



Curtain Wall Assessment

For: Cumulus Architects Inc.

Attn: Greg Haist

Type of Document:

Final

Project Name:

Curtain Wall Assessment at University Health Network
SEM Centre – Ground Floor
399 Bathurst Street, Toronto, ON

Project Number:

BRM-21013311-C0

Prepared By:

Agnes Smolarska, Project Associate
EXP Services Inc.
1595 Clark Boulevard
Brampton, ON L6T 4V1
t: +1.905.793.9800
f: +1.905.793.0641

Reviewed By:

Mark Haladuick, Senior Project Manager, Building Science

Date Submitted:

July 17, 2024

Table of Contents

1. Introduction.....	1
2. Background.....	1
3. Building Description.....	2
4. Objectives	2
5. Methodology	2
6. Observations and Discussions	3
6.1 SEM, GROUND FLOOR – VISUAL REVIEW.....	3
6.2 CAFS TEST RESULTS.....	4
6.3 THERMOGRAPHY RESULTS	4
6.4 CURTAIN WALL - EXPLORATORY OPENING – OFFICE 1EW435.....	5
6.5 CURTAIN WALL – WATER TESTING – OFFICE 1EW421	6
7. Discussion and Conclusions	7
7.1 CURTAIN WALL CONDITION	7
7.2 CAFS TEST RESULTS.....	8
7.3 THERMOGRAPHY RESULTS	8
7.4 EXPLORATORY OPENINGS	8
7.5 WATER TESTING.....	9
8. Recommendations.....	9
8.1 CLASS C ESTIMATE FOR REPAIRS	9
9. Limitations	10
10. Professional Limitations.....	10
Appendix A – Interpretation & Use of Study and Report	12
Appendix B – Photographs	13
Appendix C – Drawings	36

1. Introduction

EXP Services Inc. (EXP) was retained by Cumulus Architects Inc. to carry out a window and curtain wall assessment of select portions of the Toronto Western Hospital (TWH), located at 399 Bathurst Street, Toronto, Ontario. The Schroeder Arthritis Institute (SAI) offices and Seniors Emergency Medicine (SEM) centers were assessed, and observations are provided in 2 separate reports. This letter report has been prepared to provide comments on the future Seniors Emergency Medicine (SEM) center.

The terms of reference for this assessment were set out in EXP's proposal, dated January 26, 2024, which was subsequently approved by Cumulus Architects Inc. The fieldwork for this survey was carried out on April 15, 2024, and EXP was accompanied by Mr. Jonatas Alves of the University Health Network (UHN). The terms and conditions were modified to accommodate additional review and testing work which was performed on June 17, 2024.

2. Background

Cumulus Architects is designing renovations at TWH, and the current ground floor offices will be replaced with exam rooms for the new Seniors Emergency Medicine (SEM) department. The SEM centre is located along the south and east elevations (see Figure 1 and Photograph No. 1).

EXP understands that UHN is concerned with some reported water penetration at the curtain wall, which was installed in approximately 2004.



Figure 1: SEM centre – ground floor, south and east elevations (white arrows)

3. Building Description

The building is a 9-storey high hospital building, with offices and labs occupying the various floors. The ground floor SEM center is clad in a drained curtain wall system. At the north end of the east elevation, rainscreen brick masonry opaque walls are installed (i.e. at the stairwell). The curtain wall is aluminum framed, with a combination of pressure plates with snap covers and structural silicone joints. It has both vision and spandrel glazing. A canopy is installed along the east and south elevations directly above the ground floor.

4. Objectives

The objectives of this assessment were to assess the condition of the windows and determine the cause of water penetration, IGU failure, and overall thermal performance of the wall system.

5. Methodology

EXP performed the following scope of work:

1. Review relevant existing documentation, including architectural drawings for the building, if available.
2. Interview site property management to gain knowledge of any problems, past or present, with the curtain wall.
3. Attend a virtual project kick-off meeting.
4. Perform an interior and exterior visual review of the curtain wall.
5. Perform glass thickness readings utilizing a Glass Chek meter.
6. Perform a thermographic scan of the window areas to assist in determining source(s) of air leakage. A FLIR camera was utilized.
7. Perform Compressed Air Frost Spray (CAFS) Testing of representative insulating glass units (IGUs).
8. Perform exploratory openings at two locations, at the southeast corner of the ground floor.
9. Perform water testing at the active water leakage location on the east elevation.
10. Provide reports of the observations including recommendations and budget costs.

Site visits were conducted on April 15 and June 17, 2024.

6. Observations and Discussions

EXP reviewed the provided architectural drawings and found the package to be incomplete and missing information pertaining to the SAI and SEM exterior window systems. Therefore, EXP was unable to use the provided drawings, and focused instead on the site observations and site test results.

6.1 SEM, Ground Floor – Visual Review

The review consisted of visual, tactile, and non-destructive testing on randomly selected IG units on ground floor, at the south and east elevations. Currently, the ground floors consist of occupied office areas, which were unlocked for access by Mr. Alves. The site visit occurred on April 15, 2024.

6.1.1 Interview

The following information was provided when discussing the window condition with Mr. Jonatas Alves:

1. The curtain wall system installation date is unknown, however, the IGU spacer was stamped with “04”, suggesting a manufacture date of 2004. Therefore, the curtain wall system is approximately 20 years old.

6.1.2 Observations – Curtain Wall Information

A visual assessment of the windows was conducted by an interior review at the ground floor office spaces, and an exterior review. EXP selected random IGUs for the glass-chek readings and CAFS testing.

The general observations of the curtain system are documented below:

1. Only the ground floor curtain wall was reviewed, however, visually the system was observed be the same type and colour at the above floors (Photograph No. 2).
2. The curtain wall system contains both vision and spandrel glazing. It is primarily a pressure plated system, with structural silicone joints along the verticals of the vision IG units. The snap covers contain drainage openings at the underside (Photograph Nos. 3, 4).
3. A canopy is installed onto the face of the curtain wall system, along the ground floor of the south and east elevations.
4. The exterior glass lite contains a stamp indicating that the exterior lite is 6mm thick, and it is tempered glass (Photograph No. 5).
5. The IG units were measured to have a 25mm overall thickness, with 6mm glass lites and a 13mm airspace. A low emissivity coating is located on surface #2 (interior side of exterior glass lite) and was installed as a soft coat (Photograph Nos. 6, 7). EXP did not confirm the presence of a gas (Argon or Krypton).
6. The IG units contain a stainless-steel spacer bar, which was stamped with “04” and “Trulite IGMAC Toronto”, indicating the IGUs were manufactured in 2004 by Trulite Glass and Aluminum Solutions, in Toronto.
7. A typical curtain wall contains gaskets between the IGU and framing, which provides the air barrier and water barrier seals. The pressure plates and structural silicone hold the glass in place.

6.1.3 Observations – Curtain Wall Deficiencies

The observations of typical curtain wall system deficiencies are documented below:

1. Typically, on the interior side of the curtain wall, water stains were observed on the mullions (Photograph No. 8).
2. Typically, evidence of moisture collection via towels was observed at some of the offices which were accessed (Photograph Nos. 9, 10).
3. Interior glazing gaskets were flattened and weathered due to age (Photograph Nos. 11, 12).

4. Some deterioration of exterior weather sealant joint was observed. The sealant was split along the bond line to the glass edge (Photograph No. 11).
5. The spacer bar was visible at some points where the sealant was discontinuous (Photograph No. 12).
6. Significant staining from dirt was observed below the canopy, on the spandrel panel and framing (Photograph No. 13).
7. Joints of the curtain wall snap caps were not tightly abutted or misaligned at some locations (Photograph No. 14).
8. A loose snap cover was observed on the southwest corner of the south elevation (Photograph No. 15). The fasteners at the pressure plate were corroded. Additionally, weep holes were an inadequate size on the pressure plates.
9. A cracked spandrel glass lite was observed on the west elevation (Photograph No. 16). EXP understand this elevation will be enclosed with the SEM renovations.
10. On the east elevation, at the curtain wall to brick masonry joint, the vertical sealant was debonded along the brick. Additionally, the edge of the transom framing was sealed with spray foam (Photograph No. 17).

6.2 CAFS Test Results

The CAFS test procedure consists of introducing compressed air onto the IGU surface, which quickly lowers the temperature of the glass and subsequently the interior air space between the glass panes. The surface frost that develops on the glass surface is then removed and the glass is visually reviewed for condensation or frost on the glass surface within the air space. This simplified test criteria has been adapted from *ASTM E576-08 "Standard Test Method for Frost/Dew Point of Sealed Insulated Glass Units in the Vertical Position"* in order to quickly test a larger sampling of IGUs than can be tested following the standard. An IGU is considered a "fail" if condensation or frost remains within the air space between the glass panes.

6.2.1 Observations

A total of 10 IGUs were tested on the ground floor, future SEM Centre, on the east and south elevations. Of the tested IGUs, all 10 passed the test. The IGUs did not develop condensation within the airspace, therefore, the IGU seals are functioning as intended (Photograph Nos. 18, 19).

6.3 Thermography Results

An infrared thermographic scan was conducted from the interior and exterior of the SEM office areas commencing at approximately 12:30 am on April 16, 2014, with no induced pressure differential. The scan was conducted by Rami Laitila of EXP, certified Level 1 Thermographer (#162841888). Temperature and humidity conditions at the time of the review were measured with a Fluke 971 Temperature and Humidity Meter as below:

Environmental Test Conditions:

Test Date and Time	Exterior Temperature (°C)	Exterior Relative Humidity (%)	Wind Speed (km/hr)	Indoor Temperature (°C)	Indoor Relative Humidity (%)	ΔT (°C)
April 16, 2024 12:30 am	10	53	13 (E)	23.5-27	22-24	13.5-17

6.3.1 Observations

During the thermography it was noted that the interior temperature varied between offices and was measured to be between approximately 23-27°C. Additionally, the scan from the interior was limited due to the desks, possessions, and window coverings obstructing view of the exterior walls. Blinds were noted to be covering nearly all the IGUs, which were raised where possible for the scan.

The images provided in Appendix A (Photograph Nos. 20 – 28) show examples of the thermal anomalies observed, and the drawing in Appendix B identifies the locations of the observed thermal anomalies.

During the scan EXP observed thermal anomalies at the following locations:

1. Along the base of the wall throughout at various locations, noted from the interior and exterior.
2. At some mullion locations, noted from interior and exterior.
3. At a few glass spandrel locations on the south elevation, air leakage was noted from behind the snap covers.
4. At the fire department water connection at the north end of east elevation.

6.4 Curtain Wall - Exploratory Opening – Office 1EW435

EXP returned to the site to review the exploratory openings at the southeast corner (Photograph Nos. 29 to 38). Two openings were made at this location – a bottom spandrel glass panel and the tie-in along the base of the curtain wall, and upper mullions (Photograph No. 29). The purpose of the review was to determine the continuity of the air barrier of the curtain wall at locations where thermal anomalies were observed in the thermography scan.

At the sill location, the general observations of the curtain system are documented below:

1. The curtain wall system drains along the vertical mullions and then to the horizontal mullions to exit at the weep holes on the pressure plates. However, the weep holes in the pressure plates were generally misplaced and missing at some locations.
2. Some of the fasteners at the pressure plates were corroded (Photograph 30).
3. The bottom pressure plates were not compressing the glass adequately along the top edge due to the inadequate extruded insulation pocket filler. Also, some of the horizontal pressure plates were missing a gasket along one side. The extruded insulation pocket filler behind the sill closure piece is not rigid enough to support the pressure plate compression (Photograph 31).
4. The curtain wall was installed above the concrete floor slab at the opened location and is supported on anchors. The curtain wall is tied-in along its base by a metal closure panel that is fastened to the shoulder at the top, and to the face of the concrete floor slab at the bottom (Photographs 31, 32).
5. The metal closure panel was sealed with sealant along the top edge, which is good practice. However, along the bottom edge, sealant may be missing as air exfiltration was observed during the exploratory opening. The continuity of the air barrier could not be confirmed along the bottom. Additionally, fasteners along the bottom of the metal closure were corroded (Photograph 32).
6. Water stains on the metal closure panel were observed as white stains (Photographs 31, 32).
7. The drainage channels were blocked, and corner blocks were deteriorated (Photograph 34).

8. On the east elevation, the bottom of the metal panel was corroded (Photograph 35).
9. The metal backpan was filled with mineral wool insulation as per good practice (not shown in photo), and the metal joints were sealed with sealant at the perimeter for continuity of the air barrier (Photograph 36).
10. Directly behind the spandrel glazing, a painted metal “screen” was installed in front of the mineral wool insulation (not shown in photo).
11. At the interior exploratory opening, the bottom of the curtain wall was not insulated (Photograph 37).

At the upper mullions, the general observations of the curtain system are documented below:

1. Short pressure plates were observed at the horizontal mullions (Photograph 38), in other words, the pressure plate does not extend the full width of the glass.
2. The pressure plate weep hole was missing next to the setting block (Photograph 38); and was misplaced on the east end since it was partially blocked by the setting block (Photograph 39)

6.5 Curtain Wall – Water Testing – Office 1EW421

EXP returned to the site to conduct water testing where active water leakage was confirmed by UHN. The water testing was performed with a spray rack, and an elevated work platform (i.e., zoom boom) was utilized during the testing. A blower door was installed to create a pressure differential between the exterior and interior environments of 150 Pa (Photographs 40 to 44).

The following is a summary of the water testing:

1. A total of 5 water tests were conducted, starting on the curtain wall below the canopy and finishing at the 2nd floor windows (above the canopy). Water was sprayed for 10 to 20 minutes at each location
2. The following locations were tested:
 - a) Test 1: At the upper part of the ground floor curtain wall immediately below the canopy. Water leakage was not observed during this test.
 - b) Test 2: Above the canopy, at the metal flashing joinery at the base of the metal panel cladding. Water leakage was not observed during this test.
 - c) Test 3: Above the canopy, along approximately 1.5m of metal flashing at the base of the metal panel cladding. Water leakage was not observed during this test.
 - d) Test 4: Above the canopy, at the bottom-right corner of the glazing unit (Photograph 42). Water leakage was observed during this test. The water on the interior was observed at a small section at the head of the curtain wall, not the full length of the curtain wall (Photograph 43).
 - e) Test 5: Above the canopy, in the vertical metal cladding joint above the metal flashing (Photograph 42). Water leakage was observed during this test, at the same location as in Test 4.

It was also observed that the canopy was installed with a TPO membrane, and a low spot in the “roof” was observed near the water leakage area (Photograph 44).

7. Discussion and Conclusions

7.1 Curtain Wall Condition

The curtain wall IGU date stamp was observed to be 2004, which indicates that the wall system is approximately 20 years old. A typical service life of a curtain wall framing is approximately 50 years, with an IGU service life of approximately 20-25 years.

The curtain wall is an aluminum and glass drained system, installed with pressure-plates and structural silicone joints (two sided structurally glazed system). At a few locations, evidence of moisture was observed on the framing inside; corroded fasteners were observed at pressure plates, and deteriorated weather seal sealants were noted. The CAFS testing did not produce condensation within the IGUs, indicating that the IGU seals are intact and functioning as intended.

Based on field observations, EXP was able to conclude that the curtain wall system is generally in fair condition. Based on the exploratory openings and water testing, the curtain wall construction and workmanship is below expected performance.

Overall, the continuity of the air barrier along the bottom of the metal closure panel was inaccessible and is questionable. The curtain wall is experiencing water leakage at one location on the east elevation.

7.1.1 Interior Water Staining

The water stains on the interior framing, and the towels located on the framing, indicate potential water penetration, and water testing results are discussed below.. The interior relative humidity measured during the thermography scans was typically at approximately 23%.

7.1.2 Exterior IGU Sealant and Spacer Bar

The sealant at the vertical joints of the IGUs was split at some locations, which is likely due to aging and weathering of the material. The sealant should be replaced to prolong the life of the curtain wall system.

The visible spacer bar from the exterior may be due to inconsistent application of the primary and/or secondary sealant or incorrect glass placement (i.e. setting blocks being too high). However, given the negligible defect amount in comparison to the overall curtain wall area, this is considered acceptable.

7.1.3 Exterior Staining

The staining of the curtain wall system below the canopy seems to be related to the water management detailing of the canopy above. However, canopy details were not available for our review. EXP would recommend that the curtain wall system be cleaned at this location to allow for any re-occurring staining to be monitored.

7.1.4 Exterior Perimeter Sealant

Perimeter sealant at the curtain wall to brick masonry was exhibiting typical aging and weathering, given that a sealant service life is approximately 12-15 years.

7.1.5 Pressure Plates

Corroded fasteners are indicative of using the incorrect fasteners for the exterior environment – galvanized instead of stainless-steel fasteners. This is critical to keep the pressure plates and IGUs secure since the pressure-plates together

with the structural silicone holds the glass in place. It is unclear what the condition the fasteners are in at other locations, however, it is assumed that the condition of pressure plates is similar throughout the ground floor, at the horizontal pressure plate locations.

Additionally, weep holes on the pressure plates are required to be 32mm (1-1/4”) wide, whereas the site observed weep holes were round and approximately 9mm in diameter, and therefore not as effective for drainage.

7.1.6 Broken Glass

The broken spandrel glass on the west elevation is an isolated location, and the cause is unknown, however it may be due to impact damage. The broken glass is to be replaced for safety reasons.

7.2 CAFS Test Results

The CAFS Testing results confirmed that the IGUs are performing as intended, which corresponds to observing no visible condensation at IGUs which were not tested. IGU service life is approximately 25-30 years and should be scheduled in the next 5 to 10 years. However, it should be anticipated that some IGUs will fail and need to be replaced in the meantime on an individual as needed basis.

7.3 Thermography Results

The thermography conducted at the SEM offices identified various thermal anomalies, most notably along the base of the wall. The exploratory opening was carried out at this location and revealed missing insulation and a discontinuity in the air barrier at the base of the curtain wall.

Thermal anomalies were also noted at some mullions glass spandrels, and at a fire department water connection. The anomalies tend to appear related to the concrete column locations as they were typically at or near the columns. These anomalies appear to be air leakage attributed to poor compression from the pressure plates against the glazing components, due to improper pocket filler or missing splines.

7.4 Exploratory Openings

The exploratory openings conducted at the southeast corner indicated that the curtain wall was in fair condition, although significant defects were observed.

Typically, water was draining adequately from the vertical mullions at some locations, however at other locations, the corners were filled with debris, blocking the drainage. Additionally, weep holes in the pressure plates were missing and/or misplaced, affecting the efficacy of the water drainage. Inadequate drainage resulted in staining on the metal closure panel, and potentially fastener corrosion.

At the sill, the curtain wall was not insulated along the base metal panel, creating a thermal bridge allowing heat to leave the interior.

At the sill, inadequate pressure plate compression was observed due to inadequate filler material being utilized (rigid insulation instead of extruded metal or PVC).

At the sill, corroded fasteners were observed on the pressure plates due to improper choice fastener materials being utilized, galvanized steel instead of stainless steel. Corroded fasteners were observed at the base of the metal closure panel, which could also be caused by air leakage.

At the sill, air exfiltration was noted at the bottom of the metal closure panel, where air barrier continuity was not present.

At the upper mullions, we were unable to find evidence of defects contributing to the visible thermography anomalies. However, a lack of compression of the pressure plates may be a contributing factor.

7.5 Water Testing

The water testing on the east elevation confirmed water entering the system from above the canopy. The water entered the interior from the 2nd floor exterior vertical metal panel joint. Additionally, the tie-in at the head of the curtain wall and slope of the canopy can be impacting the water leakage.

The service life of a TPO membrane is approximately 20 years and its replacement should be considered. Replacement will allow for improvement in roof slope on the canopy to avoid ponding.

8. Recommendations

EXP recommends that the curtain wall window system at the future SEM centre be refurbished to improve its durability. The system is approximately 20 years old and requires maintenance. EXP understands that a portion of the west elevation will be enclosed at the ground floor.

EXP recommends that the curtain wall be re-furbished by cleaning the drainage channels, replacing corner blocks, and augmenting or replacing the horizontal pressure plates and fasteners. At the base of the curtain wall, the metal closure panel can be replaced with an insulated metal backpan, complete with an air seal to the concrete floor slab. Additionally, exterior sealant replacement at IGU vertical joints, and exterior sealant replacement at the curtain wall-to-brick masonry joints should be implemented.

Additionally, due to water entry from the water testing, EXP recommends repairing the 2nd floor joint above the office and canopy. This will include dismantling the metal cladding, metal flashing and sealant joint to review and repair any defects.

EXP suggests considering replacing the TPO membrane, including sloping low areas to direct water away from the 2nd floor exterior wall.

IGU replacement can be scheduled in 5-10 years and has not been budgeted at this time.

Consideration is to be given to reviewing the remainder of the UHN floors above the SEM center, to establish a proactive repair schedule and budget.

8.1 Class C Estimate for Repairs

The costs below are our opinion of the probable cost for the work described in this report. EXP has estimated the costs based upon the deterioration present at the time of our site review and average unit prices obtained in 2024 by competitive bidding on similar projects in the Greater Toronto area.

Please be aware that the preparation of a cost estimate requires making assumptions as to the actual conditions encountered on site, the means and methods of construction, the costs and extent of labour, equipment and materials employed, the contractor's technique in determining prices and market conditions at the time of tender, and other factors over which EXP has no control. Given that these cost estimates are Class C, we have included a twenty percent (20%) contingency allowance to address unforeseen conditions. The costs below are approximate figures for comparison of options and for order-of-magnitude budgeting purposes. The actual costs can only be established once the work is tendered and completed, and final repair quantities are known. Please note that our opinion of the probable cost excludes EXP's engineering fees to prepare specifications or to provide construction review services.

Table 3: Repairs

Description of Repair Item	Recommended Repair Work
	2024
Curtain Wall Refurbishment (SEM Centre, ground floor at south and east elevations)	\$130,000.00
<ul style="list-style-type: none"> Refurbish pressure plates, including new splines and fasteners 	
<ul style="list-style-type: none"> Repair corner blocks, clean drainage channels 	
<ul style="list-style-type: none"> Replace sealant at vertical joints of IGUs 	
<ul style="list-style-type: none"> Clean surface of curtain wall below the canopy 	
<ul style="list-style-type: none"> Replace vertical sealant at the curtain wall-to-brick masonry joints at ground floor 	
Curtain Wall Head Tie-in (SEM Centre, 2 nd floor at water test location on east elevation)	\$4,500.00
<ul style="list-style-type: none"> Remove 2nd floor metal panels and flashing details at head of curtain wall 	
<ul style="list-style-type: none"> Repair area including potentially new through-wall flashing 	
Replace TPO Membrane at Canopy	\$55,000
Replace IGUs	5-10 years
Mobilization, Access, Demobilization	\$15,000.00
Sub-Total	\$204,500.00
20% Contingency	\$40,900.00
Total (excluding HST)	\$245,400.00

9. Limitations

We recommend that EXP Services Inc. be retained to prepare technical repair specifications, and to carry out construction review and testing during the actual repair work. Should you wish to have these services carried out by others, we would suggest that EXP Services Inc. be retained for a general review of the repair scope of work to verify that our recommendations are properly interpreted and implemented in the scope of work, and that they are in accordance with the present state of knowledge. If EXP Services Inc. is not given the privilege of conducting this review, we can assume no responsibility for misinterpretation of our recommendations.

10. Professional Limitations

This report has been prepared for the sole use of UHN and Cumulus Architects. Refer to Appendix A for more information about limitations of this report.

The information presented in this report provides an assessment of the current condition at the site within the terms of reference and limitations outlined in our proposal. EXP has been asked to make recommendations and opinions based solely on noted visual sampling and testing of existing components.

EXP arrived at conclusions based upon the best information presently known to us. No investigative method can eliminate the possibility of obtaining partially imprecise or incomplete information; it can only reduce the possibility to an acceptable level. Professional judgment was exercised in gathering and analyzing the information obtained and in the formulation of the conclusions. Like all professional people rendering advice, we do not act as absolute insurers of the conclusions we reach, but we commit ourselves to care and competence in reaching those conclusions.

We trust that this report meets your immediate requirements and if you have any questions or comments concerning this report, or if you require any further assistance, please do not hesitate to contact the undersigned.

Sincerely,
EXP Services Inc.



Agnes Smolarska, M.Eng.
Project Associate
Building Science



Mark Haladuick, P.Eng.
Senior Project Manager
Building Science



Paul J. Pushman, B.Tech. (Arch.Sc).
Manager - Facade Engineering
Building Science

Appendix A – Interpretation & Use of Study and Report



INTERPRETATION & USE OF STUDY AND REPORT

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental consulting unless specifically stated in the engineering report.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorize only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorized use of the Report.

5. INTERPRETATION OF THE REPORT

- a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b. Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.
- c. To avoid misunderstandings, EXP Services Inc. (EXP) should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by EXP. Further, EXP should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with EXP's recommendations. Any reduction from the level of services normally recommended will result in EXP providing qualified opinions regarding adequacy of the work.

6.0 ALTERNATE REPORT FORMAT

When EXP submits both electronic file and hard copies of reports, drawings and other documents and deliverables (EXP's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EXP shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EXP shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of EXP's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EXP. The Client warrants that EXP's instruments of professional service will be used only and exactly as submitted by EXP.

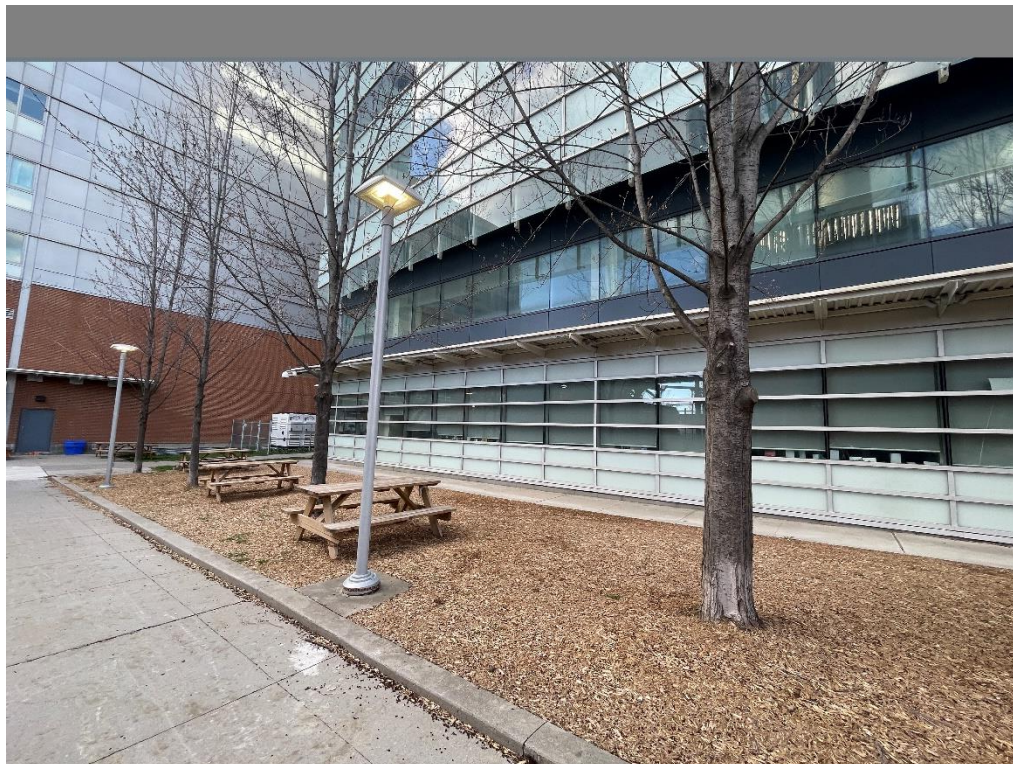
The Client recognizes and agrees that electronic files submitted by EXP have been prepared and submitted using specific software and hardware systems. EXP makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

Appendix B – Photographs



Photograph No. 1

Western Hospital – view of north and east elevations. Buildings in scope are SAI and SEM centers.



Photograph No. 2

Ground floor, south elevation – general view of curtain wall.



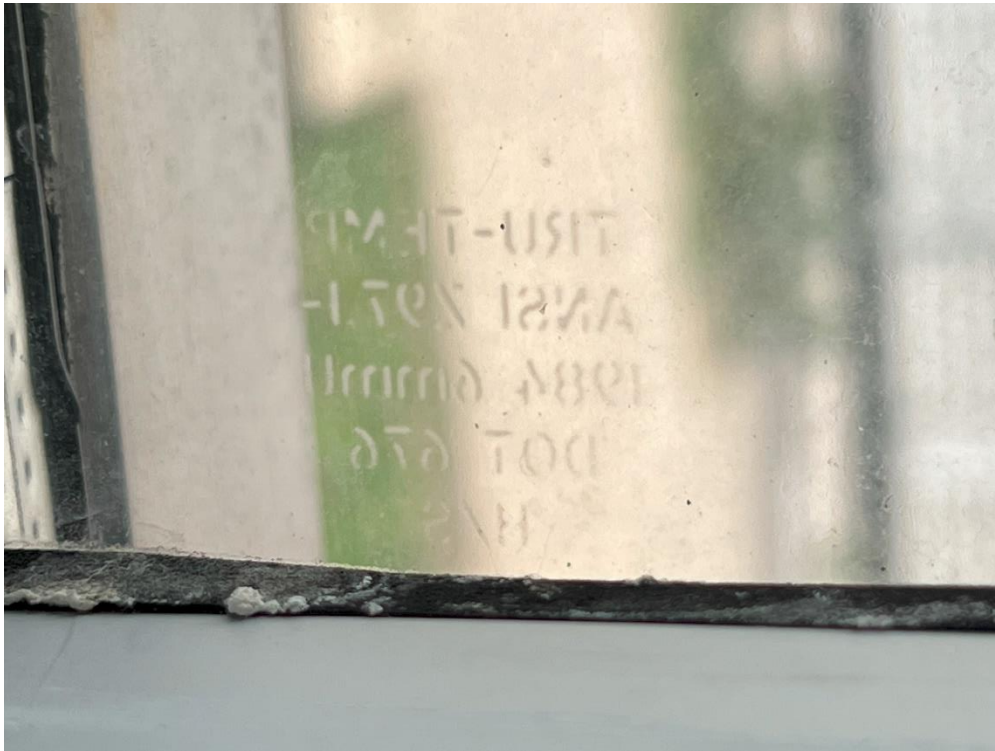
Photograph No. 3

East elevation – general view of curtain wall.



Photograph No. 4

Typical snap cover with drainage opening.



Photograph No. 5
Typical stamp on exterior glass lite.



Photograph No. 6
IGU thickness reading.



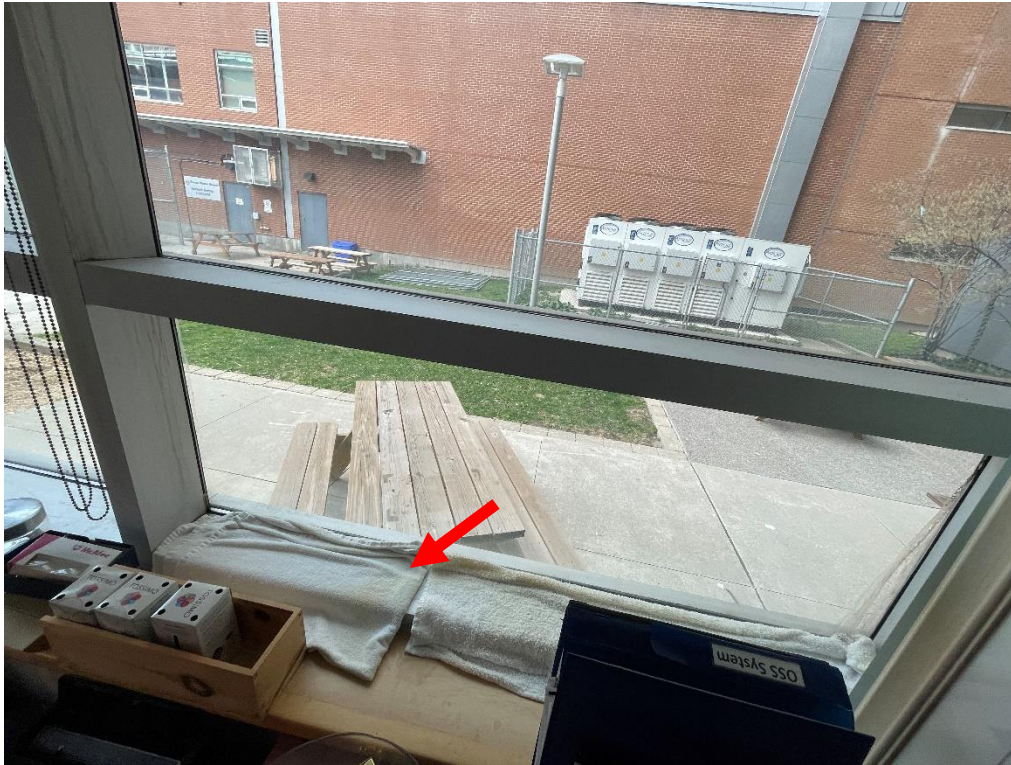
Photograph No. 7

IGU low-e coating reading.



Photograph No. 8

Typical water staining.



Photograph No. 9

Towels placed by occupant to absorb water.



Photograph No. 10

Towel placed by occupant to absorb water.



Photograph No. 11
Discontinuous sealant



Photograph No. 12
Exposed spacer bar.



Photograph No. 13

Dirt staining on the curtain wall.



Photograph No. 14

Misaligned framing.



Photograph No. 15
Corroded fasteners at pressure plates, and inadequate weep holes.



Photograph No. 16
Cracked spandrel glass.



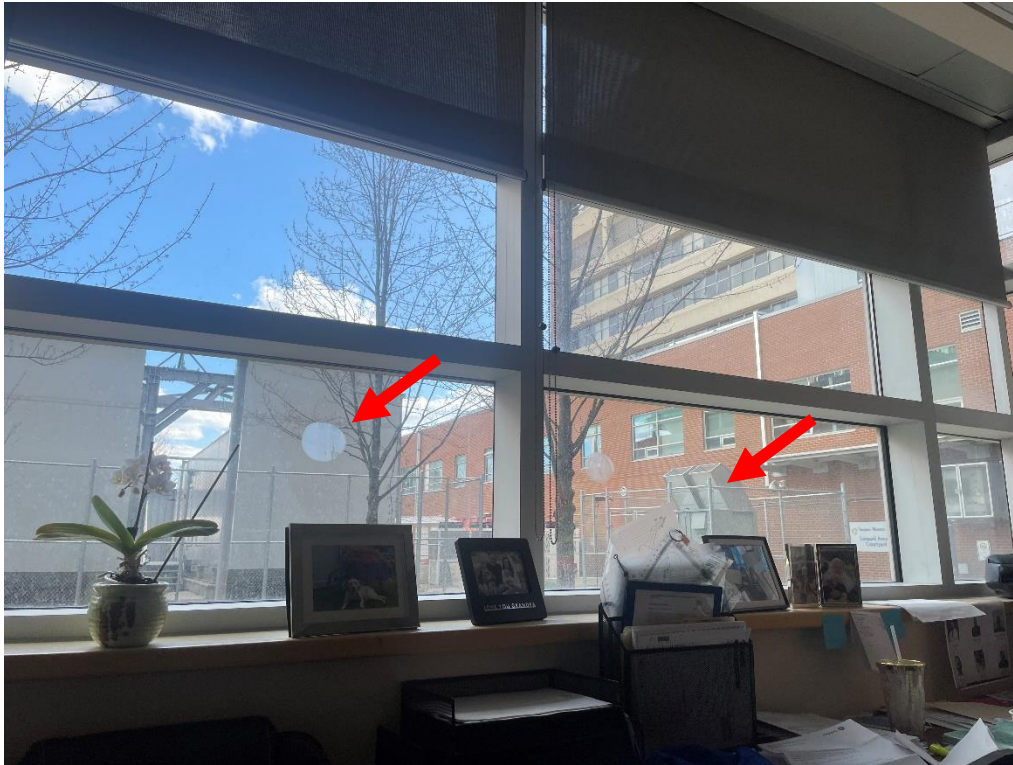
Photograph No. 17

Deteriorated sealant joint and spray foam.



Photograph No. 18

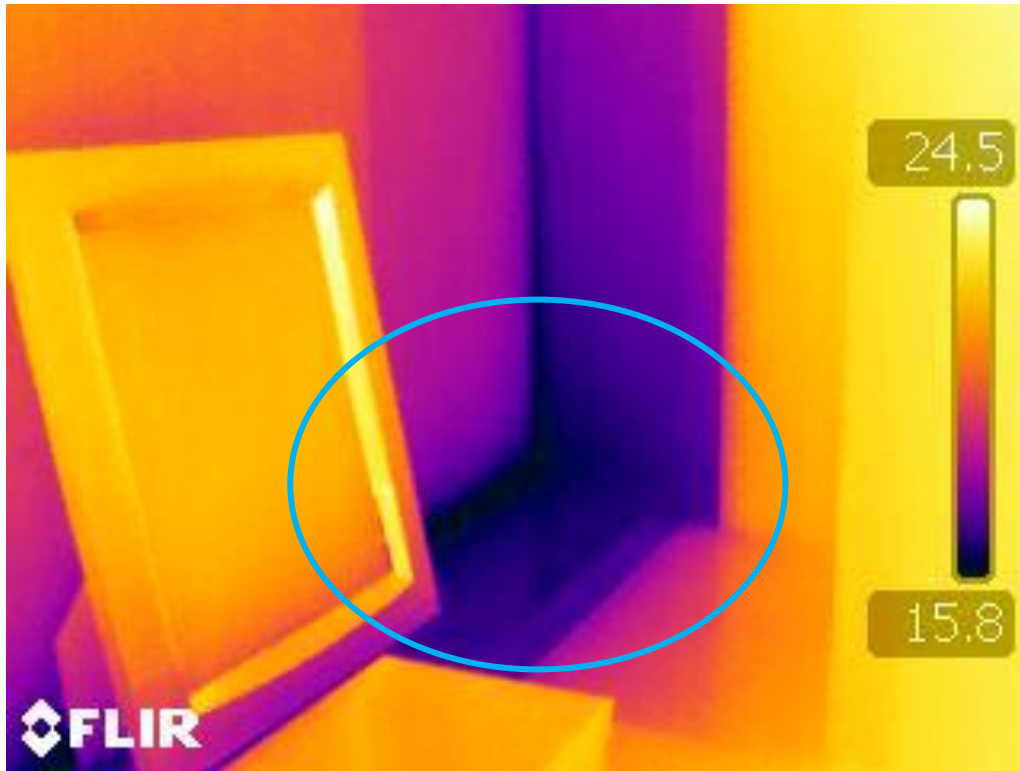
CAFS testing.



Photograph No. 19
CAFS testing.



Photograph No. 20
Thermal anomalies at window mullions on left side, from the interior.



Photograph No. 21

Thermal anomaly at lower mullions (base of windows).



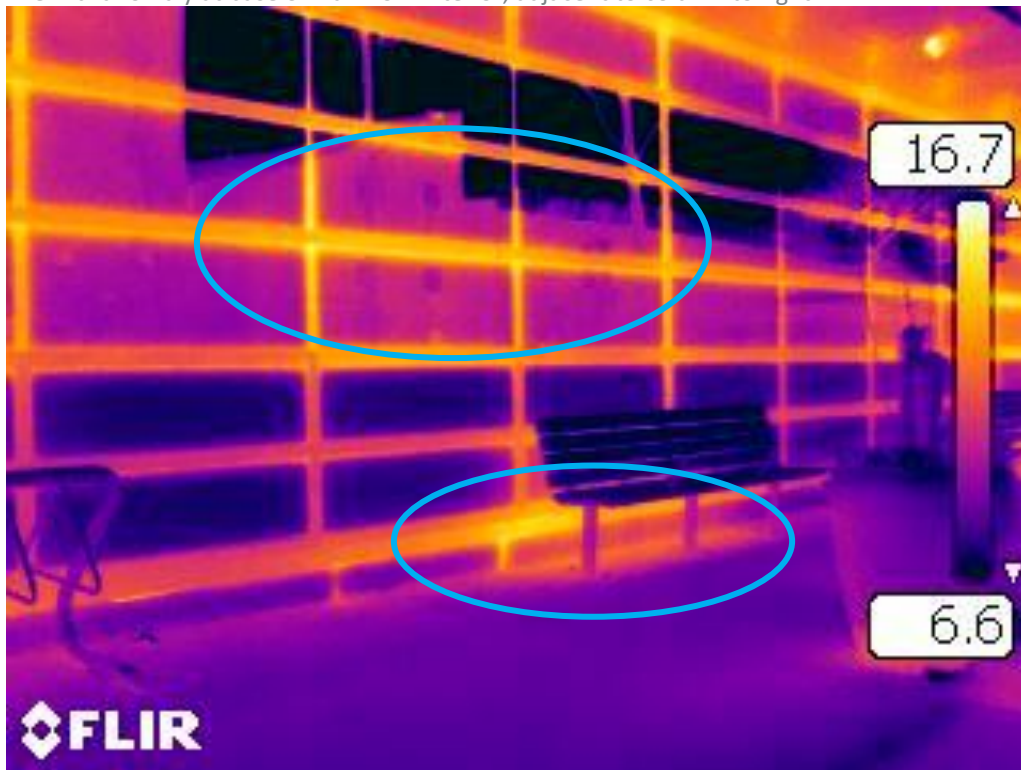
Photograph No. 22

Thermal anomaly at base of wall from interior side.



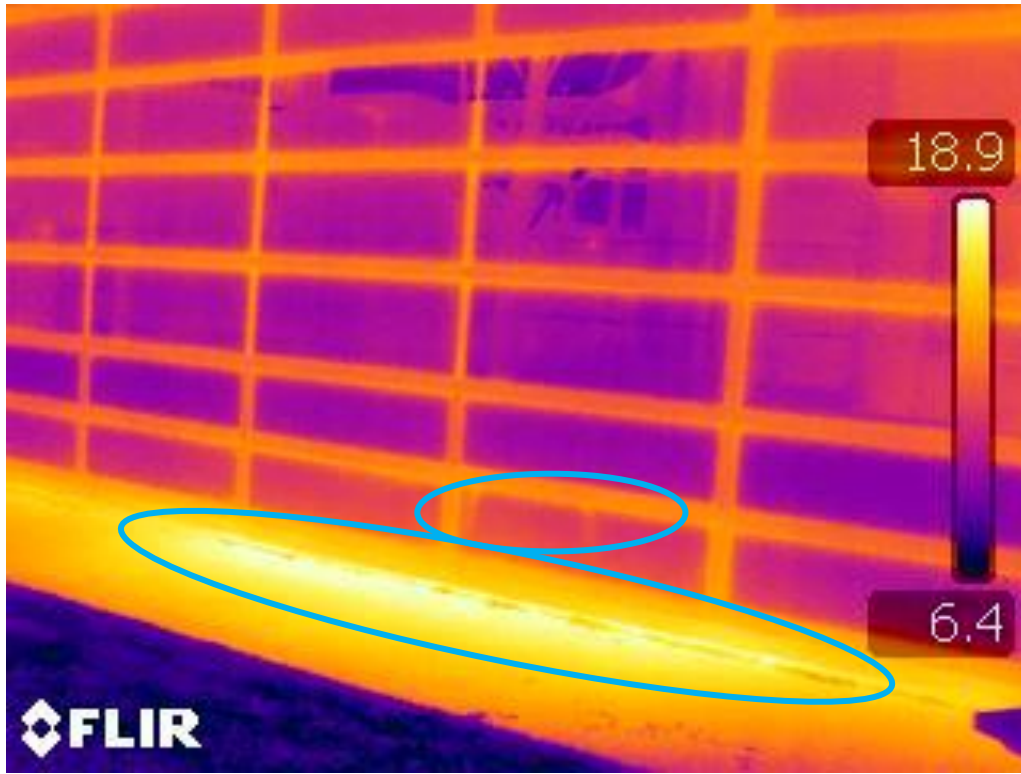
Photograph No. 23

Thermal anomaly at base of wall from interior, adjacent to column to right.



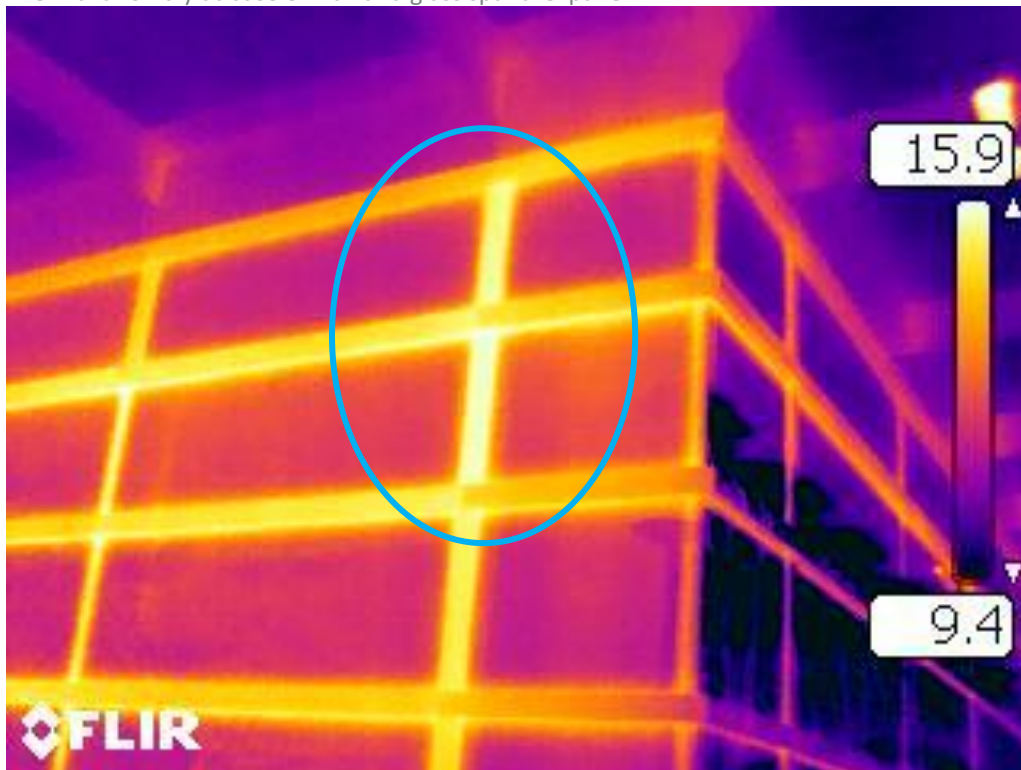
Photograph No. 24

Thermal anomaly at base of wall and at mullions from exterior.



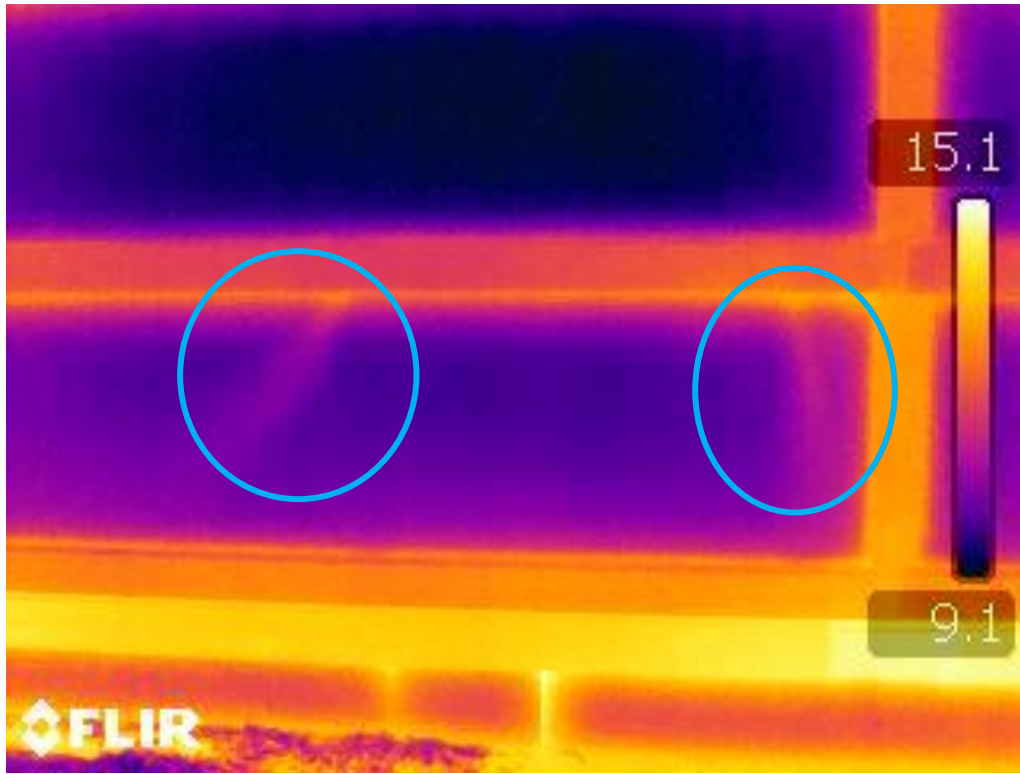
Photograph No. 25

Thermal anomaly at base of wall and glass spandrel panel.



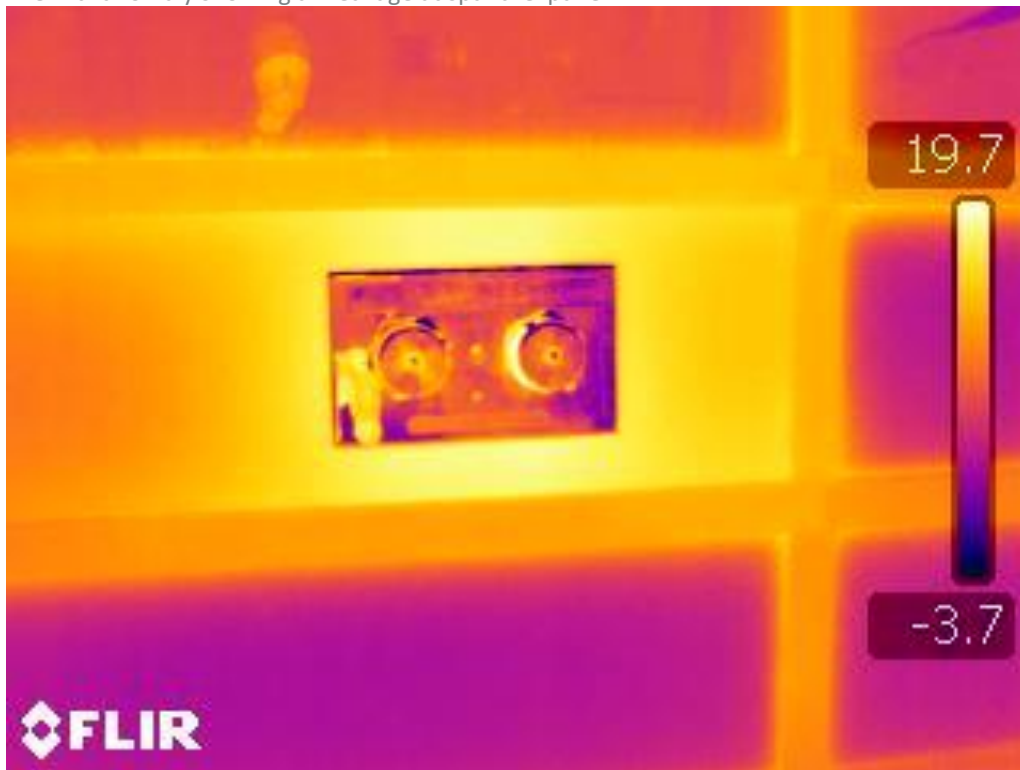
Photograph No. 26

Thermal anomaly at vertical mullion.



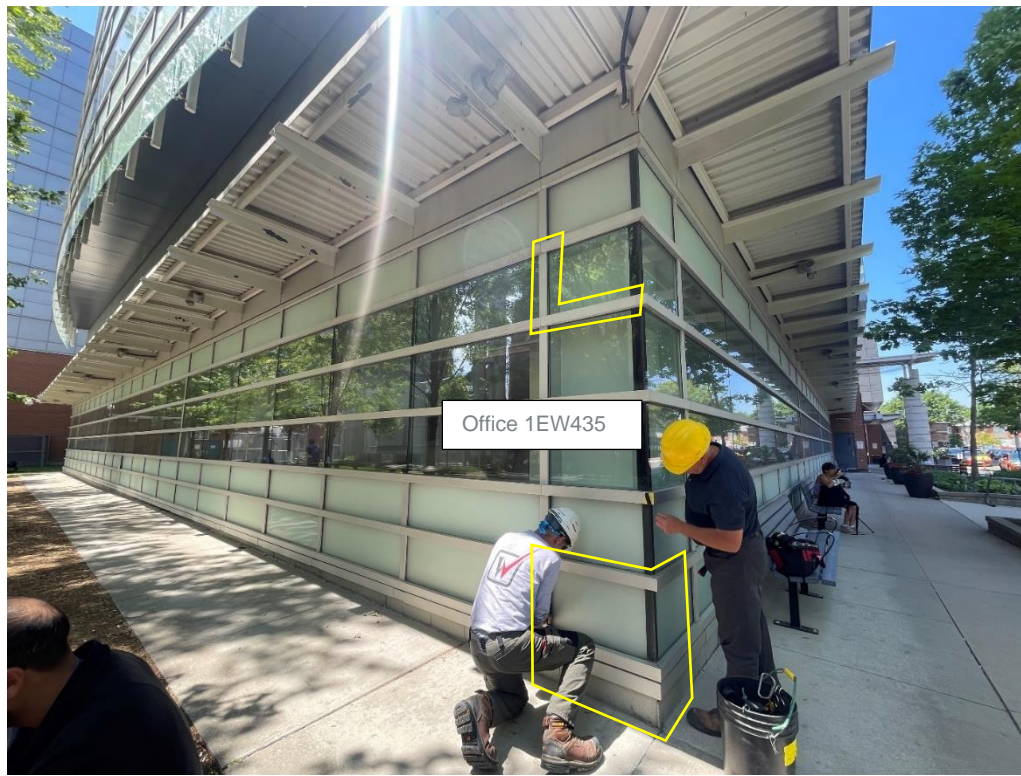
Photograph No. 27

Thermal anomaly showing air leakage at spandrel panel.



Photograph No. 28

Thermal anomaly at water connection.



Photograph No. 29

Curtain wall exploratory openings at southeast corner.



Photograph No. 30

Sill pressure plate – corroded fasteners; and misplaced weep holes.



Photograph No. 31

Metal closure panel below curtain wall; and uneven pressure plate



Photograph No. 32

Metal closure panel below curtain wall – sealant along top edge; water stains throughout



Photograph No. 33

Drainage channels are blocked and corner blocks deteriorated



Photograph No. 34

Metal closure panel with corroded fasteners along bottom edge



Photograph No. 35
Corroded metal closure panel on east elevation



Photograph No. 36
Spandrel glazing and metal panel behind with removed insulation.



Photograph No. 37

Interior exploratory opening – uninsulated wall area below curtain wall



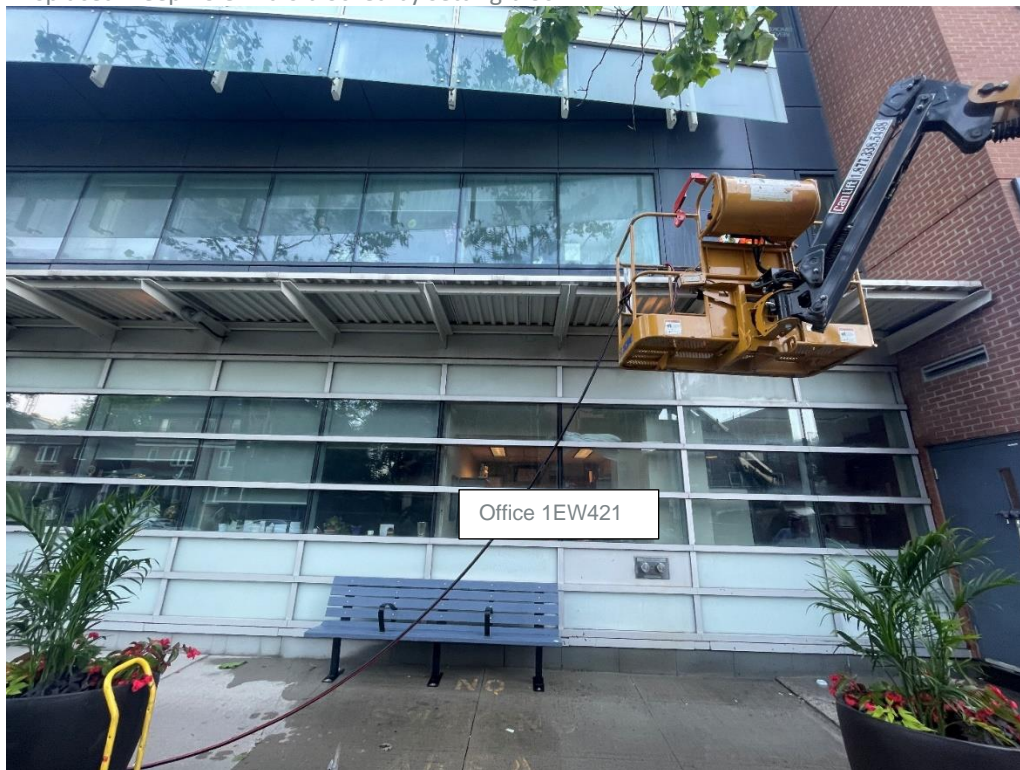
Photograph No. 38

Upper mullions - "short" pressure plates and missing weep hole



Photograph No. 39

Misplaced weep hole – it is blocked by setting block.



Photograph No. 40

Water testing on east elevation, office 1EW421.



Photograph No. 41
Blower door set up, office 1EW421.



Photograph No. 42
Water penetration occurring above canopy, at arrow locations.



Photograph No. 43

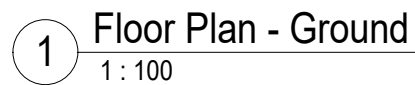
Observed water penetration at the top of the curtain wall.



Photograph No. 44

Low spot in roof membrane

Appendix C – Drawings



A201