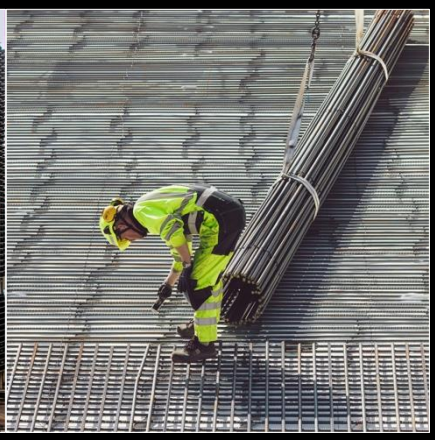
Lerch Bates
BUILDING INSIGHT

Report: E 1105 & E 783 Testing





PREPARED FOR

Mayo Clinic

PROJECT

MN12033300 (610)
Kellen Research Building

Lerch Bates
BUILDING INSIGHT

9.6.2023

Phillip Plonka
Senior Project Manager
Mayo Clinic

PROJECT NAME: **KELLEN RESEARCH BUILDING**
PROJECT NUMBER: **MN12033300 (610)**
LOCATION: **ROCHESTER, MN**

Dear Mr. Plonka,

In accordance with our agreement, Lerch Bates performed ASTM E 783 air leakage testing and ASTM E 1105 water penetration testing of one (1) MGU-8 Unitized Curtain Wall assembly at Kellen Research Building in Rochester, MN. Lerch Bates also performed AAMA 501.2 spray nozzle testing of 3 specimens, as described in Table 1 below. Henry Wehlage and Richard Fick of Lerch Bates performed testing on August 23, 2023.

Air leakage testing was conducted in accordance with ASTM E 783 *Field Measurement of Air Leakage through Installed Exterior Windows and Doors*. Water penetration testing was conducted in accordance with ASTM E 1105 *Field Determination of Water Penetration of Installed Exterior Windows by Static Air Pressure Difference.* The purpose of the testing was to evaluate the performance of the installed fenestration assemblies. This report contains summaries of the ASTM testing procedures, results, and conclusions.

A summary of the results is as follows:

Table 1 - Summary of Results

Specimen	Test	Requirement	Actual/Measured	Pass/Fail
Specimen 4 – MGU-8 Unitized Curtain Wall – North Elevation, Ground Level	ASTM E 783	0.09 CFM/SF	0.00 CFM/SF	**Pass**
	ASTM E 1105	No Water Entry	No Water Entry	**Pass**
Specimen 5 – Boot Flashing at Unitized Curtain Wall -Head North Elevation, Level 1	AAMA 501.2	No Water Entry	Water Entry	**Fail**
Specimen 6 – Punched Window – West Elevation, Ground Level	AAMA 501.2	No Water Entry	Water Entry	**Fail**
Specimen 7 – Punched Window – West Elevation, Ground Level	AAMA 501.2	No Water Entry	Water Entry	**Fail**

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Air Leakage Testing

The ASTM E 783 test method consists of "sealing a chamber to cover the interior or exterior face of a test specimen, supplying air to or exhausting air from the chamber at a rate required to maintain the specified test pressure difference across the specimen, and measuring the resultant air flow across the specimen."

Temperature was measured and recorded using a Kestrel multimeter. Wind speed/direction and barometric pressure data was obtained from National Weather Service data. Weather conditions at each point of the testing are included as part of our data analysis in Attachments A and B.

A negative pressure chamber was constructed on the interior side of the building/specimen to accomplish depressurization. Air was then exhausted from the chamber using a Wind Maker Test Kit by the RM Group, LLC, which incorporates an exhaust air system, along with pressure and airflow measuring devices into a single apparatus.

Per ASTM E 783, air leakage through the specimen was determined via a two-step process:

1. Total air leakage throughout the entire test chamber, the test apparatus, and the test specimen was measured.
2. A sheet plastic "blank" was taped onto the exterior of the curtain wall specimen covering all glazing, joints, cracks, and openings; then, extraneous air leakage was measured.

Air leakage throughout the test specimen was calculated by subtracting the difference between the total air leakage, which included the test specimen, and the extraneous air leakage when the specimen was covered with the "blank."

During testing, air was exhausted from the chambers to maintain an approximately 6.24lbf/sq.ft., or 1.2 inAq. pressure differential across the test specimen per the project specifications. Ten pressure and airflow measurements were recorded at approximately 30-second intervals. For our data analysis, 8 measurements were retained, and the average of these airflow readings was calculated to arrive at a single, average airflow.

The air leakage rate was then calculated by dividing the corrected airflow by the area of the test specimen (as measured at the outside edges of the specimen frame).

The unitized curtain wall was previously laboratory tested in accordance with ASTM E 283, with an allowable leakage of 0.06 CFM/SF. As such, 0.09 CFM/SF is the presumed field testing maximum allowable leakage.

TEST SPECIMEN 4: The specimen was an MGU-8 Unitized Curtain Wall section including a spandrel section. It can be identified on A3/A-203 in the shop drawings and was located on the north elevation of the building, ground level. The specimen measured approximately 75 SF.

Photo 1 – Specimen 4, masked.

Photo 2 - Specimen 4 – No masking.

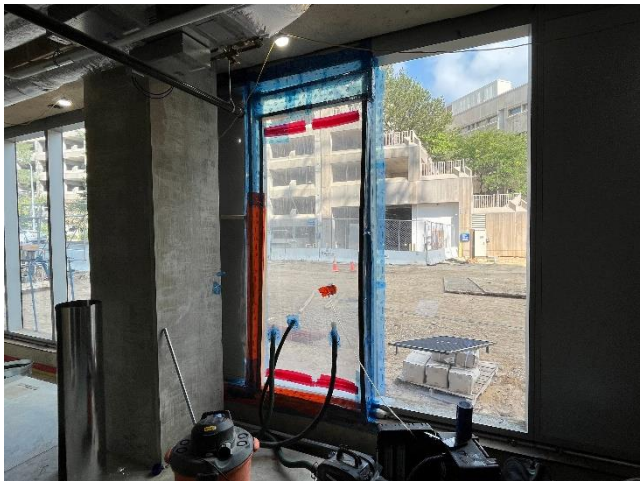

Photo 3 – Specimen 4, interior view of test chamber.

Photo 4 – Specimen 4 – Interior test chamber pressure at 1.2 in Aq.

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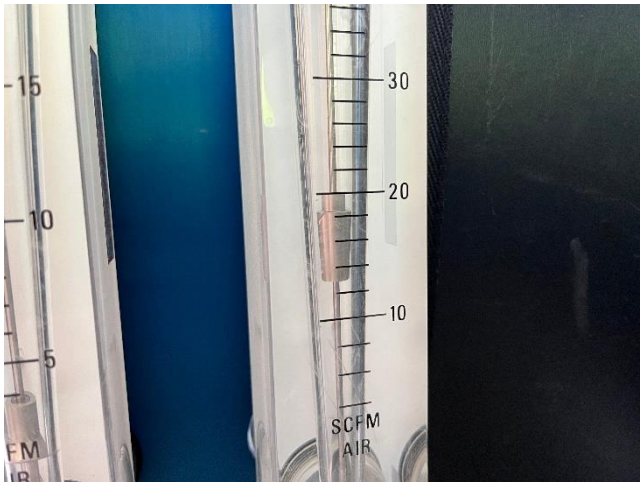

Photo 5 – Specimen 4 airflow reading at 18 CFM, masked.

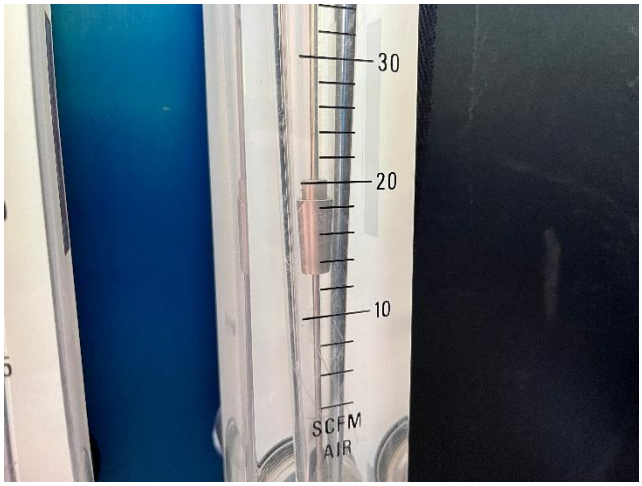

Photo 6 – Specimen 4 airflow reading at 18 CFM, no masking.

TEST PARAMETERS AND RESULTS: Table 2 provides a summary of the parameters and results from the ASTM E 783 testing at Test Specimen 4.

Table 2 – Air Leakage Testing Parameters and Results

Specimen Description	Testing Equipment	Average Pressure (in H_2O)	Allowable Air Leakage (cfm/sf)	Measured Air Leakage (cfm/sf)	Pass/Fail
Specimen 4	Wind Maker and Shop Vacuum	1.20	0.09	0.00	Pass

† Actual extraneous air leakage was likely greater than 0.0 cfm/sf; however, the precision of the testing equipment does not allow for relatively small readings to the "hundredth" of CFM/SF. Therefore, especially small leakage values (<<0.05) are presented as 0.0 CFM/SF.

Water Penetration Testing

The test methods utilized were in accordance with the ASTM E 1105 protocol. As stated in the ASTM E 1105 protocol, the test is "intended primarily for determining the resistance to water penetration through such assemblies for compliance with specified performance criteria, but it may also be used to determine the resistance to penetration through joints between the assemblies and the adjacent construction."

The ASTM E 1105 test method consists of, "sealing a chamber to the interior or exterior face of assembly to be tested, supplying air to a chamber mounted on the exterior or exhausting air from a chamber mounted on the interior, at the rate required to maintain the desired air pressure difference across the assembly while simultaneously spraying water onto the exterior face of the assembly at the required rate and observing the interior face for any water penetration."

Failure is defined by ASTM protocol as, "penetration of water beyond the vertical plane intersecting the innermost projection of the test specimen, not including interior trim and hardware, under the specified conditions of air pressure difference across the specimen… Failure also occurs whenever water penetrates through the perimeter frame of the test specimen. Water contained within drained flashing, gutters, and sills is not considered a failure."

Lerch Bates performed field testing at a uniform static air pressure differential of 10 psf for the test specimen, which is 2/3 of the laboratory tested design pressure. AAMA 502 4.9 and 503 4.7 identify the 2/3 test pressure reduction. Lerch Bates performed the test in general accordance with ASTM E 1105 Procedure A – Test Under Uniform Static Air Pressure Difference.

The water spray rack system used for the test consisted of one (1) Rainmaker spray rack, manufactured by RM Group, LLC, with 12 total spray nozzles spaced on a uniform grid at 24-inch centers, placed approximately 20 inches from the test specimen. The spray was positioned at the lower and upper halves of the test area, respectively during testing. The testing was conducted with two rounds of 15-minute water application starting with the bottom section. A measured pressure at the spray rack of 10 (ten) pounds per-square-inch (psi) was achieved, which calibrates to a minimum water application rate of approximately five (5) U.S. gal/ft2·hour.

TEST SPECIMEN 4: The specimen was an MGU-8 Unitized Curtain Wall section including a spandrel section. It can be identified on A3/A-203 in the shop drawings and was located on the north elevation of the building, ground level. The specimen measured approximately 75 SF.

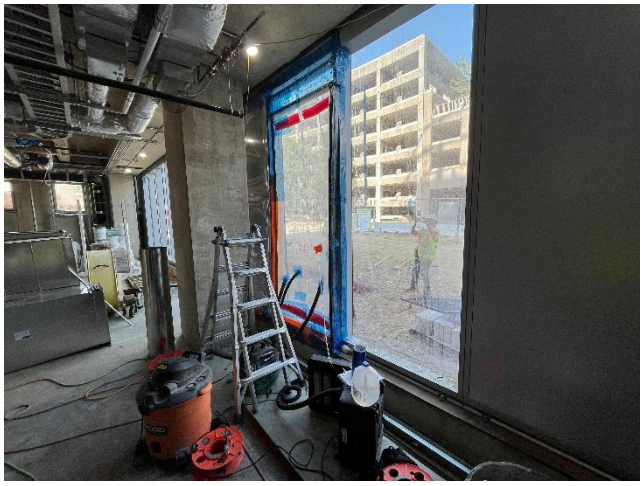

Photo 7 – Specimen 4, interior chamber setup.

Photo 8 – Specimen 4, spray rack positioning at bottom of test area.

Photo 9 – Specimen 4, spray rack positioning at top of test area.

Photo 10 – Specimen 4, spray rack pressure at 10 psi.

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Photo 11 – Specimen 4, interior chamber pressure at 1.9 in Aq.

TESTING SUMMARY

Round 1 (lower half):

0:00 Start of test - water spray @ 10-PSI; air pressure @ approximately 10 lbf/ sq. ft.

15:00 Test terminated. No water observed at specimen interior.

Round 2 (upper half):

0:00 Start of test - water spray @ 10-PSI; air pressure @ approximately 10 lbf/ sq. ft.

15:00 Test terminated. No water observed at specimen interior.

AAMA 501.2 Water Diagnostic Testing

Lerch Bates tested Specimens 5, 6, & 7 at general locations at the north and west elevations of the building. The test method was in general accordance with the AAMA 501.2 protocol. According to the test protocol, the purpose of the test is to “provide a quality assurance and diagnostic field water check method for installed storefronts, curtain walls, and sloped glazing systems. The procedure outlined in this document is not intended to test the rated or specified water performance representative of a wind driven rain event.” This test is generally intended to identify likely point locations of water infiltration within the assemblies.

According to the test procedure, “water leakage is defined as any uncontrolled water that appears on any normally exposed interior surfaces, that is not contained or drained back to the exterior, or that can cause damage to adjacent materials or finish. Water contained within drained flashings, gutters, and sills is not considered water leakage. The collection of up to 15-ml (1/2-oz) of water in a five-minute test period on top of an interior stop or stool integral with the system shall not be considered water leakage.”

A calibrated RainWand, manufactured by the RM Group, LLC, was utilized to apply a water spray at a pressure of approximately 30-pounds-per-square-inch (PSI). The RainWand is equipped with a Type B-25, #6.030 brass nozzle. The nozzle was held perpendicular to the test specimen, approximately 12-inches from the surface. Water spray was applied along the test specimens for approximately 5 minutes per 5-linear-feet, per the AAMA 501.2 protocol.

Photos 12-20 include photographs that show Test Specimen 5 diagnostic spray testing.

Photo 12 – Test Specimen 5 test area.

Photo 13 – Typical spray wand water pressure at 30 psi.

Photo 14 – Typical water spray application at Specimen 5.

Photo 15 – Interior view of test area for Specimen 5.

Photo 16 – View of moisture intrusion observed at interior.

Photo 17 – Interior view of moisture intrusion location (red arrow – on top of horizontal mullion).

Photo 18 – Exterior view of where water application resulted in moisture intrusion.

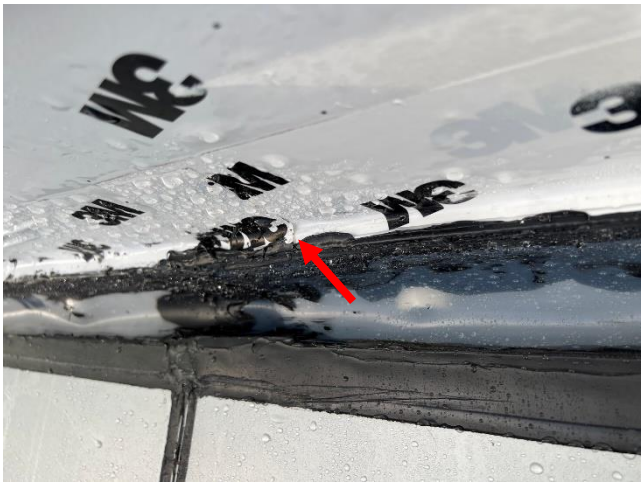

Photo 19 – Potential fish mouth deficiency within the 3M self-adhered flashing.

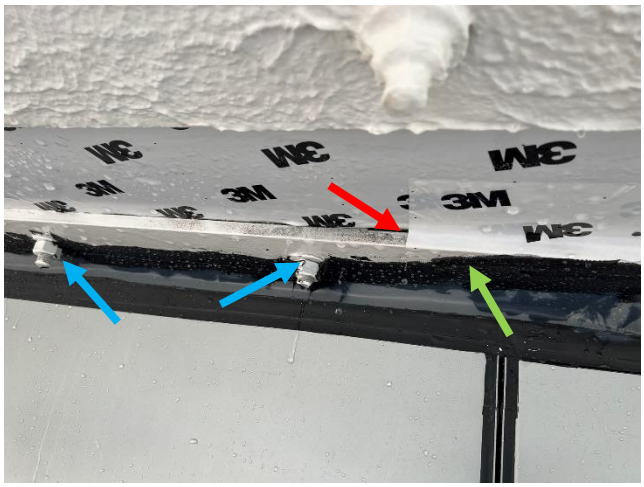

Photo 20 – Specimen 5, Potential moisture intrusion path locations (refer to “Results & Recommendations”).

Photos 21-25 include photographs that depict Test Specimen 6 diagnostic spray testing.

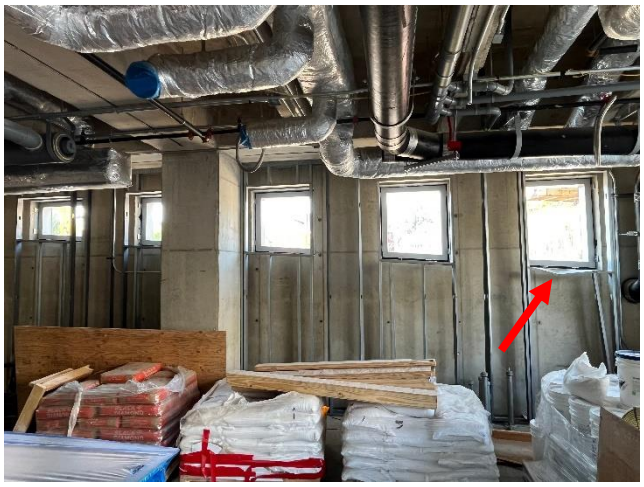

Photo 21 – Interior view of Specimen 6 location at north elevation, ground level.

Photo 22 – Exterior view of Specimen 6.

Photo 23 – View of Specimen 6 moisture intrusion at interior right sill/jamb interface.

Photo 24 – Location of moisture intrusion, interior view.

Photo 25 – Enlarged exterior view of moisture intrusion location.

Photos 26-27 include photographs that depict Test Specimen 7 diagnostic spray testing.

Photo 26 – Interior view of Specimen 6 location at north elevation, ground level.

Photo 27 – Exterior view of Specimen 6.

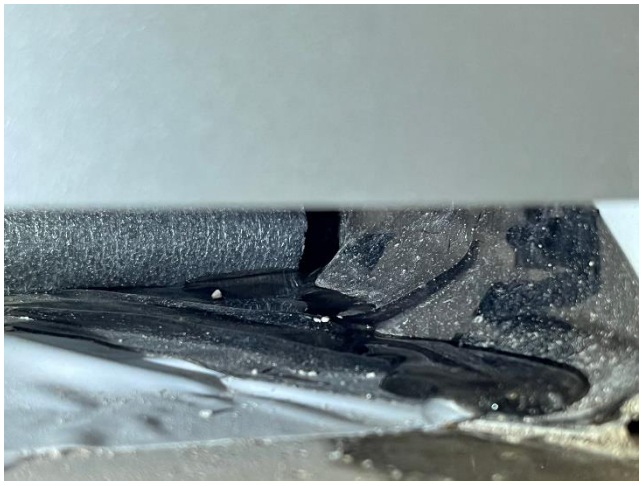

Photo 28 – View of Specimen 7 moisture intrusion at interior right sill/jamb interface.

Photo 29 – Enlarged view from exterior.

Results & Recommendations

ASTM E 783 AIR LEAKAGE TESTING

SPECIMEN 4:

It is Lerch Bates' opinion, based on a reasonable degree of engineering certainty, air leakage measured during ASTM E 783 testing of the MGU-8 Unitized Curtain Wall test specimen was below the leakage allowed by the specifications. The test specimen, therefore, passed the ASTM E 783 air leakage testing.

ASTM E 1105 WATER PENETRATION PERFORMANCE TESTING

SPECIMEN 4:

It is Lerch Bates' opinion, based on a reasonable degree of engineering certainty, that the MGU-8 Unitized Curtain Wall test specimen did not exhibit water penetration. The test specimen therefore passed the ASTM E 1105 test.

AAMA 501.2 DIAGNOSTIC SPRAY NOZZLE TESTING

SPECIMEN 5:

It is Lerch Bates' opinion, based on a reasonable degree of engineering certainty, that the transition detailing between Ground and Level 1 of the north elevation exhibited water penetration. The test specimen, therefore, failed the AAMA 501.2 test.

While water spray was applied to the transition detailing between the Level -1MGU-8 Unitized Curtain Wall assembly the Level 2 soffit, moisture intrusion was observed at the interior of the building and accumulated on top of the horizontal mullion framing. Lerch Bates interior view was limited due to construction build-out, so moisture intrusion was observed through photos and videos captured during testing (refer to Photo 16 which shows interior moisture intrusion and water accumulation on horizontal mullion).

After the moisture intrusion was initially observed, Lerch Bates re-applied moisture at general locations shown in Photos 18-20. There were various deficiencies/potential moisture infiltration paths within the weather barrier detailing membrane including fish mouths (Photos 19 & 20), general sealant applications and tooling along the edge of the boot flashing, sealing around steel plate bolts (Photo 20), and at a location where the self-adhered membrane detailing appeared to terminate along the steel plate (Photo 20 red arrow).

Lerch Bates recommends the air barrier installer reviews detailing at this condition to confirm continuity of the air/weather barrier including sealant applications and proper detailing around steel plates (which appeared to bridge between the seal at this location). Recommend retesting the test area after repairs have been completed.

SPECIMEN 6:

It is Lerch Bates' opinion, based on a reasonable degree of engineering certainty, that the glazing system installed within the west elevation punched opening exhibited water penetration. The test specimen, therefore, failed the AAMA 501.2 test.

Refer to general comments with Specimen 7 below for similar observations and recommendations.

SPECIMEN 7:

It is Lerch Bates' opinion, based on a reasonable degree of engineering certainty, that the glazing system installed within the west elevation punched opening exhibited water penetration. The test specimen, therefore, failed the AAMA 501.2 test.

Light was visible through the framing joints indicating lack of sealant application within the framing of Specimens 6 and 7 and therefore inability to resist water infiltration. Lerch Bates recommends repairing the glazing systems

installed within the west elevation punched openings to provide intended system performance; retesting will confirm remediation effort have been successful.

Note: Lerch Bates recommends reviewing all west elevation punched openings as it appears to be a systemic condition. Review of the issue with HDR will be undertaken and if in agreement, additional units will be tested to confirm punched openings meet project performance targets after MG McGrath has an opportunity to review and remediate units as necessary.

Limitations of Liability

All comments made are based on conditions seen at the time of visual observations or testing. We do not accept any responsibility for unknown or unknowable conditions within the existing assemblies or structures. Lerch Bates agrees to be responsible for its own or its employees' negligent acts, errors, or omissions.

Sincerely,
Lerch Bates

PREPARED BY:
Henry Wehlage
Specialist

REVIEWED BY:
Ryan R. Krug, BECxP, CxA+BE
National Practice Leader – Enclosure, Design & Consulting

HJW:RRK:mm

Attachments: Attachment A – Test Specimen Locations

https://lerchbates.sharepoint.com/sites/PieProjects/MN_Active Projects K/2020_MN/MN12033300/Phase_610-Field_Performance_Testing/05_Rpts_Att_Submtls/Rpt04/230906-KellenResearchBuilding-ASTME1105Rpt04.docx

9780 S. Meridian Boulevard
Suite 450
Englewood, CO 80112