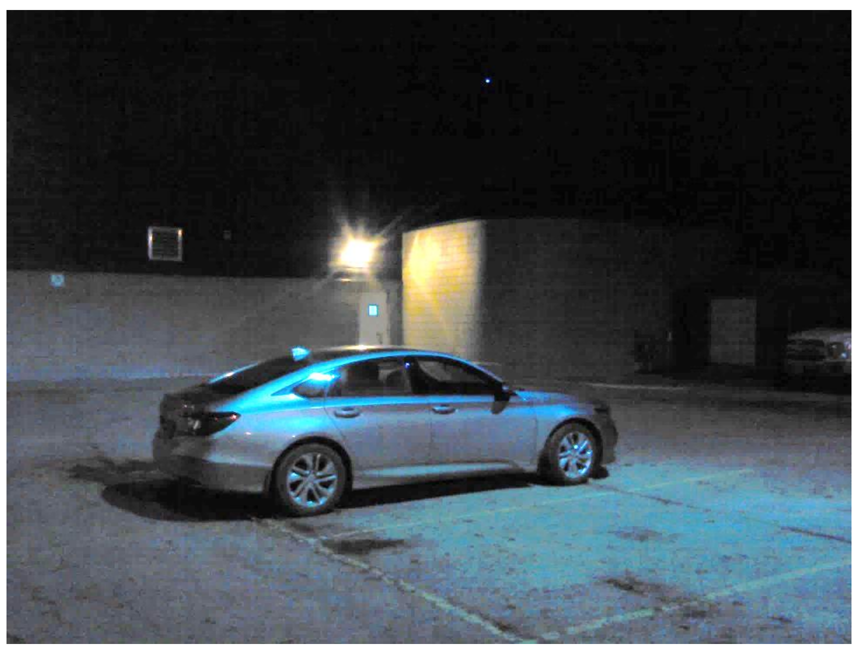
<u>Photograph #25:</u>

West elevation, north half.
Note:

- Thermal bridge at siding control joints.
- Thermal anomaly at light fixture.
- Air leakage at masonry control joints.
- Air leakage at door.

<u>Photograph #26:</u>

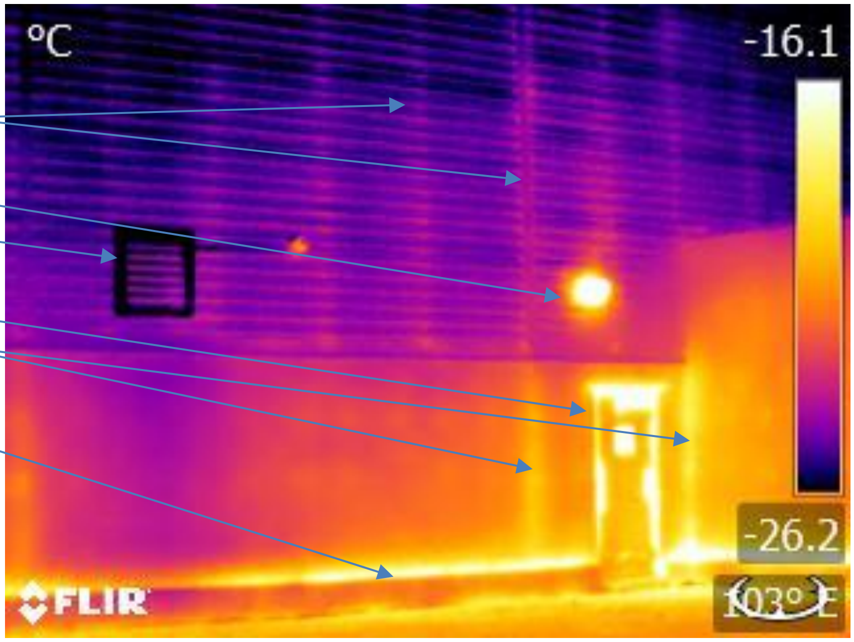
West elevation, north half.



Photograph #27:

West elevation, south end.
Note:

- Thermal bridge at siding supports and control joint.
- Thermal anomaly at light fixture.
- Thermal anomaly at intake grille.
- Air leakage at door.
- Air leakage at masonry control joints.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



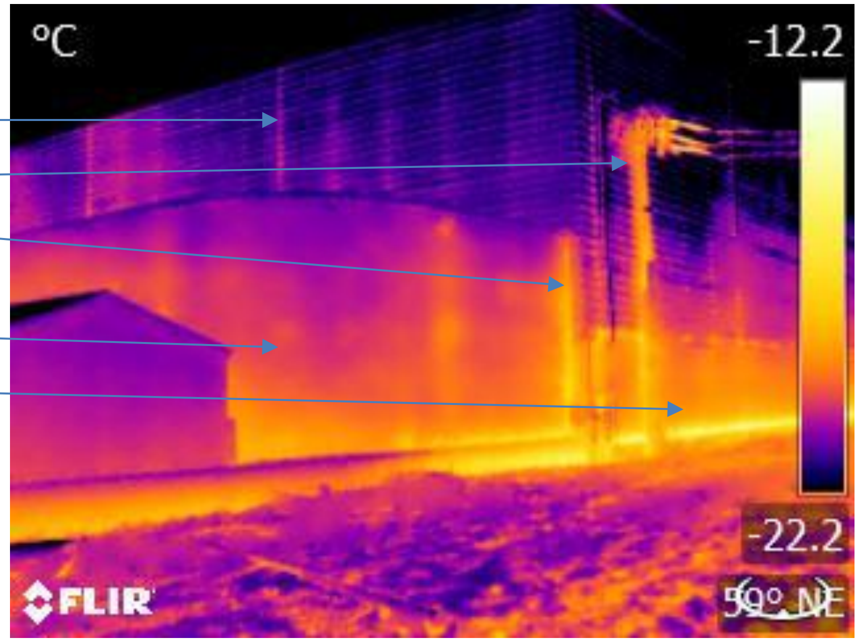
Photograph #28:

West elevation, south end.

Photograph #29:

South-West corner.
Note:

- Thermal bridge at siding control joints.
- Thermal anomaly at electrical connection.
- Air leakage at intersection of masonry and siding cladding.
- Thermal bridge at masonry wall ties.
- Thermal anomaly at intersection of siding cladding and foundation wall.



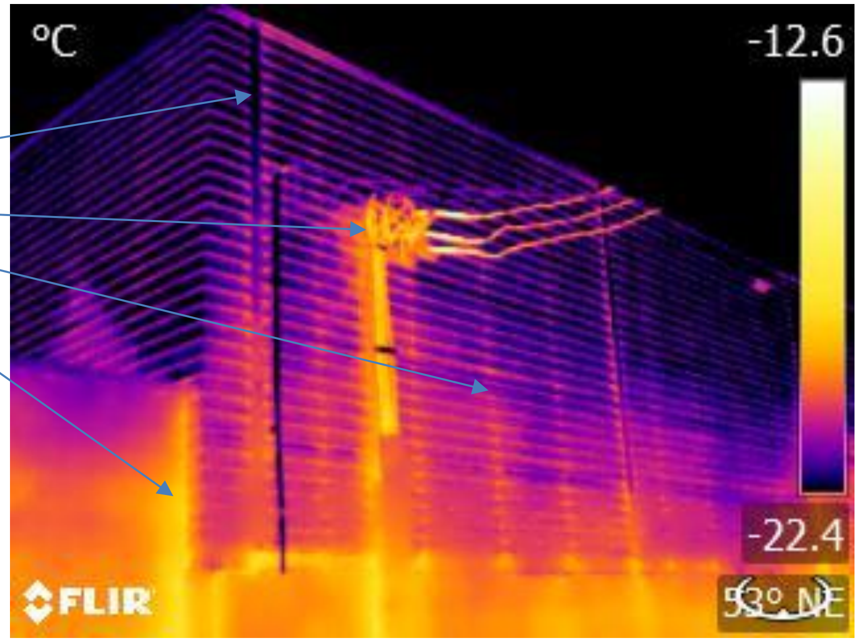
Photograph #30:

South-West corner.

<u>Photograph #31:</u>

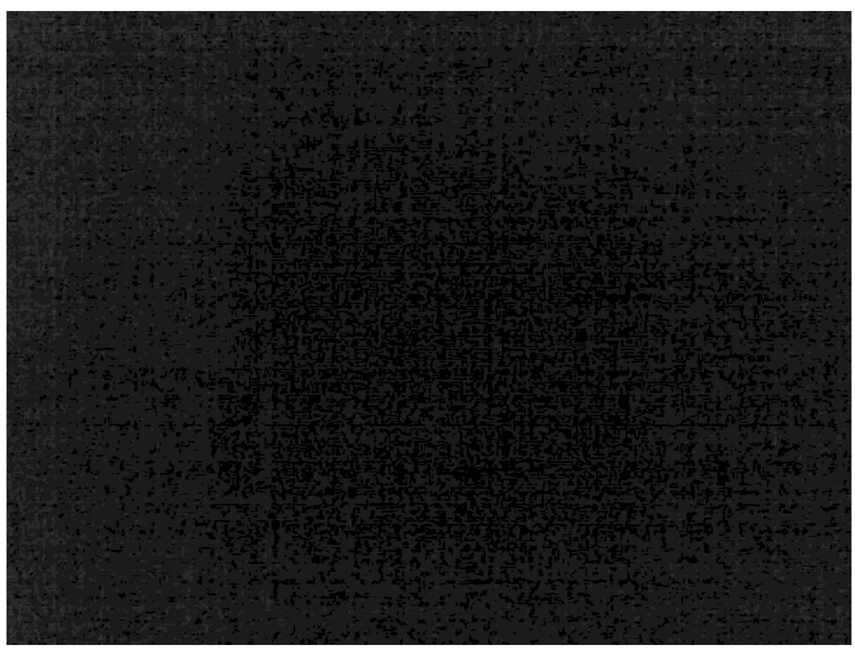
South-West corner. Close-up view of siding section. Note:

- Thermal anomaly at siding control joint.
- Thermal anomaly at electrical connection.
- Thermal bridge at siding supports.
- Air leakage at intersection of siding and masonry cladding.



<u>Photograph #32:</u>

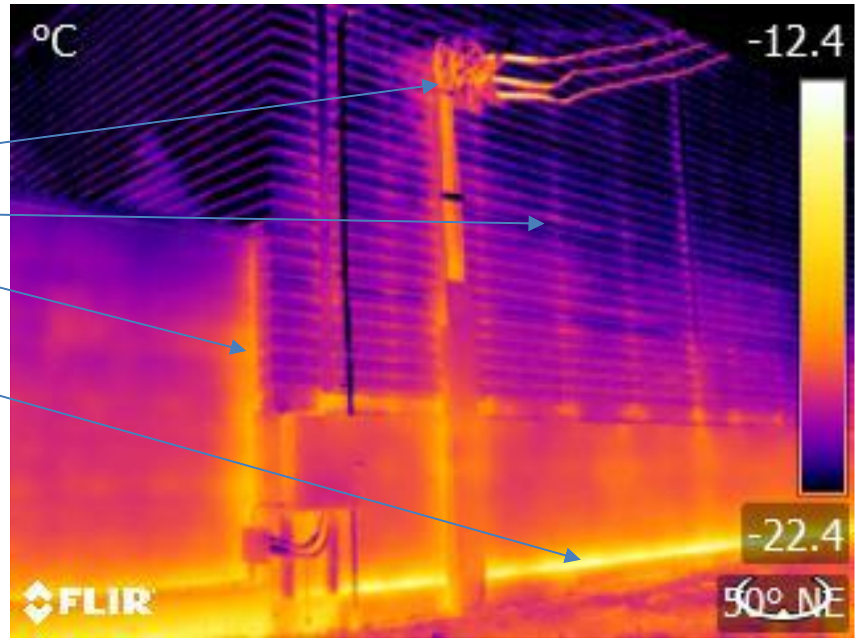
South-West corner. Close-up view of siding section.



Photograph #33:

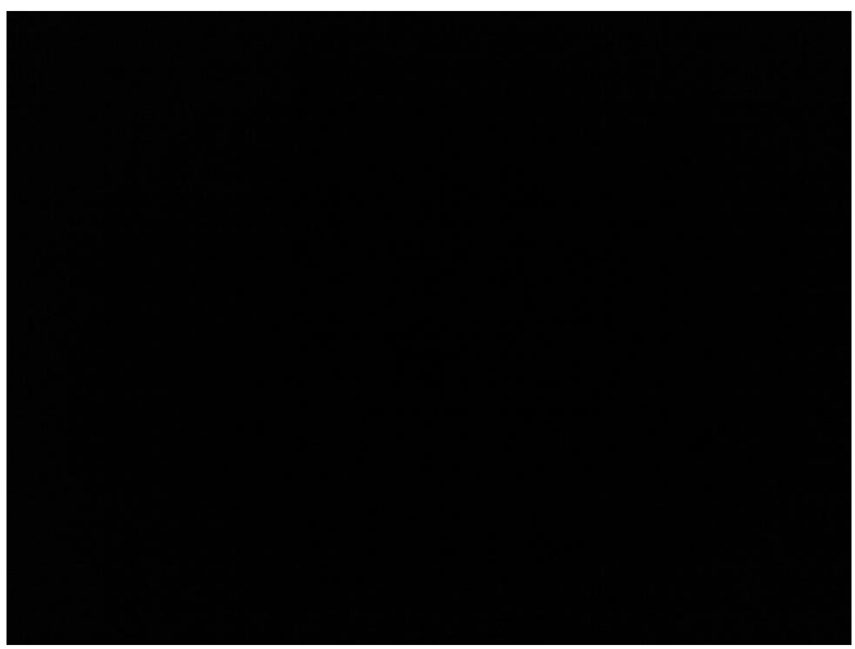
South-West corner. Close-up view at base of wall.
Note:

- Thermal anomaly at electrical connection.
- Thermal bridge at siding supports.
- Thermal anomaly at intersection of siding and masonry cladding.
- Thermal anomaly at intersection of masonry wall and foundation wall.



Photograph #34:

South-West corner. Close-up view at base of wall.

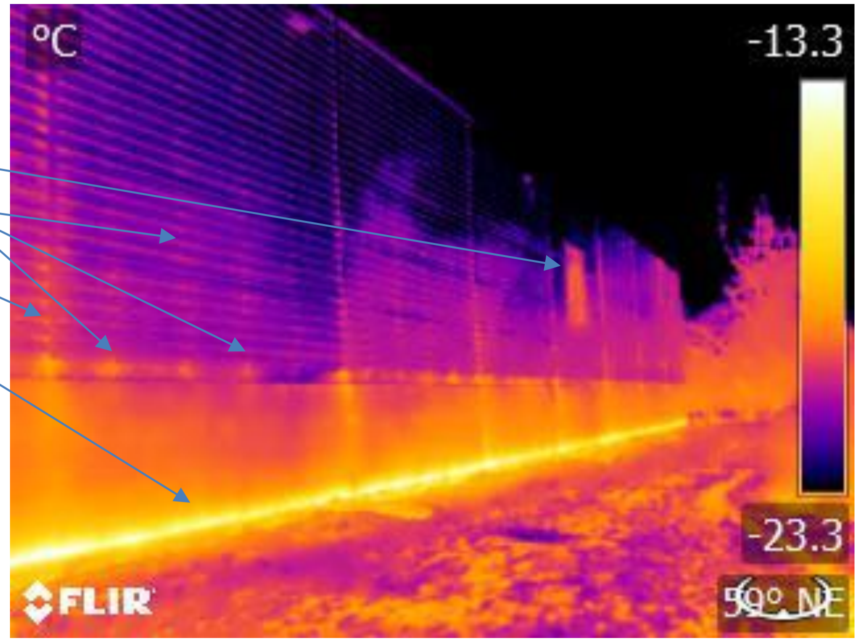


Photograph #35:

South elevation. View looking east.

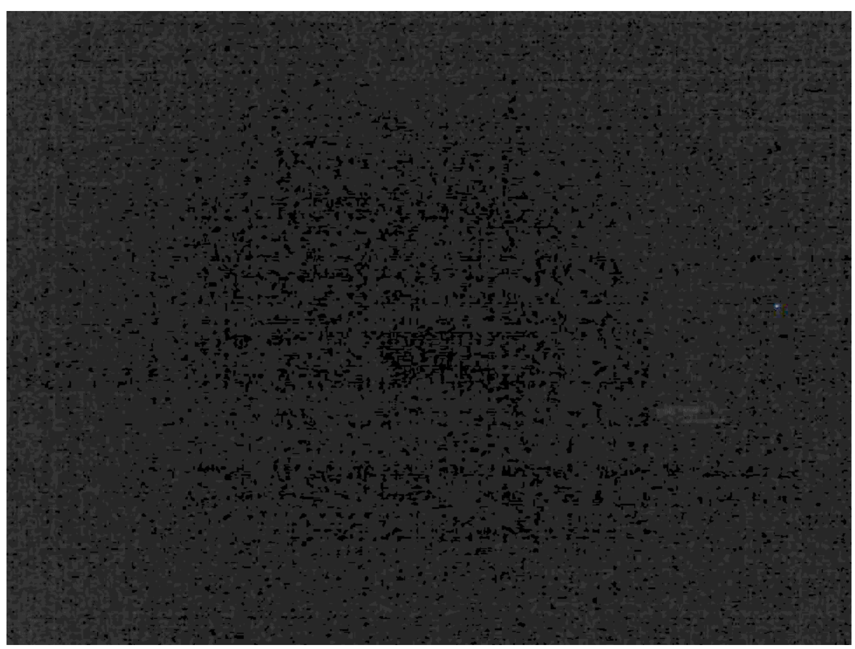
Note:

- Thermal anomaly at mechanical vent.
- Thermal bridge at siding supports.
- Thermal bridge at siding control joints.
- Thermal bridge at intersection of masonry cladding and foundation wall.



Photograph #36:

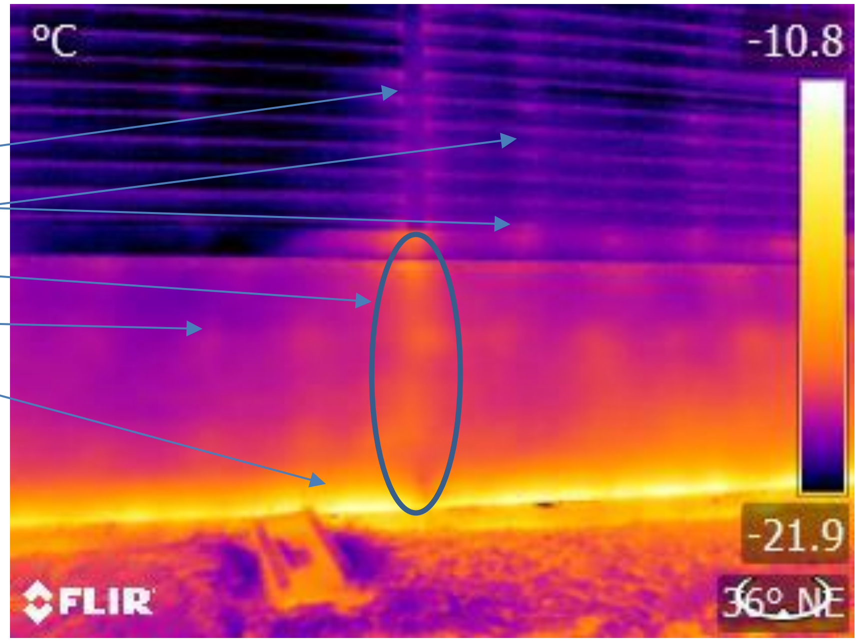
South elevation. View looking east.



Photograph #37:

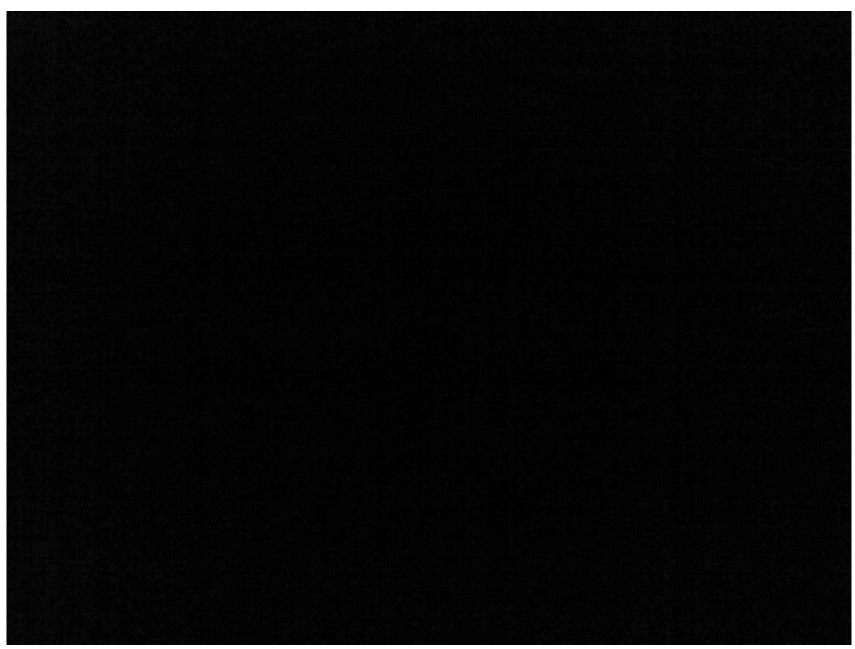
South elevation. Close-up view of base of wall.
Note:

- Thermal bridge at siding control joint.
- Thermal bridge at siding supports.
- Thermal bridge at masonry control joint.
- Thermal bridge at masonry wall ties.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



Photograph #38:

South elevation. Close-up view of base of wall.



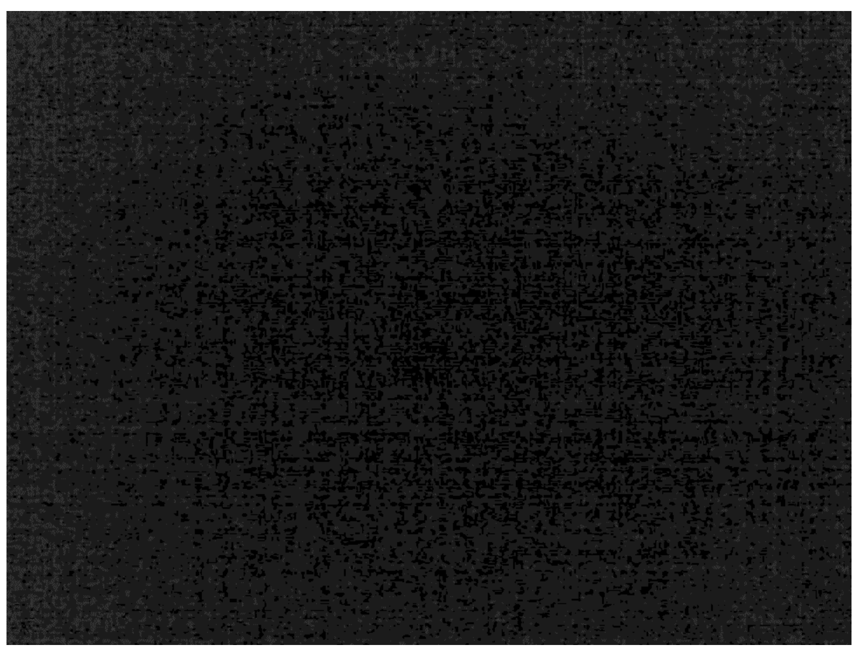
<u>Photograph #39:</u>

South elevation, close-up view of mechanical vent.
Note:

- Thermal anomaly at mechanical vent.

<u>Photograph #40:</u>

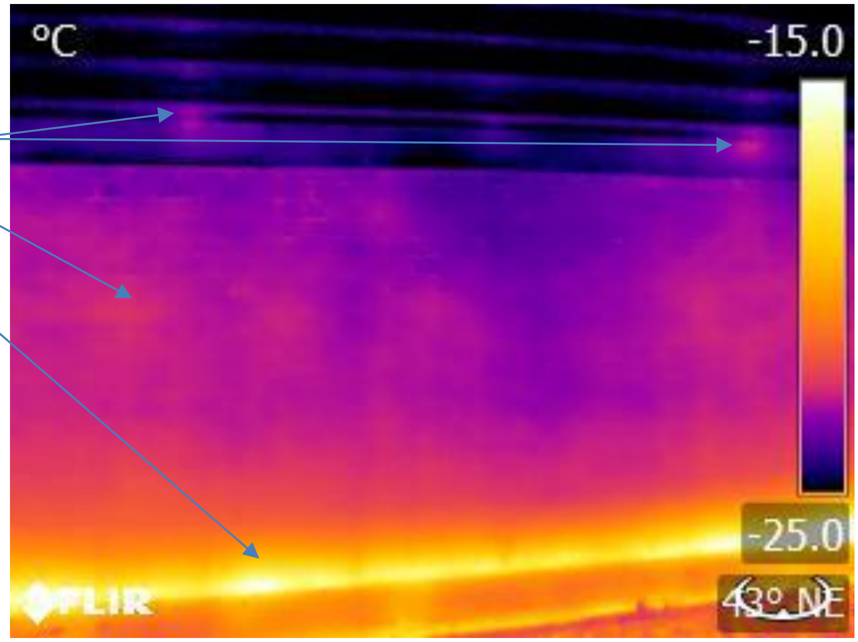
South elevation, close-up view of mechanical vent.



<u>Photograph #41:</u>

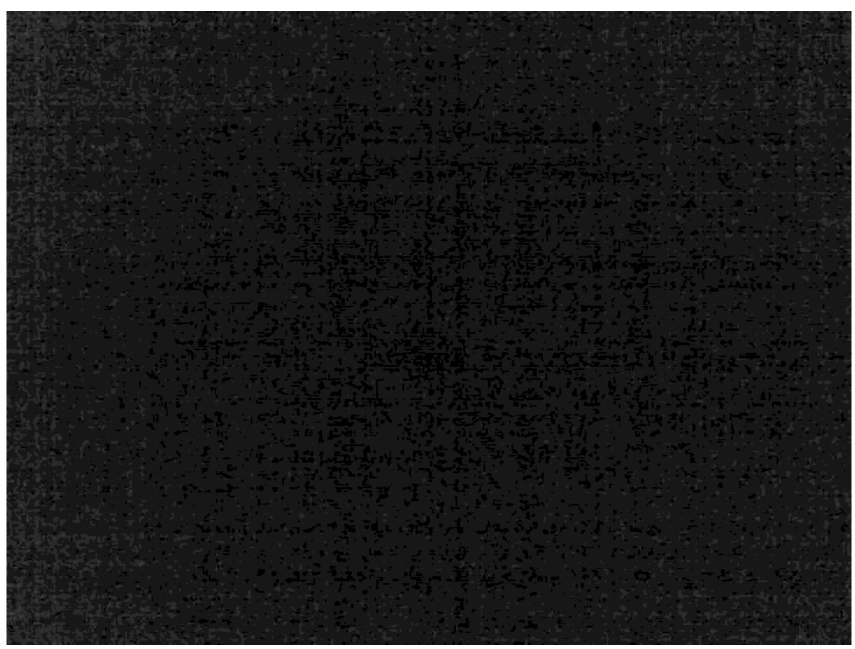
South elevation. Close-up view of base of wall.
Note:

- Thermal bridge at siding supports.
- Thermal bridge at masonry wall ties.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



<u>Photograph #42:</u>

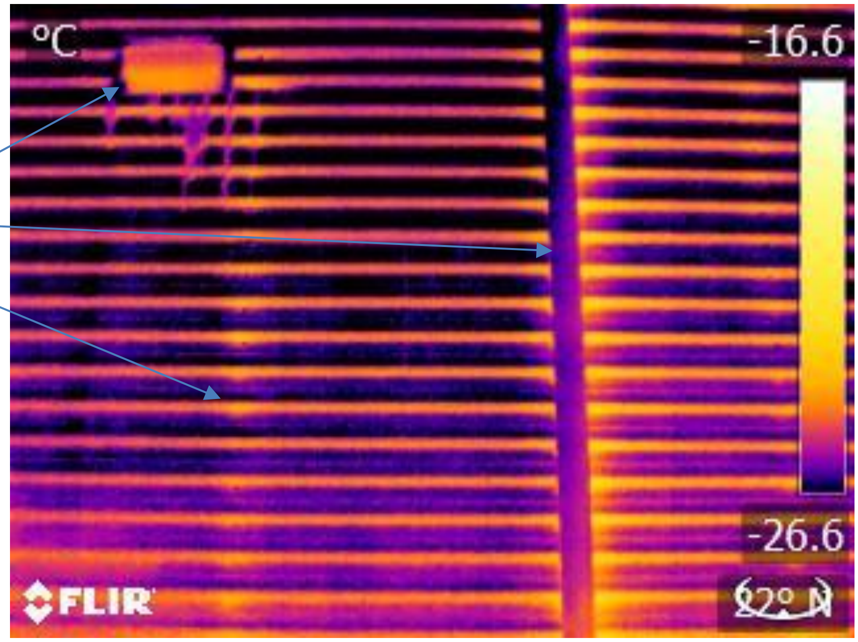
South elevation. Close-up view of base of wall.



Photograph #43:

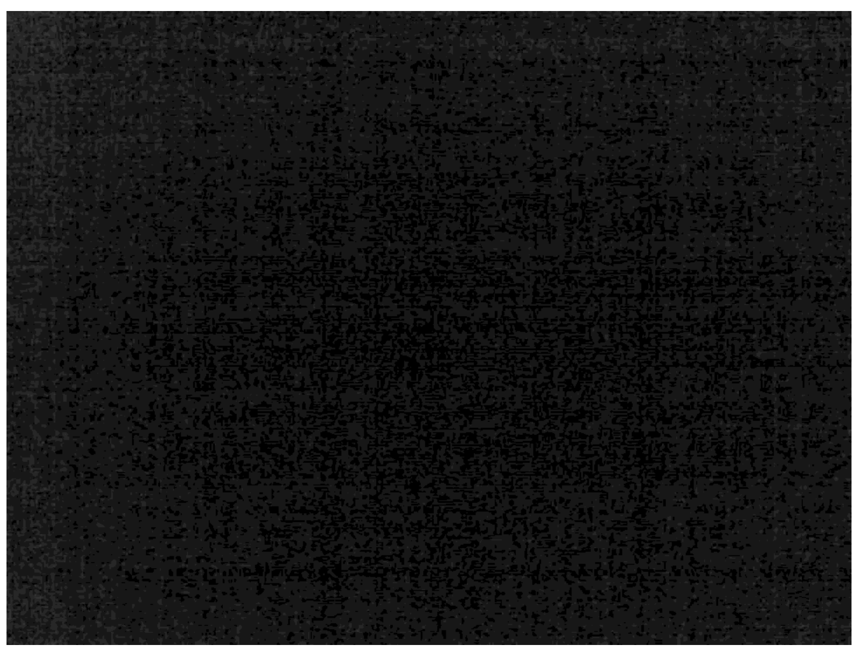
South elevation. Close-up view of rain water leader at top of wall.
Note:

- Thermal anomaly at roof scupper.
- Thermal anomaly at siding control joints.
- Thermal bridge at siding supports.



Photograph #44:

South elevation. Close-up view of rain water leader at top of wall.

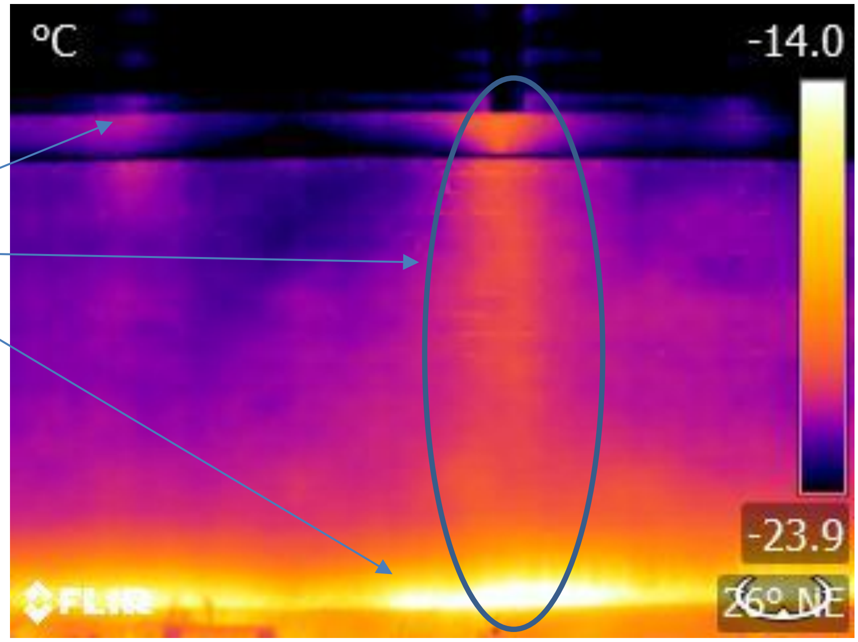


Photograph #45:

South elevation. Close-up view of rain water leader at base of wall.

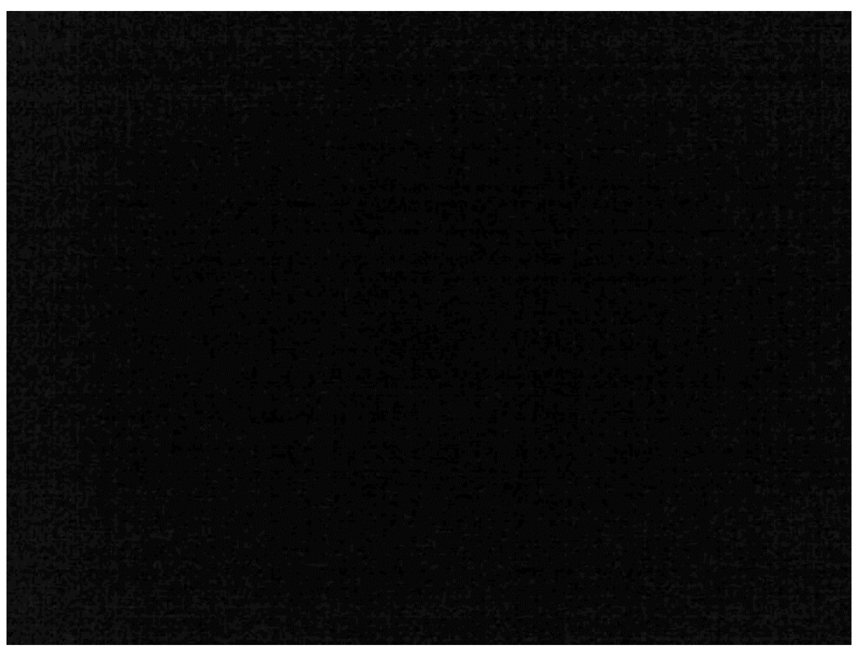
Note:

- Thermal anomaly at siding support.
- Thermal bridge at masonry control joint.
- Thermal anomaly at intersection of brick cladding and foundation wall.



Photograph #46:

South elevation. Close-up view of rain water leader at base of wall.

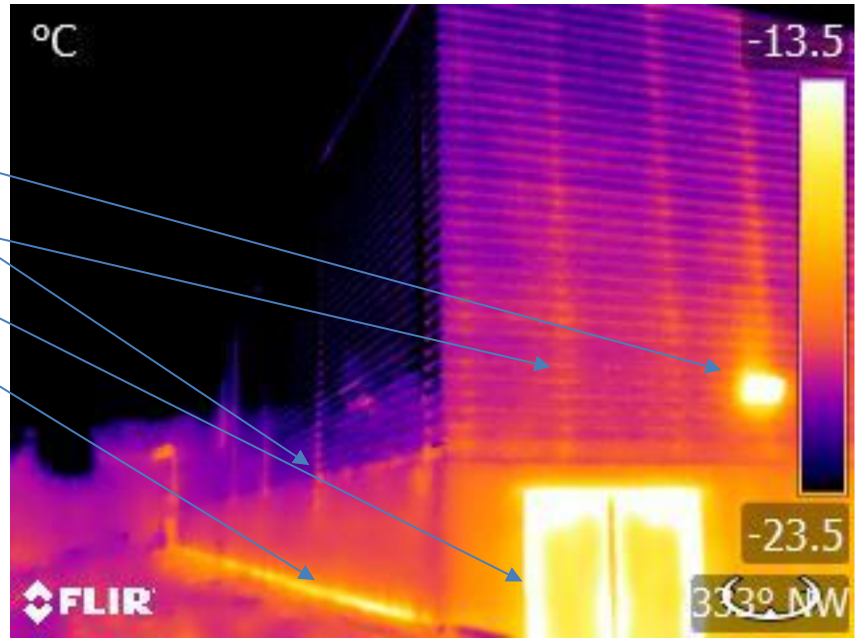


Photograph #47:

South-east corner. View showing length of South elevation.

Note:

- Thermal anomaly at light fixture.
- Thermal bridge at siding supports.
- Air leakage at doors.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



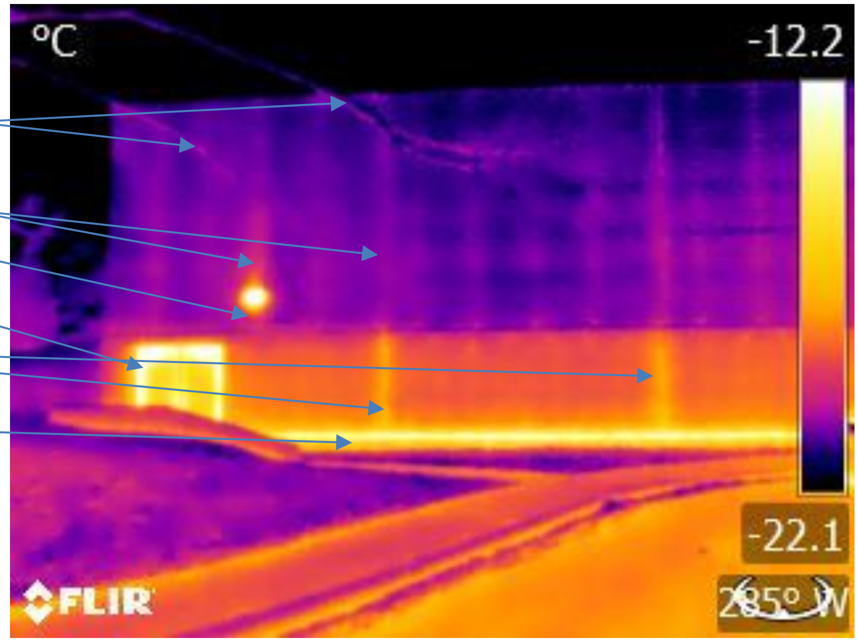
Photograph #48:

South-east corner. View showing length of South elevation.

Photograph #49:

East elevation at South end.
Note:

- Thermal anomaly at tree branch in front of building.
- Thermal bridge at siding supports.
- Thermal anomaly at light fixture.
- Air leakage at doors.
- Air leakage at masonry wall control joints.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



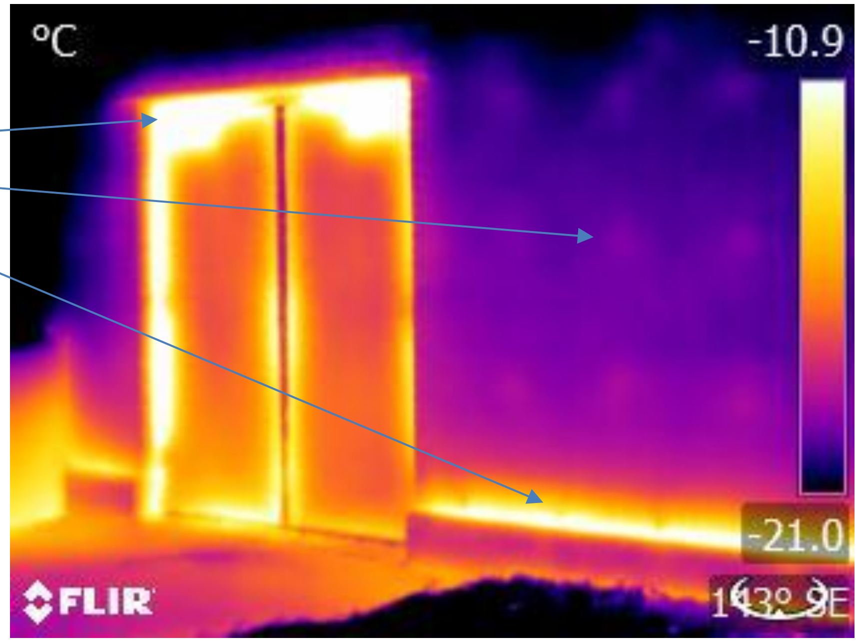
Photograph #50:

East elevation at South end.

Photograph #51:

East elevation. Close-up view of double service doors. Note:

- Air leakage at doors.
- Thermal bridge at masonry wall ties.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



Photograph #52:

East elevation. Close-up view of double service doors.

Photograph #53:

East elevation.
Note:

- Thermal bridge at siding supports.
- Thermal anomalies at exhaust vent and light fixture.
- Air leakage at doors.
- Air leakage at masonry control joints.
- Thermal anomaly at intersection of masonry cladding and foundation wall.

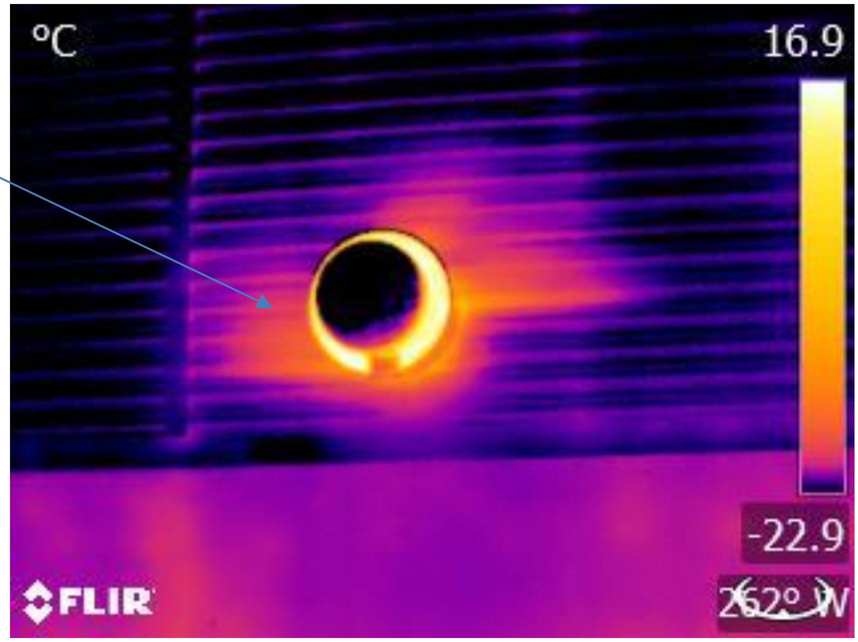
Photograph #54:

East elevation.

Photograph #55:

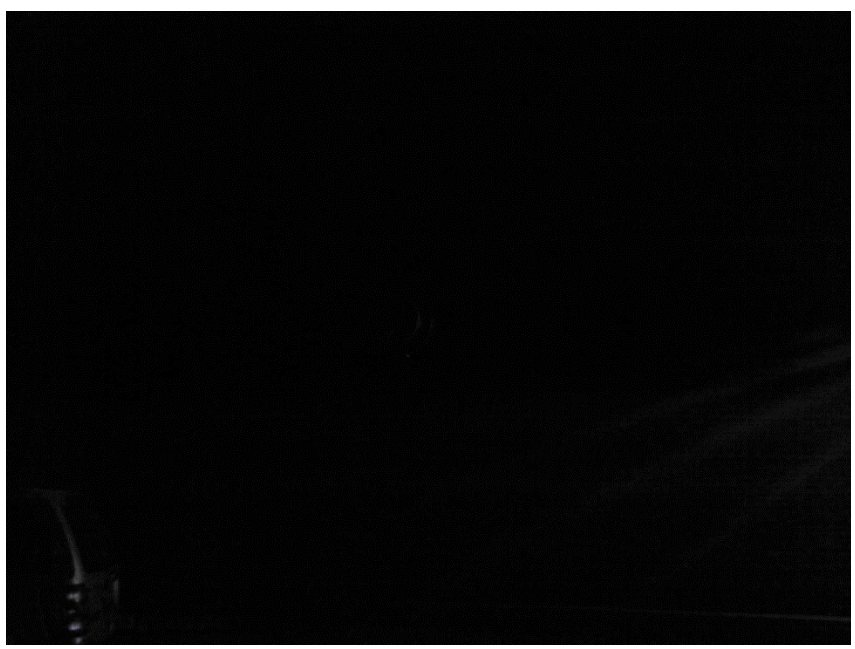
East elevation. Close-up view of exhaust vent.
Note:

- Air leakage at vent.



Photograph #56:

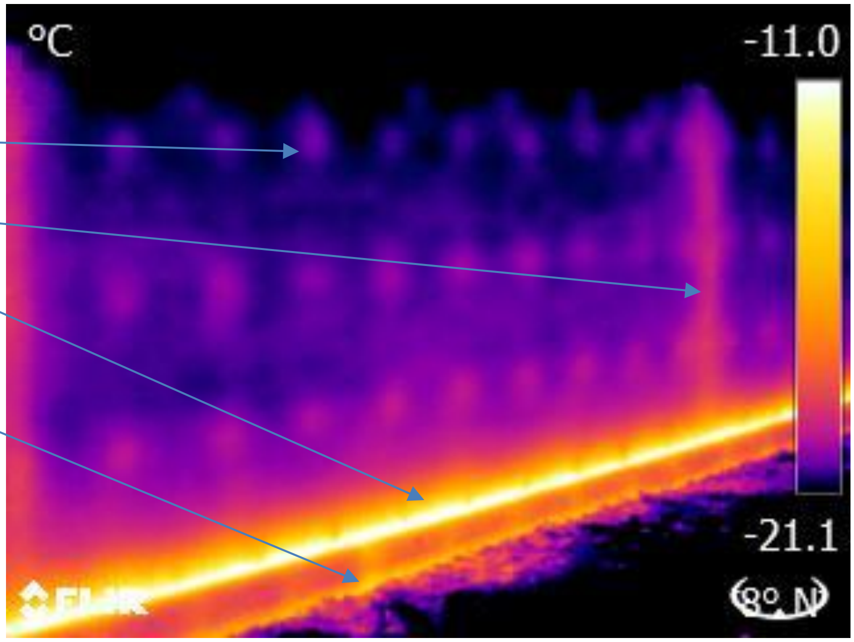
East elevation. Close-up view of exhaust vent.



Photograph #57:

East elevation. Close-up view of base of wall.
Note:

- Thermal bridge at masonry wall ties.
- Air leakage at masonry control joints.
- Thermal anomaly at intersection of masonry cladding and foundation wall.
- Thermal bridge at intersection of foundation wall and grade.



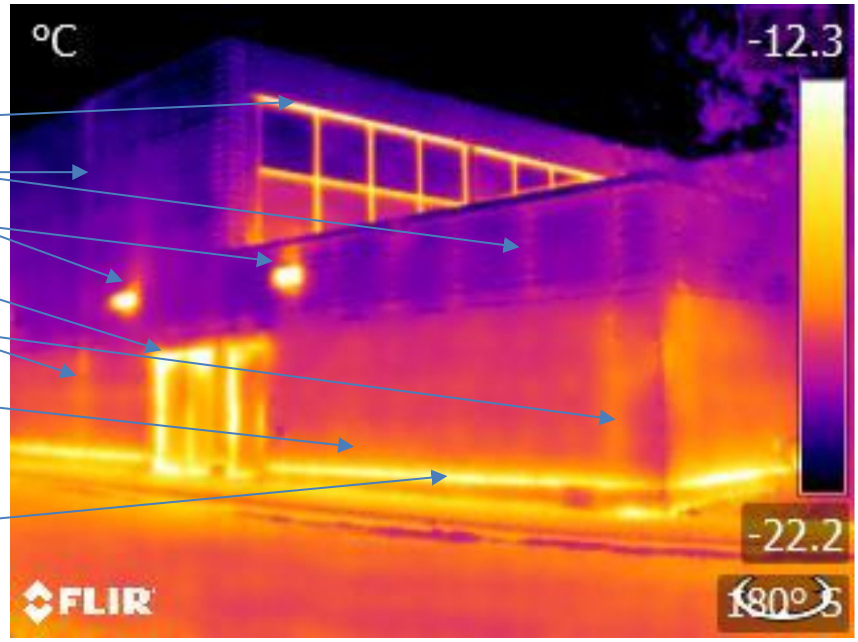
Photograph #58:

East elevation. Close-up view of base of wall.

<u>Photograph #59:</u>

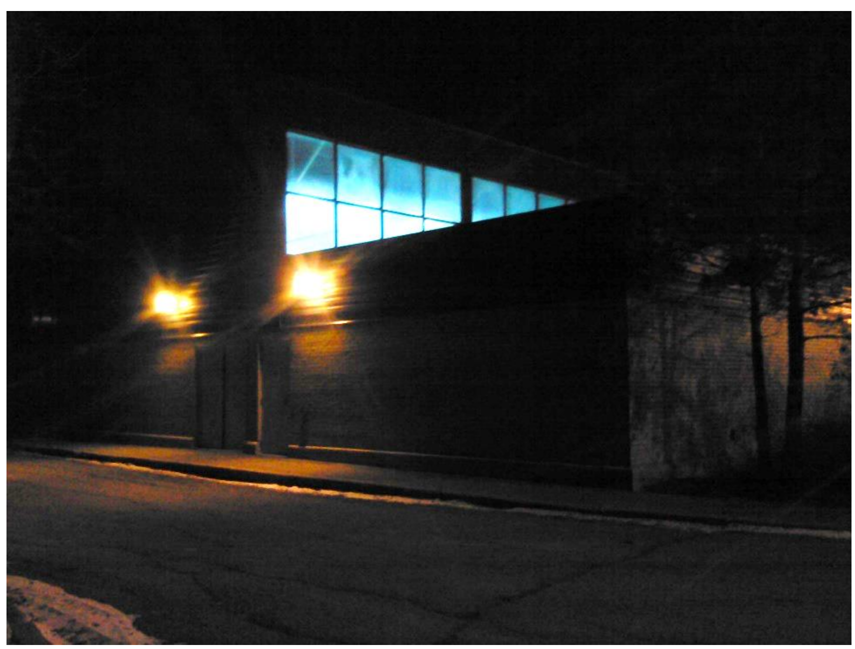
East elevation at north end.
Note:

- Thermal bridge at window frames.
- Thermal bridge at siding supports.
- Thermal anomaly at light fixtures.
- Air leakage at doors.
- Air leakage at masonry wall control joints.
- Thermal anomaly at intersection of masonry cladding and foundation wall.
- Thermal bridge at intersection of foundation wall and grade.



<u>Photograph #60:</u>

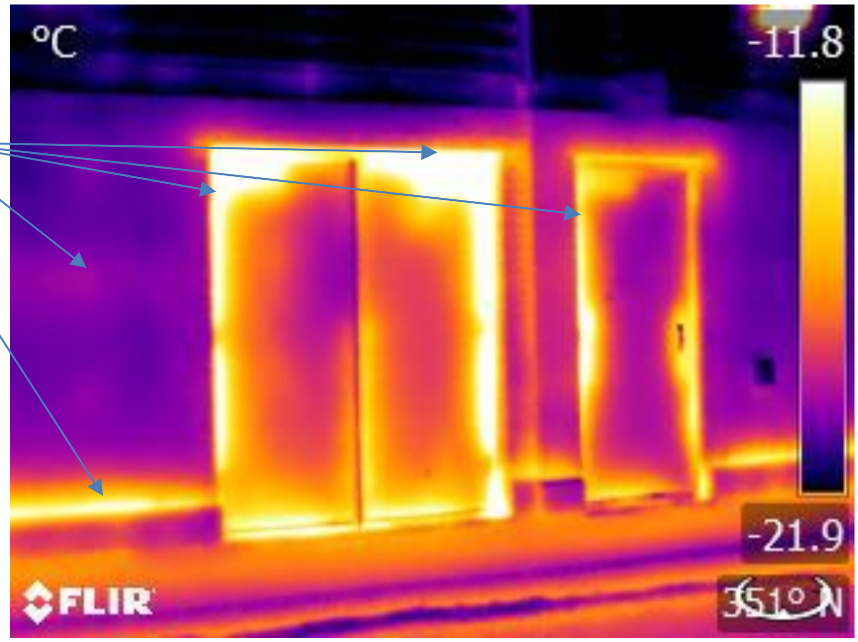
East elevation at north end.



Photograph #61:

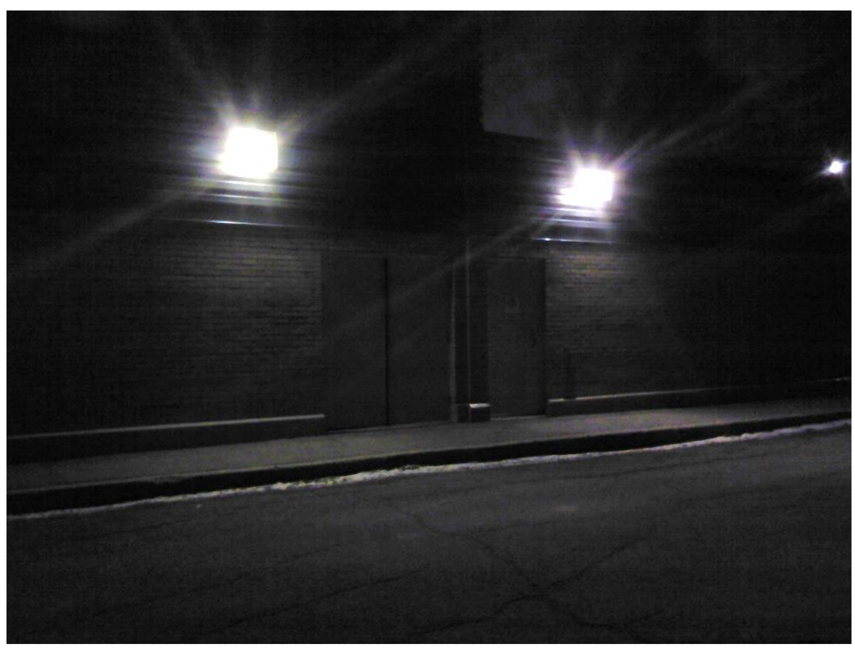
East elevation. Close-up view of doors at north end.
Note:

- Air leakage at doors.
- Thermal bridge at masonry wall ties.
- Thermal anomaly at intersection of masonry cladding and foundation wall.



Photograph #62:

East elevation. Close-up view of doors at north end.

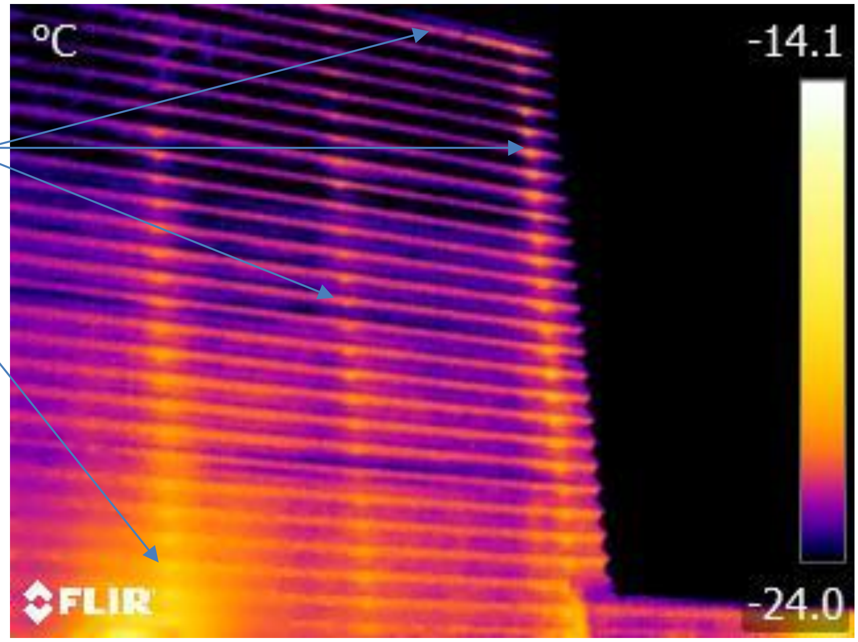


Photograph #63:

East elevation. View of north end of pool section.

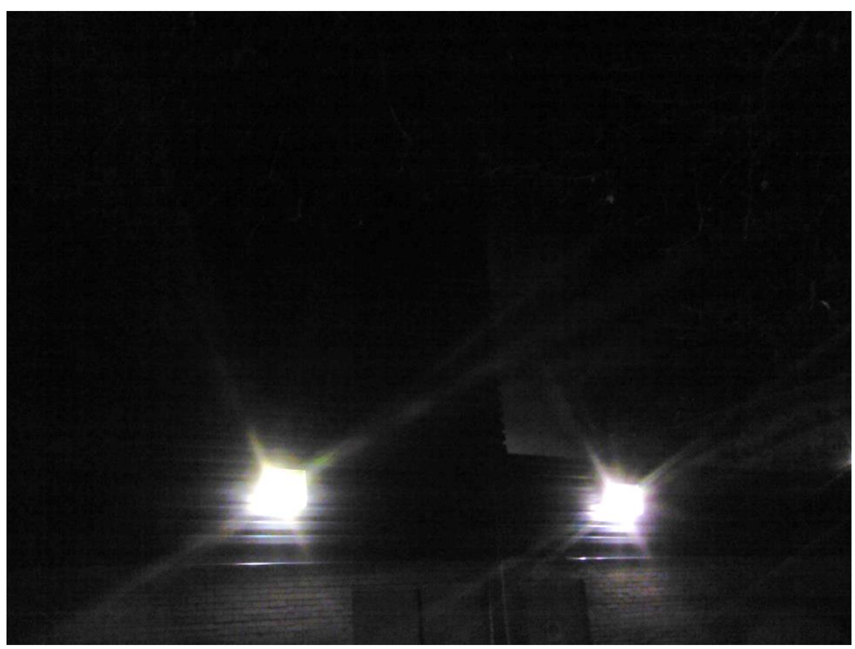
Note:

- Thermal bridge at siding supports.
- Thermal anomaly caused by light fixture.



Photograph #64:

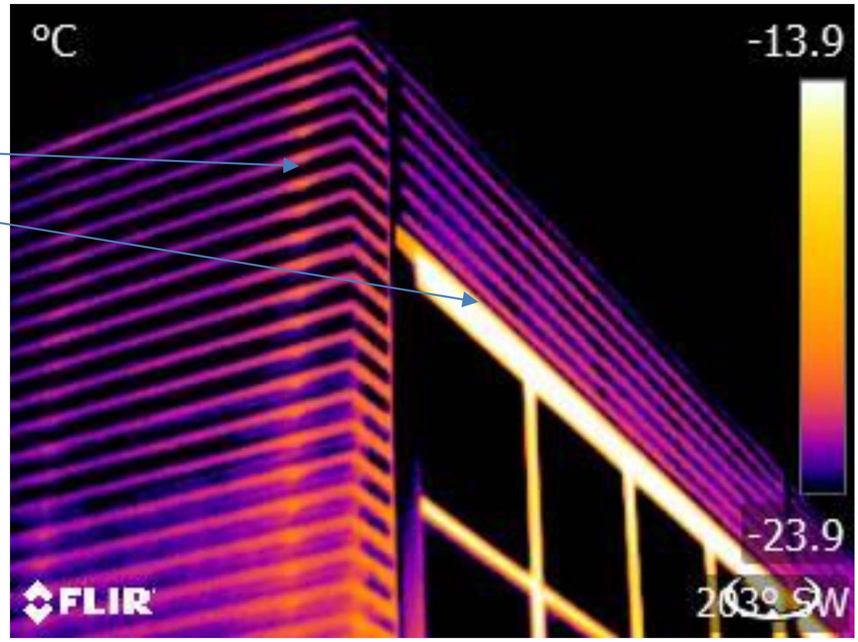
East elevation. View of north end of pool section.



Photograph #65:

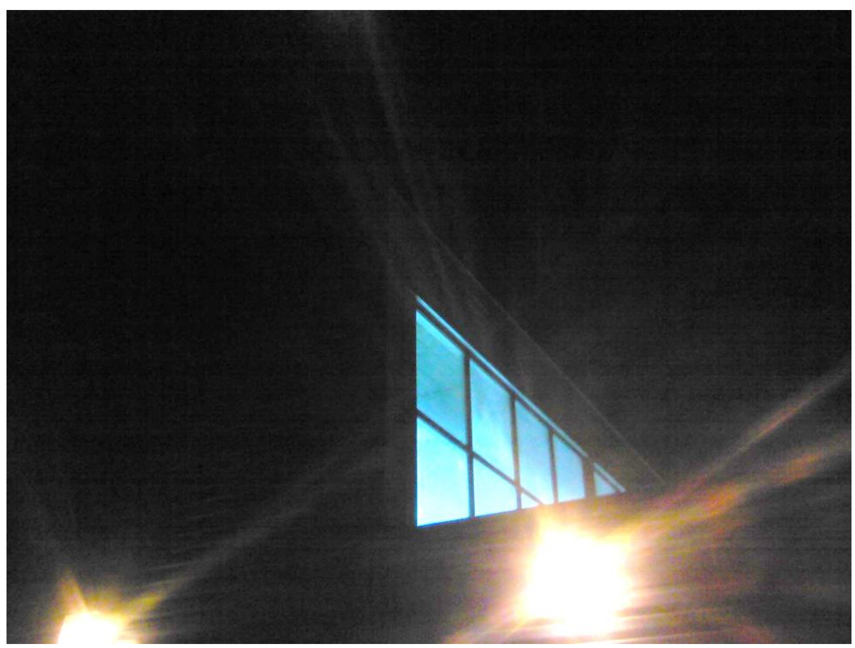
North-east corner. View of roof at pool section.
Note:

- Thermal bridge at siding supports.
- Thermal bridge at window frames.



Photograph #66:

North-east corner. View of roof at pool section.



6. Weather Data

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Hourly Data Report for November 27, 2018

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

WINNIPEG INTL A
MANITOBA
Current Station Operator: NAVCAN

Latitude:	49°54'36.000" N	**Longitude**:	97°14'24.000" W	**Elevation**:	238.70 m
Climate ID:	5023227	**WMO ID**:		**TC ID**:	YWG

Hourly Data Report for November 27, 2018

TIME	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
00:00	-16.6	-19.2	81	30	16	24.1	99.48		-25	Clear
01:00	-16.4	-19.1	80	30	17	24.1	99.47		-25	NA
02:00	-17.0	-19.7	80	31	16	24.1	99.43		-26	NA
03:00	-17.6	-20.4	79	33	8	24.1	99.37		-23	Clear
04:00	-18.7	-21.5	79	31	9	24.1	99.35		-25	NA
05:00	-18.5	-21.2	80	28	16	24.1	99.36		-28	NA
06:00	-18.6	-21.3	80	28	14	24.1	99.33		-27	Clear
07:00	-19.2	-22.0	79	29	10	24.1	99.31		-26	NA