



07: BUILDING ENCLOSURE COMMISSIONING

by Amanda Gibney Weko

Special thanks to Jennifer Keegan, Regional Manager - Building Sciences of Intertek, for her contributions. Don't miss Jennifer present more about BECx at the November 2016 Architectural Boot Camp.



DEVIL'S DETAIL

ALL ABOUT BECx

Architects and glaziers – we're in this together.

Building Enclosure Commissioning (BECx) arose in the mid 2000s after owners and enclosure consultants sought improved methods to ensure specifications adequately addressed building envelope performance. BECx emphasizes functional performance testing, expanding beyond air and water testing of individual façade components – such as curtain wall or windows – and instead addresses whole building performance by holistically examining building enclosure assemblies.

BECx Drivers - Economic Resiliency

- Redundancy
- Recovery
- Robustness
- Resourcefulness



According to the Building Commissioning Association (BCxA), BECx on existing buildings is becoming more common and economical. Evan Mills of the U.S. Department of Energy says that BECx should be viewed as "the single-most cost-effective strategy for reducing energy, costs, and greenhouse gas emissions in buildings today." He cites a BECx cost around 0.5-1 percent of construction cost. While rules of thumb may be helpful, the use, occupancy, and performance expectations of a building will influence its BECx cost. BCxA can provide cost comparisons of similar projects and evaluate the value brought to projects through BECx. For example, the U.S. Army Corps of Engineers reports that BECx can realize 20 percent energy savings in the northeast. BCxA also suggests long-term performance problems, such as water leaks, could be resolved with effective existing building BECx. On new projects, BECx has the potential to impact long-term energy, safety, and functional performance and advance sustainable practices across the building industry.

Architects and glaziers may have a new player on their design and construction team in a BECx agent (BECxA). Unlike a curtain wall consultant who focuses only on the glazing system, a BECxA examines how all aspects of the façade interrelate, and validates installation during construction and through the commissioning process. In its simplest terms, BECx is a quality assurance program to give owners peace of mind that their building enclosures will perform as expected.

CONCERNS AND CRITIQUE

With every new building technology or process, there are concerns and critics. In a May 2015 Field Notes editorial in USGlass magazine, Technical Glass Products curtain wall manager Chuck Knickerbocker asks, "Do we really need another player whose hand needs to be held to prove what we're doing is what we said we'd do?" He expresses concern over redundancies in the process, the expense and complexity of field-testing components that already earned NRFC certification, and the fact that BECx does not yet include structural system verification or checks for deflections or seismic considerations.

BECx	vs.	Enclosure Consulting
Formal process		Could be only one task
Based on performance		Based on reducing liability
More accountability		Less accountability
Based on real-world scenarios		Based on standards



In the July 2015 article, "The (BEC) X Factor: Are You Ready for Building Enclosure Commissioning?" USGlass magazine editor Ellen Rogers lays out a detailed case for BECx and encourages glazing contractors to become informed and prepared. "[BECx] can add another layer of complexity, increased oversight and testing, and is a more involved process compared to what [contract glazing professionals] are already used to," but that "BECx will continue to come on strong."

HOW DO WE VALIDATE?

At the end of the day, building owners care about whole building performance. BECx implements more specific pass/fail criteria and re-test requirements for validation.

AIR TIGHTNESS

Energy conservation concerns related to fenestration generally come in the form of solar heat gain (e.g., transmittance, reflectance, absorbance, and emittance of sunlight on, in, or through glazing systems). Thermal discontinuities may also be present.

Understanding the plane of air tightness is truly the devil in the BECx details. A BECxA will confirm the air barrier is sealed while also ensuring an airtight tie-in with the primary seal line of the curtain wall or window system. This is a relatively new concept for many trades.

Through architectural peer reviews and shop drawing reviews, BECx identifies opportunities for improvement, such as identifying thermal bridging of anchors or break metal flashings and examining sealants, interior framing, and building anchorages. Interior stud framing necessary for anchorage may need to be sealed to the air vapor barrier.



Energy modeling and design must consider all six sides of the enclosure (walls, roof, floors) as seen in Habitat 67 (image courtesy Fotolia)



Using theatrical smoke under pressure makes air leakage visible and serves as a diagnostic tool.



Mockup testing prior to cladding installation isolates the window to verify the integrity of the window-to-wall transition.

Substrate preparation also factors in; substrates must be continuous and free of major surface irregularities prior to air barrier installation in order to maintain integrity and air tightness of the system.

Critics such as Knickerbocker feels that glaziers are already proactive about issues of air tightness in particular. "Maybe the other wall systems haven't been held to the same standard as we in the glass and glazing biz have been?" he asks. In any case, BECx ensures all subcontractors are playing at the same level.

ENERGY MODELING

Energy modeling now influences all phases of design. Whole building air tests (ASTM E779) are expressed as air flow through the wall, roof, and floor – not just the façade. As such, energy modeling is a natural fit for BECx. BECx implements energy modeling during the programming phase, using models to validate design and evaluate options. Since models do not accurately account for air leakage, BECx agents provide building enclosure performance inputs.

Energy modeling trends attributed in part to BECx include increased model accuracy, increased model comparison with actual performance, modeling requirements for more projects, and modeling dictating design decisions.

According to GSA Division of Facilities Construction & Management Energy Development Director, John Burningham, "DFCM has learned the immense value of having high performing building envelopes." BECx in tandem with systems that perform as designed provide long-term value. DFCM analysis indicated that "annual energy cost savings ranged from four to 32 percent, with a majority of buildings experiencing savings in the 10 to 15 percent range."

SPECIFICATION TESTING

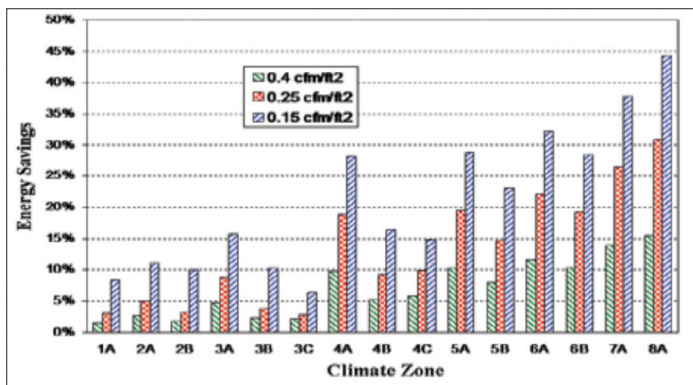
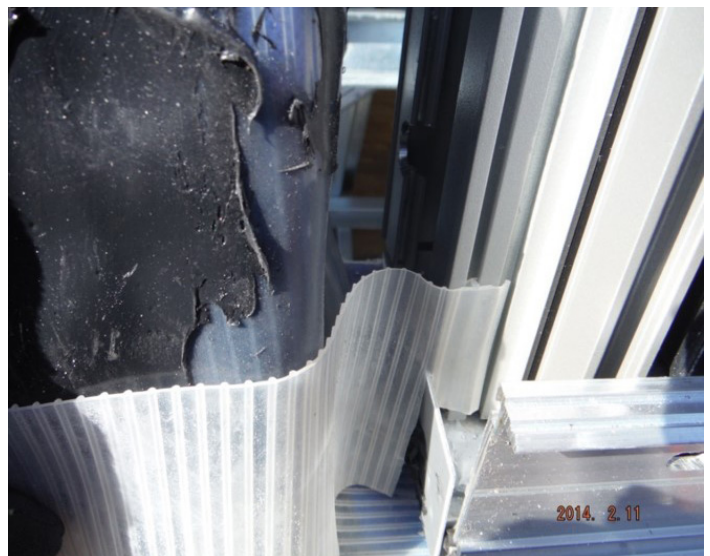
During the pre-design phases, the BECxA works with the building owner to develop project requirements and evaluate these against the architect's basis of design. New BECx Division 1 specifications fall in Section 019115 – Building Enclosure Commissioning Requirements and Section 019117 – Building Enclosure Functional Performance Testing. BECx specifications speak in terms of whole building performance rather than material performance alone, establishing a systematic process of ensuring all building enclosure systems responsible for environmental separation perform interactively according to the owner's project requirements and the architect's basis of design.

PERFORMANCE TESTING

Functional performance testing is used to detect air or water leakage through building envelopes or air barrier systems. Chamber pressurization or depressurization in conjunction with smoke tracers, detection liquid, or infrared scanning techniques and blower door or fan pressurization tests can be used to detect air leaks. Cyclic static air pressure differential, dynamic pressure, and other water spray tests can be used to check for water leakage. Functional testing assesses the entire enclosure rather than elements in isolation.

DIAGNOSTIC TESTING

Diagnostic testing examines what went wrong by recreating problems that are known to occur. It may help identify a problem's source, but is not a quality assurance procedure and can't be used to verify compliance with design criteria. Typically, diagnostic tests are adapted from in-service quality assurance methods. For example, a sill flood test may be used to determine leakage. Testing may isolate specific components within one installation (such as a frame vs. receptor system) by sequentially removing and measuring flow differential to confirm leakage in individual components.



Left: Energy savings realized through BECx process reduction in air leakage. (image courtesy Journal of Building Enclosure)

Above, top and middle: Water intrusion observed during mockup testing; Bottom: difficult transition of silicone sheet membrane at glazing corner (all images courtesy Intertek if not credited otherwise)

GOALS AND RESULTS

BECx aims to create durable structures, save energy, improve indoor air quality, prevent air and water leaks, increase occupant comfort, and deliver buildings that function as intended. By implementing strategies and a rigorous process from programming and pre-design through design and construction to operations and maintenance, BECx examines both the whole building enclosure and its life cycle. LEED v4 calls for BECx, and organizations such as the General Services Administration and Army Corps of Engineers are beginning to require it. Goals of BECx are gaining global traction.

LEARN MORE

Want to better understand BECx and performance verification testing? Want to engage with architects and other design and construction professionals? Attend AGI's November Boot Camp.

The hands-on activity will include the testing of stick-built curtain wall for the detection of water infiltration and the steps to successfully trace and remediate failures. Boot Camp is an AIA/CES registered program for 3 HSW learning units.

Wednesday, November 30, 2016

5:00 – 8:30 pm (5:00 – 5:30 registration and light dinner)

at the **Finishing Trades Institute**

2190 Hornig Road | Philadelphia, PA 19116

Jennifer Keegan, Intertek Regional Manager of Building Sciences, will explain the connection between a functional building enclosure and occupant health and safety and how to enhance performance on your next project. Understand and apply building enclosure-related performance verification testing from lab to field. Discuss challenges, review tips for addressing conditions that are difficult to detail, and learn strategies for successful testing. Discuss how our changing environment and construction practices dictate modifications to traditional building enclosure quality assurance. Explore how building enclosure commissioning can help you right-size mechanical equipment, by understanding what quantifiable results are achievable in today's buildings. *The BECx Boot Camp will build on the content in this article, with additional case study examples and hands-on testing.*

Architectural Glass Boot Camp is an interactive instructional program developed specifically for architects. Boot Camp reinforces the importance of collaboration and communication in design by providing an opportunity for design professionals to interface with apprentice glaziers and enhances the educational experience by providing a forum for the exchange of information between these two groups about complex construction issues.

RESOURCES

Read and understand what BECx means for you:

- NIBS Guideline 3-2012: Building Enclosure Commissioning Process (BECx)
- ASHRAE Standard 202-2013
- ASTM E2813-2013: Standard Practice for Building Enclosure Commissioning
- ASTM E2947-2014: Standard Guide for Building Enclosure Commissioning
- US Green Building Council LEED Reference Guide for Green Building Design and Construction
- LEED BD+C Core and Shell v4: Enhanced Commissioning
- International Green Construction Code 2012

[Read the Field Notes editorial:](#)

<http://www.usglassmag.com/fieldnotes/?tag=becx>

[Read the USGlass article:](#)

<http://industry.glass.com/USGlass/2015/July/XFactor.htm>



About the Devil's Details

The AGI educational series illustrates and describes common glazing challenges as a means to communicate best practices for the design and construction industry, not as a sole source for design guidance. AGI recommends design professionals consult with an AGI contractor regarding specific project challenges. AGI contractor profiles may be accessed at www.theagi.org. To share a devilish detail of your own, contact info@theagi.org.