Building Enclosure Commissioning

Daniel J. Lemieux, AIA
Principal - Wiss, Janney, Elstner Associates / Chairman - ASTM E06.55, Performance of Building Enclosures

21st National Conference on Building Commissioning
Overview and Industry Update

- Overview of Building Enclosure Commissioning (BECx)
- Introduction to ASTM E2813, Standard Practice for Building Enclosure Commissioning
- History of BECx Standards Development
- Introduction to the ASTM/NIBS Memorandum of Agreement for BECx
- Introduction to the ASTM/NIBS BECx Certification and Training Program
Learning Objectives

At the end of this session, participants will be able to:

- Recognize the origin and significance of BECx
- Describe the basic structure of ASTM E2813 as a first step toward complementary and enforceable standards in BECx
  - Enforceable Levels of BECx
  - Enforceable Levels of Performance Testing
  - Minimum Core Competencies of the BECx Service Provider
- Appreciate the history and intent of the ASTM/NIBS Memorandum of Agreement for the delivery of higher performing buildings
- Contribute to the development of the ASTM/NIBS BECx Certification and Training Program (ISO 17024)
  - Consensus Through Collaboration (TAC)
BUILDING ENCLOSURE COMMISSIONING

What is It?

“Building Enclosure Commissioning (BECx) is a holistic process that...endeavors to ensure that the exterior enclosure of a building...meets or exceeds the Owner’s Project Requirements...” - ASTM E2813, Standard Practice for Building Enclosure Commissioning

- The BECx Process
  - Predesign
  - Design
  - Preconstruction
  - Construction
  - Post-Occupancy

- Owner Project Requirements (OPR) - OPR Development Software
  - Energy
  - Environment
  - Safety
  - Security
  - Durability
  - Sustainability
  - Operation and Maintenance

RESILIENCY
BUILDING ENCLOSURE COMMISSIONING
Why Is It Important?

- Uncontrolled rainwater penetration and condensation are two of the most common threats to building enclosure performance.
- Together, they represent up to 80% of all construction-related claims in the United States.
- 90% of all water intrusion problems occur within 1% of the total building area (interfaces).
- Building Sector consumes nearly 50% of all energy produced in the United States.

Compartmentalization of the Design Profession
Declining Skill Levels in the Construction Trades
Rising Incidence and Cost of Litigation
Failure to Deliver...
BUILDING ENCLOSURE COMMISSIONING
Standard of Care?

“It is not the standard of care to provide exhaustively detailed and annotated documents. If architects were expected to provide that level of detail, our fees would need to increase dramatically or we would be out of business quickly…”

-Testimony of Architect During Litigation

“Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage, or moisture disposal…”

-Technical Specification by Architect
BUILDING ENCLOSURE COMMISSIONING
Timeline of Recent Standards Development

- **2005:** ASHRAE Guideline 0, The Commissioning Process
- **2006:** NIBS Guideline 3, Exterior Enclosure Technical Requirements for the Commissioning Process
- **2012:** ASTM E2813, Standard Practice for Building Enclosure Commissioning (BECx)
- **2012:** ASTM/NIBS Memorandum of Agreement on Building Enclosure Commissioning
- **2012:** NIBS Guideline-3, Building Enclosure Commissioning Process
- **2014:** ASTM Standard Guide for Building Enclosure Commissioning (Replaces NIBS GL-3)
- **2014:** ASTM/NIBS BECx Certification and Training Program
BUILDING ENCLOSURE COMMISSIONING
ASTM E2813 Standard Practice for BECx

ASTM E2813 Stands on the Shoulders of...

✓ ASHRAE Guideline 0, The Commissioning Process

✓ NIBS Guideline 3, Exterior Enclosure Technical Requirements for the Commissioning Process

Establishes Enforceable Levels of BECx

Fundamental
- BECxA Engagement During the Design Phase
- Review and Refinement of the OPR
- Minimum Level of Performance Testing as Required in Annex A2 for “Fundamental” BECx

Enhanced
- BECxA Engagement During the Pre-Design Phase
- Development and Documentation of the OPR
- Minimum Level of Performance Testing as Required in Annex A2 for “Enhanced” BECx

Precedent...
- 1998: Public Works Canada Originates “Basic” and “Enhanced” Levels of Cx
- 2001: USGBC Adopts “Fundamental” and “Enhanced” Levels of LEED
# Building Enclosure Commissioning

## ASTM E2813 Standard Practice for BECx

Establishes Enforceable Levels of Performance Testing

![Image](image-url)

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard Designation</th>
<th>Title</th>
<th>Lab System Testing</th>
<th>Enhanced</th>
<th>Fundamental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Field Mockup Testing</td>
<td>In-Situ Field Testing</td>
</tr>
<tr>
<td></td>
<td>ANSI S12.8</td>
<td>Methods for Determination of Insertion Loss of Outdoor Noise Barriers</td>
<td>…</td>
<td>(OF)</td>
<td>(OF)</td>
</tr>
<tr>
<td></td>
<td>ANSI S12.60</td>
<td>Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools</td>
<td>OL</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Air Infiltration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air flow</td>
<td>ASTM E2319</td>
<td>Test Method for Determining Air Flow Through the Face and Sides of Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>Air leakage</td>
<td>ASTM E283</td>
<td>Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen</td>
<td>L (M)</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td></td>
<td>ASTM E779</td>
<td>Test Method for Determining Air Leakage Rate by Fan Pressurization</td>
<td>…</td>
<td>…</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>ASTM E1827</td>
<td>Test Methods for Determining Airtightness of Buildings Using an Office Blower Door</td>
<td>…</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>ASTM E782a</td>
<td>Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors</td>
<td>…</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Opaque Walls</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Windows</td>
<td>Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors</td>
<td>…</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Establishes Minimum Core Competencies for the BECx Service Provider

- Building and Materials Science
- Procurement and Project Delivery
- Contract Documents and Construction Administration
- Performance Test Standards and Methodology
Building and Materials Science

Principles associated with heat transfer via conduction, convection, radiation, and air infiltration/exfiltration;

Principles associated with moisture storage and transport via gravity, diffusion, convection, capillary action, absorbed flow, and osmosis; and

Characteristics and behavior of materials, components, systems, and assemblies when specified for a given application, geographic region, location, exposure, or climate...
Procurement and Project Delivery

Influence of the project delivery method selected by the Owner on the scope, adaptation, implementation, and cost of the BECx process

Influence of the number and type of contracts established between the Owner and the design and construction teams on the role and responsibilities of the BECx and individual members of the BECx team

Influence of design and construction scheduling, phasing, and sequencing of the work on the scope, adaptation, implementation, and cost of the BECx process

Influence of the experience, qualifications, technical depth, and commitment of the design and construction teams to the BECx process on the role and responsibilities of the BECx team
BUILDING ENCLOSURE COMMISSIONING

ASTM E2813 Standard Practice for BECx

**Contract Documents and Construction Administration**

Influence of Procurement Documents, Contract Documents, Contract Drawings and Specifications and other legally binding documents on the BECx process (and vice-versa)...

Enclosure-related design, detailing, and integration...

Product selection, allowable construction tolerances, and dimensional requirements at building enclosure interface conditions...

Material compatibility and **continuity of primary heat, air, and moisture control layers** throughout the building enclosure on fully integrated building enclosure performance...

Timely preparation and distribution of subject-direct, technically sound, and actionable documentation...
Performance Test Standards and Methodology

Pre-construction laboratory and field-applied mock-up test standards and methodology

**Appropriate and quantifiable thresholds of performance**
and clear and unambiguous definitions of failure

Application of test standards and **appropriate interpretation of test results**
relative to the requirements of the contract documents

Timely, clear, and unambiguous translation of all modifications to the design arising from pre-construction laboratory mock-up testing into the construction

Distinction between errors and omissions in architectural design vs. product design and installation or workmanship defects

Conflicts between voluntary guide specifications and standards and corresponding impact on the enforcement of the contract documents…
BUILDING ENCLOSURE COMMISSIONING

ASTM/NIBS Memorandum of Agreement (2012)

A Step Toward Consensus...

Support the development of standards, guidelines, certifications, education and training materials and programs for building enclosure design, construction and commissioning;

Promote and encourage discussion, training, education, technology transfer and engage in the exchange of information about all matters concerning the building enclosure and the related science;

Initiate and promote cross-disciplinary dialogue between all sectors of the building community and professions in the interest of high performance building enclosures;

Facilitate improvements in the building process, including inspection, approval, codes, regulations, standards, liability matters, and the other areas affecting building enclosures;

Improve the knowledge of their respective memberships in building enclosure science.
BUILDING ENCLOSURE COMMISSIONING
ASTM/NIBS BECx Certification and Training Program

- **ISO/IEC 17024 Standard for Personnel Certification Programs**
  - Formation of Technical Advisory Committee
  - Define Scope
  - Conduct Job Task Analysis
  - Draft Exam Blueprint
  - Hold Item Writing Workshop
  - Select Item Banking System
  - Conduct Beta Testing
  - Construct Test Forms
  - Set Cut score
  - Equate Additional Forms
  - Rescore Beta Exams
  - Quality Assurance
  - **Rollout (2014)**
BUILDING ENCLOSURE COMMISSIONING
ASTM/NIBS BECx Certification and Training Program

**ASTM/ NIBS BECx Certification**

**Technical Advisory Committee**

**Owner/ Developer**
- U.S. General Services Administration (GSA)
- U.S. Army Corps of Engineers (USACE)
- BOMA

**Design**
- American Institute of Architects (AIA)
- American Society of Healthcare Engineers
- ASHRAE
- Construction Specifications Institute (CSI)

**Construction**
- Associated Builders and Contractors

**Building Codes**
- International Code Council (ICC)
- International Accreditation Service (IAS)
- U.S. General Services Administration

**Research and Academia**
- National Institute of Building Sciences (NIBS)

**Industry and Trade Associations**
- Air Barrier Association of America
- BCA
- ACG
- AAMA
- RCI
- SSPC

**Insurance and Legal**
- Ujjval Vyas
- Fred Butters
- Greg Field
- Outside Counsel to AIA
- Legal Counsel to Real Estate Investment Advisors

21st NCBC Conference
ASTM/NIBS BECx Certification Will Establish Verifiable Levels of Personnel Certification

- **Certified Building Enclosure Professional (Advanced)**
  - Personnel Certification Program - ASTM/NIBS/ISO
  - Professional Registration or Equivalent Experience
  - Continuing Education Required

- **Certified BECx Authority (Intermediate)**
  - Personnel Certification Program - ASTM/NIBS/ISO
  - Continuing Education Required
  - Specialty Certifications Available

- **Certified Building Enclosure Technologist (Entry Level)**
  - Training-Based Certificate Program - ASTM
  - Individual Test Standards for Air, Water, Structural, and Thermal Performance Testing
  - ASTM Certificate
Certified Building Enclosure Technologist
Will demonstrate a basic understanding of...

- Building Science
- Construction Technology, Materials and Methods
- Architectural Drawings, Specifications and Detailing
- Quality Assurance and Quality Control
- Building Enclosure Commissioning Process
- Performance Test Standards and Methodology
Certified BECx Authority
Will demonstrate a working knowledge of...

✓ Building and Materials Science
✓ Construction Technology, Materials and Methods
✓ Contractual Roles and Responsibilities
✓ Governmental Laws and Regulations
✓ Industry Standards, Guidelines and Best Practices
✓ Documentation and Detailing:
✓ Analysis Tools
✓ Contract Documents and Construction Administration
Certified Building Enclosure Professional

The purpose of the ASTM/ NIBS Building Enclosure Professional certification is to provide building owners, facility managers, developers and others involved in the construction industry with a means to verify competence of design professionals with the specialized skills, knowledge, experience, expertise and abilities to analyze, design, and document building enclosures that control the passage of heat, air, and moisture while integrating with daylighting, heating, ventilation, and air conditioning systems to optimize for human occupancy and intended use.
Building Enclosure Commissioning

Road Ahead...

ICC
IAS AC476: Accreditation Criteria for Organizations Training/Certifying Individuals Involved in Commissioning
- Challenges remain...
- ASHRAE Standard 202
- ASTM E2813

USG BC
LEED v.4: Reference to NIBS GL-3 in the new LEED documents will be replaced in 2014 via addendum with a reference to the following:
- Challenges continue...
- ASTM E2813
- ASTM Standard Guide for BECx (GL-3)

NIBS/BETEC BECx Training Program
NIBS/BETEC will develop the BECx training program required for ASTM BECx Certification and administer it through the regional Building Enclosure Councils (BECs)
NIBS National Performance Based Design Guide (ASTM?)
BUILDING ENCLOSURE COMMISSIONING
ASTM Committee E06 Performance of Buildings

ASTM E06.55 Performance of Building Enclosures

ASTM E06.55.09 Standard Practice for Building Enclosure Commissioning
Martina Driscoll, Chair

ASTM E06.55.10 Standard Guide for Building Enclosure Commissioning
Rob Kistler, Chair

ASTM E06.55.11 Building Enclosure Commissioning Certification
Kevin Knight, Chair

ASTM E06.55.12 Building Enclosure Professional Certification
David Altenhofen, Chair

21st NCBC Conference
THANK YOU

Daniel J. Lemieux, AIA
Principal and Unit Manager
Wiss, Janney, Elstner Associates
Washington, DC
dlemieux@wje.com