Pushing the Envelope
Opportunities for Building Enclosure Commissioning (BECx) in Commercial Passive House Projects

9th Annual North American Passive House Conference
Friday, September 12, 2014
Baumann Consulting
Meredith Marsh
M.Sc., LEED AP BD+C
Green Building Consultant
Baumann Consulting

Board Member
Passive House Alliance, Chicago Chapter

312.386.7710
m.marsh@baumann-us.com

30 S Wacker Drive, Suite 3903
Chicago, Illinois 60606
Program Description.
This session focuses on how to deliver high-performance enclosures—from detailing requirements to achieving results. This session is intended to discuss approaches to understanding and applying Building Enclosure Commissioning (BECx) to commercial Passive House projects. New requirements for BECx in LEED v4 is expected to significantly impact the growth of these services. This emerging practice area provides both an opportunity for specialization for individuals and service growth for firms. Learn what BECx is, why it’s important and how Passive House practitioners can leverage their building science know-how to reposition themselves as leaders in thermal and moisture performance of the built environment.

Learning Objectives.
1. Articulate three or more strategies employed in BECx to determine performance compliance.
2. Build knowledge of the best-practice tests and standards used during BECx.
3. Understand how to apply BECx principles to your company’s current service offerings.
4. Describe the added value of BECx to clients.
bigger projects = bigger (envelope) problems
Passive House Standard

Airtight building envelope ≤ 0.6 ACH @ 50 Pascal pressure

Annual heat and/or cooling requirement ≤ 15 kWh/m²/year (4.75 kBtu/sf/yr)

Primary Energy ≤ 120 kWh/m²/year (38.1 kBtu/sf/yr)

bigger projects = bigger (envelope) problems
the enclosure is key
# LEED BD+C: New Construction v4 Commissioning Requirements

<table>
<thead>
<tr>
<th>Credit</th>
<th>Tasks</th>
<th>Building Systems Cx</th>
<th>Monitoring Based Cx</th>
<th>Building Enclosure Cx</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fundamental Cx</strong></td>
<td>Cx Plan</td>
<td>●</td>
<td></td>
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<tr>
<td>EAp (prerequisite)</td>
<td>OPR/BOD Reviews</td>
<td>●</td>
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<tr>
<td></td>
<td>Design Review</td>
<td>●</td>
<td>Not Required</td>
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<td></td>
<td>Specifications</td>
<td>●</td>
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<td>Installation &amp; Performance Verification</td>
<td>●</td>
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</tr>
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<tr>
<th>Enhanced Cx</th>
<th><strong>Option 1</strong></th>
<th><strong>and/or</strong></th>
<th><strong>Option 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>EAc (3-6 points)</td>
<td>Option 1: <strong>Path 1</strong> (3 pts.)</td>
<td>or</td>
<td>Option 1: <strong>Path 2</strong> (4 pts.)</td>
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<tr>
<td></td>
<td>Submittal Reviews</td>
<td>●</td>
<td>Achieve Path 1 &amp; Include Monitoring Based Cx in all the Fundamental &amp; Enhanced Systems Commissioned</td>
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<tr>
<td></td>
<td>Systems Manual</td>
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<td></td>
<td>Training</td>
<td>●</td>
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what the heck is Cx?

Commissioning Process: “…verifying and documenting that the facility and all of its systems…meet the Owner's Project Requirements.”

- ASHRAE Guideline 0-2005
what the heck is Cx?

Cx = Documenting Decisions
what the heck is Cx?

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Cx = Risk Mitigation
what the heck is Cx?
what the heck is Cx?
what the heck is Cx?
Exterior Shell:
• Concrete
• Framers
• Masons
• Steelworkers
• Sheathing(s)
  • Exterior Claddings
• Windows/Doors
  • Skylights

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Building Systems:
- HVAC Trades
  - Plumbers
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- Telecom Trades
- Alarm Systems

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Thermal / Moisture:
- Insulators
- Flashing Trades
- Air/Moisture/Vapor Barrier Trades
- Waterproofers
- Caulkers
- Roofers

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Finishes:
- Drywallers
- Window Coverings
- Painters
- Tile Workers
- Ceiling Installers

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Specialties/Other:
- Shading Devices
- Renewable Energy Systems
- Landscaping

what the heck is Cx?
what the heck is BECx?
Building Enclosure:
“...includes systems separating one defined environment from another.”

- NIBS Guideline 3-2012
Building Enclosure Commissioning (BECx):
“The process by which the design and constructed performance of building enclosure materials, components assemblies and systems are validated to meet defined objectives and requirements of the project, as established by the Owner.”

- NIBS Guideline 3-2012

what is the heck is BECx?
# Building Enclosure Commissioning (BECx) Process

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| Pre-Design     | • Establish the Commissioning (Cx) Team, including project team representatives and Commissioning Agent (CxA).  
• Develop a Cx Plan to serve as a comprehensive checklist and roadmap for the BECx process.  
• Review the Owner’s Project Requirements (OPR) and reference relevant standards as necessary. See the comprehensive checklist in NIBS Guideline 3-2012. |
| Design         | • Develop the Basis of Design (BOD) as an executive summary/game plan of how the OPR will be fulfilled. It is the “how” to the OPR’s “what.” See the comprehensive checklist in NIBS Guideline 3-2012.  
• Establish Cx specifications detailing the measures to be implemented (including contractor Cx requirements), as well as tests to be performed and performance requirements.  
• Perform Cx Design Reviews to catch potential issues and audit for design quality.  
• Develop checklists to help prevent missed steps during construction. Include installation procedures, test prerequisites, compliance with design and specifications. |
| Construction   | • The BECxA (building enclosure CxA) reviews submittals for conformity with the specifications.  
• The BECxA conducts onsite inspections using the checklist developed during the design phase to track issues prior to the closing of the enclosure.  
• Onsite testing performed by the contractor, 3rd party and BECxA to quantifiably verify the results of construction. The recommended “Big Five” tests are:  
  1. Heat, air, moisture  
  2. Airtightness (blower door)  
  3. Air penetration  
  4. Moisture penetration  
  5. Thermal imaging  
• The following tests and standards are most commonly used during this process:  
  Windows: ASTM E1105 Water Leakage, AAMA 501.2 Water Leakage, ASTM 783 Air Leakage  
  Air Barriers: ASTM 2357 Assembly Air Leakage, ASTM E 779 Fan Pressurization, ASTM E 1827 Blower Door  
  Roofing: ASTM C1153 Thermography  
  Walls: ASTM C1060 Thermography  
• A Systems Manual is developed as the building’s guidebook, including as-built drawings, test results and maintenance instructions and schedule. See guidance from NIBS Guideline 3-2012 and LEED v4 Cx requirements.  
• Facilities staff trained on how to use the systems manual and how to check for issues. |
| Occupancy & Operations | • Seasonal testing is performed post-occupancy to follow-up on any outstanding issues. Scheduled follow-up testing can be conducted at this time.  
• The Cx Report is completed, documenting the results of all Cx activities and serving as an addendum to the systems manual. The report includes the resolved issues log and benefits of the Cx process. |
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onsite testing: the big 5

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2. Airtightness (blower door)
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4. Moisture Penetration
5. Thermal Imaging
BECx and the 7 Seas C’s

Cost
Carbon
Claims
Comfort
Certification
Code
Continuity
BECx and the 7 Seas C’s

- Cost
- Carbon
- Claims
- Comfort
- Certification
- Code
- Continuity
"If architects did their job there wouldn't be any need for building science." So says Joe Lstiburek, principal at Building Science Corporation, in an interview with Andrew Michler of Inhabitat. Actually, there still would be building science. It's just that it would be fully integrated into the design process, where it belongs.

The photo at left is the Aqua Tower in Chicago. As Lloyd Alter points out in his Treehugger article about this abomination, this building has been called "architectural pornography" by engineer Ted Kesik. This building exhibits two of the biggest problems with the design of commercial buildings: Too much glass and too much thermal bridging. If you don't believe it, see the thermal image in engineer Robert Bean's article about the Aqua Tower.

Why Do Architects Focus on Art More than Building Science?

Posted by Allison Bailey on Fri Jun 01, 2012

"If architects did their job there would be building science." So says Joel, at Building Science Corporation Andrew Michler of Inhabitat. Architects would be building science. It's just not fully integrated into the design process it belongs.

The photo at left is the Aqua Tower. Lloyd Alter points out in his Treehugger this abomination, this building is "architectural pornography" by the Chicago Bean's article about the Aqua Tower.


NEWS:

Lawsuit Suggests New Liability for Architects

By Fred A. Bernstein

August 20, 2014

“In prior cases, California courts had ruled that an architect owes no duty of care to ‘downstream’ users. This time, the court held that such a duty exists, in part because architects, in the court’s view, are uniquely qualified to choose the right building materials.”
“In 2001, insurance companies paid out $1 billion in claims for moisture and mold-related issues, which tripled to $3 billion by 2003. During this time, insurance premiums increased by 50%, forcing one third of all contractors to abandon work in markets where they could not obtain liability insurance.”

ASHRAE Journal: July, 2008
“Moisture-related defects alone represent 69% of all claims.”

Association of General Contractors (AGC)
“Thermal comfort in commercial buildings remains one of the top three occupant complaints.” (in addition to visual comfort/glare and acoustics)

BOMA
(Building Owners and Managers Association)
“Building Enclosure Commissioning is the single-most cost-effective strategy for reducing energy, costs, and greenhouse gas emissions in buildings today...”

Evan Mills, PhD, Researcher
Lawrence Berkeley National Laboratory
selling the 7 C’s
AAMA 501.2: Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems

ASHRAE Guideline 0-2005: The Commissioning Process

ASTM E779-10: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization


ASTM C1060-11a: Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings


ASTM C1153-10: Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging


ASTM E2813-12: Standard Practice for Building Enclosure Commissioning

NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx


U.S. Green Building Council (USGBC), LEED v4: Fundamental Commissioning and Verification & Enhanced Commissioning

references
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