BUILDING ENVELOPE COMMISSIONING: GET READY FOR THE STORM

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Imagine you are part of a project team that finishes a project and, shortly after completion, you get a call back because of water leakage issues during a storm. Not something anyone wants to see or have to deal with shortly after the completion of a new building.

Building Envelope Commissioning (BECx) is a great way to test the performance level of a building envelope and verify that the envelope was constructed in general conformance to the project documents, and will perform to a level that will meet the demands of weather conditions the envelope will be exposed to. BECx can involve testing the building as a whole (whole building air leakage testing, thermography) or a specific component or assembly such as a window (water penetration/air leakage testing) or wall.

Currently the Government of Alberta requires all new construction and major renovation projects to meet a minimum of Silver certification under LEED V4, the U.S. Green Building Council's Leadership in Energy and Environmental Design green building rating system. "The enhanced commissioning credits are mandatory, with additional options for Enhanced and monitoring-based commissioning, and Envelope commissioning1 . LEED requires that the commissioning process (CxP) for the building's envelope is completed in accordance with ASHRAE Guideline 0–2005 and the National Institute of Building Sciences (NIBS) Guideline 3–2012, Exterior Enclosure Technical Requirements for the Commissioning Process, as they relate to energy, water, indoor environmental quality and durability.

Even for projects that are not seeking LEED certification, BECx can be a requirement set out by the design authority or owner, to verify whether the performance of the final product complies with the design requirements of the project. Too often it seems, products installed on site do not meet the requirements of the project specifications and contracts agreed between owner and contractor. BECx can be beneficial from the viewpoint that testing will identify deficiencies that may exist with a product (such as a window that does not meet the design criteria when installed) during construction stage, providing the owner and contractor with the opportunity to have deficiencies repaired before the end of the project or before product and workmanship warranty periods end. This could save the owner and contractor money in the short term by reducing the number of callbacks and even in the long term by increasing the chances of avoiding expensive lawsuits because of failures that stem from deficiencies during construction, deficiencies that could have been avoided if BECx was part of the project quality control procedures.

A Building Envelope Commissioning Agent (BECxA) will perform the commissioning of the building envelope. "The BECxA is a specialist in designing, testing, and building of specific building envelope assemblies under the expected conditions (both interior and exterior) on the type of building that is being considered"1.

A BECxA will act as an independent reviewer and can perform many duties including but not limited to the following:

- Attend design charrettes and aid in the schematic design and design development stages of a project.
- Review and comment on the architectural drawings and specifications at various stages of development.
- Periodic review of work in progress.
- Carry out performance testing on exterior cladding assemblies such as windows, curtain wall, etc.
- Thermography of the whole building to assess continuity of insulation and air barriers.
- Warranty reviews before warranty periods end.

Field testing during the construction phase

Although there are many components to BECx, air and water penetration field testing of assemblies is one way to determine that the building envelope assemblies are storm ready and give the Owner reassurance that the risk of water leakage is reduced.

Project specifications will set out the field-testing requirements for assemblies to be tested on site based on the Owner's Project Requirements (OPR) and the Basis of Design (BOD) (Figure 1).

ASTM E1105-15: Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls is used during field water penetration testing procedures. This is a qualitative test to determine if water leakage is evident through the assemblies tested. Water leakage rates typically are not quantified as part of this testing.

When testing to ASTM E1105, an airtight chamber is required to be constructed on the interior side of a test specimen (e.g. window or portion of curtain wall, etc.) and that chamber is held at specific static pressures during the course of the test (Photo 1). The test can be performed by using one of two approved testing procedures:

- Procedure A is based on a 15-minute cycle where the interior chamber pressure is held at a constant static pressure for the duration of the test.
- Procedure B tests the assemblies under is a cyclic static air pressure difference in four six-minute cycles where the air chamber was pressurized for five minutes, followed by one minute without pressure.

On the exterior of the test specimen water is sprayed with a calibrated water spraying apparatus (spray rack) to provide a uniform water spray at a pressure consistent with the requirements of the standard (Photo 2). To meet the standard, water must be sprayed at a consistent water pressure of 12 psi (flow rate of five gallons/square feet).

It is also common to use non-toxic smoke to determine locations of air leakage through the specimen in

Figure 1: Example of testing requirements set out in a project specification.

1.6.5.1 Water Penetration: Field testing in accordance with ASTM E1186 Standard Practices for Air Leakage Site Detection in Building Enclosures and Air Barrier Systems and ASTM E1105-15 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls, by cyclic static air pressure difference, using AAMA 502-12 Test Method B and calibrated nozzle per AAMA 501.2. The water test pressure shall be two-thirds of the maximum positive design pressure.

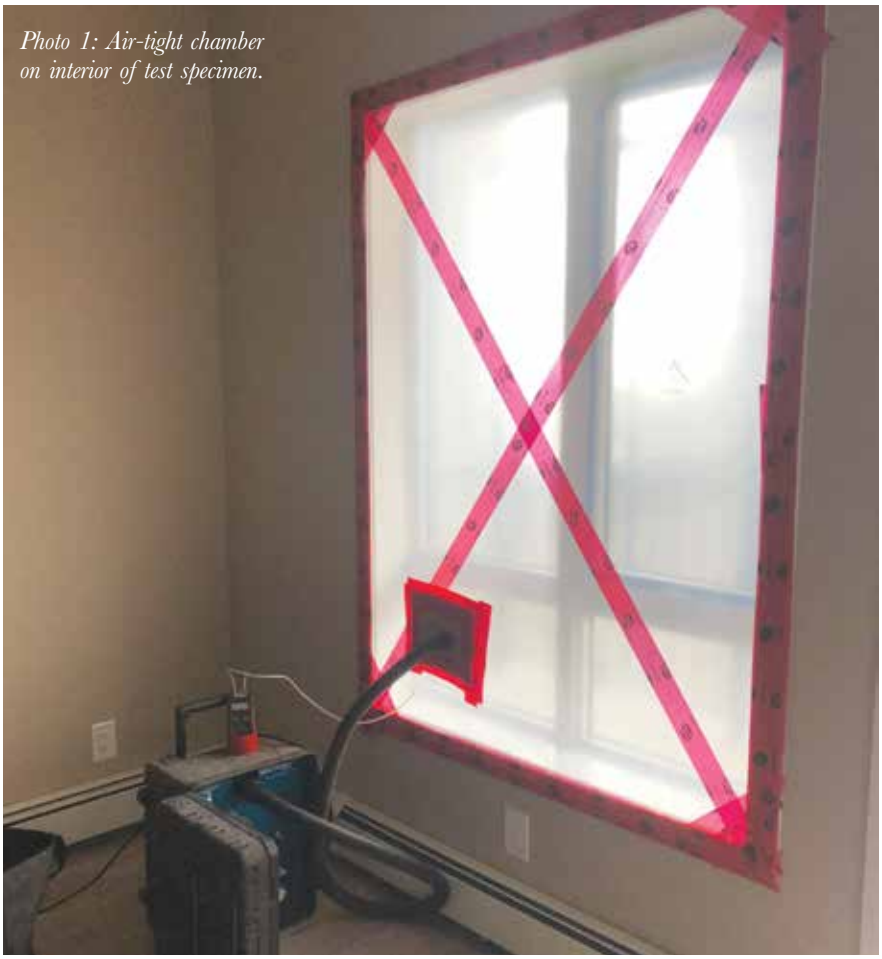

Photo 1: Air-tight chamber on interior of test specimen.

Photo 2: Spray rack on exterior of test specimen.

Photo 3: Water penetration failure.

accordance with ASTM E1186 Air Leakage Site Detection in Building Envelopes and Air Barrier Systems with the same test specimen as the water test.

What classifies a 'fail' or a 'pass' when testing to ASTM E1105?

A 'pass' is considered to be when no water penetration is noted through the assemblies that extend beyond the inner most surfaces of the specimen being tested.

A 'fail' is considered to be when water penetration extends past the inner most surface of the specimen being tested (Photo 3).

What pressure should the interior test chamber be pressurized to?

The interior test chamber pressure is measured by using a device such as a manometer. The interior test chamber pressure can be based on a variety of different requirements. Typically, field test pressures are specified in the project specifications as noted in Figure 1. If the project specifications do not specify a test pressure for the water penetration testing, the field test pressure must be decided by the design authority before testing begins. The AAMA 502, Voluntary Specification for Field Testing of Newly Installed Fenestration Products does not require test specimens to be field tested to the same pressures as laboratory tests. AAMA 502 restricts the field test pressures to two-thirds of the laboratory test pressures. For example, if a window with a laboratory water penetration test pressure of 720 Pa (maximum allowable test pressure for Canadian fenestration products), the field test pressure would be 475 Pa; however, an owner or designer can still specify higher pressures as a requirement of the contract.

What happens if the test specimen fails early during the test process?

We have seen test specimens fail early in the testing. Yes, it is a poor-performing specimen but what if there are other points of failure in the specimen? We want to know the whole story of the specimen's performance level. An example of this would be when testing a ganged mullion window (two separate windows joined together to make one larger window). At the beginning of the test, the window could fail through a deficient glazing seal. However, the ganged mullion, considered one of the weakest points in this type of window assembly, might also be a failure point and we want to know how it performs over the course of a full test or to the point of failure. Past experience suggests that it is worthwhile, if conditions permit, to continue testing until more failure points are identified or the test has completed it's full course. Many test specimens have failed near the end of the test, so tests should complete full cycles when possible.

Conclusion

BECx may be a requirement for your project if the project is pursuing LEED certification; however, BECx should not be limited to LEED projects. There are benefits to having any type of building envelope commissioned to provide the owner, contractor and design team reassurance that the building envelope will perform as intended and is durable enough to stand the test of any storm that comes its way. So get storm-ready and have your building envelope commissioned by a qualified BECxA.

1 Guideline for Building Envelope Commissioning: New Buildings – Alberta Infrastructure & Technical Design Requirements for Alberta Infrastructure Facilities Version 6 – Alberta Infrastructure.

*Latest version of LEED in Canada is LEED v4.

About

Niall is a building envelope specialist in the Edmonton office of RJC Engineers. He works on both new and existing buildings and has a good understanding of how buildings perform. He can be reached at nmccarra@rjc.ca. ■