The Building Enclosure Commissioning (BECx) Process and Its Keys to Success

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Historically, one of the most common and most expensive areas of building failure is the exterior enclosure. When applied systematically and geared toward the project's specific needs, the building enclosure commissioning (BECx) process can significantly reduce the risk of future water infiltration; improve facility operation and maintenance; and reduce the life-cycle cost of the facility. The process confirms building enclosure system and assembly functionality, durability, constructability, design and installation quality, and interoperability to meet the owner's project requirements.

The appropriate level and comprehensiveness of BECx services should match the complexity of the project. For example, a warehouse project with a $5 million budget and four typical enclosure assemblies needs a much different set of BECx commissioning services than a hospital with a $100 million budget and dozens of typical enclosure assemblies.

BECx commissioning requirements currently extend from the federal level (General Services Administration, US Army Corps of Engineers) to state (New York, California, Oregon, Indiana, Washington) and local (New York City; Seattle, Wash.) levels. In addition, there are sustainability-driven codes and standards (such as ASHRAE 189.1[1] or the *International Green Construction Code*[2]), and large and small private companies have created their own internal commissioning requirements that include BECx in part or in whole. These requirements vary from full cradle-to-grave comprehensive approaches to limited or focused commissioning or testing of specific enclosure components, usually related to air barriers or energy codes.

BECx commissioning benefits the entire project team by reducing risk, improving durability, providing vetted designs, validating performance, and reducing long-term costs, including maintenance costs. These benefits explain why sustainability programs are promoting and rewarding owners for engaging in the BECx process.

WHAT'S THE INTENT?

If you have been through the BECx process before, you might think that its intent is to consume reams of paper or to fill a hard drive. But if you ask owners who have committed themselves to this process, they will tell you that the BECx process helps them make sure that they get what they intended and what they are paying for. Buildings that are properly commissioned using the BECx process typically have fewer change orders, tend to be more energy efficient, and have lower operational and maintenance costs.[1]

When a person hears the word "commissioning," concepts such as "testing and balancing," "system confirmation," and "checklists" may come to mind. This is because decades of successful mechanical commissioning processes have been distilled into guidelines for performing the specific tasks that are most frequently parts of those processes. However, this oversimplification and "taskification" of commissioning can provide an unintended focus on construction-phase testing, as well as oversimplified design review, and can lead to overly generic, non-project-specific checklists.

BECx has inherited some of this oversimplification and "taskification" from commissioning of mechanical systems. However, the unintended consequences of this taskification for the overall project can potentially be more dire for BECx than for mechanical system commissioning because building enclosure assemblies are different from mechanical systems in the following ways:

- A mechanical system's performance requirements are straightforward and less likely to be effected by other system's changes. The building enclosure's per-

formance, however, is made of multiple control layers, materials, and environmental conditions. Therefore, it's more challenging to understand and quantify the unintended ramifications of modifying aspects of the enclosure.

- The performance verification testing of parts or of the whole mechanical system can be done with random sampling. A fully performing building enclosure assembly on a complex building has hundreds of transitions that might require verification. In addition, a misinstalled critical transition, whether occurring once or at some percentage of time, will lead to damage to the building. Therefore, given the critical nature of building enclosure transition installation, simple statistical sampling wouldn't identify this type of issue frequently enough (unless we got really lucky).
- Standard checklists for types of mechanical systems are relevant and usable across similar projects. Building enclosure checklists can provide a generic list of requirements, but the project-specific assemblies and transitions require verification via project-specific, non-generic checklists. This will help to avoid substrate/product incompatibility as well as other issues that can arise from overly generic standard checklists.

Another adverse effect of "taskification" of commissioning is that it encourages overreliance on templates for deliverables critical to the execution of the BECx plan. Too often, a service-strapped building commissioning (Cx) or architectural team provides templated owner's project requirements (OPR), basis of design (BOD) documents, quality assurance/quality control (QA/QC) logs, checklists, testing matrixes, and so on, with the hope that a project or commissioning guide can be executed without any project-specific thought. The reality is that more is not better in this context. When a commissioning process is not project specific, it creates the very thing that it is in place to avoid: a project that cannot be executed to meet the OPR. What value is a field observation checklist for an enclosure system that is not part of the project? What is the value of a BECx plan that outlines the role and responsibilities for a team member who will not be retained on the project? What value is a templated OPR that does not capture critical project-specific performance requirements? The answer to these questions is not simply "No value." Rather, the use of generic or templated commissioning tools likely costs the owner or the general contractor time and money.

While there are times when BECx can fall short of its intent, there are also times when the intention is terrific but the process is truncated or hyperfocused.

Starting the BECx process at the beginning of construction is admirable, but if the process begins then, it will be too late to fully achieve the intended benefit of confirming that project performance requirements and design documents meet the OPR. By the time construction starts, the ship has sailed, so to speak. And while there are benefits to confirming that the ship stays afloat, there is not much one can do if the ship is the wrong size or carrying the wrong cargo.

An emerging trend is to request BECx that is focused solely on either energy-related assemblies or the air barrier. This type of hyperfocused BECx is growing in popularity because energy codes and sustainability requirements incorporate design and construction oversight testing as project requirements. These limited BECx services provide value to the project, but the owner should be made aware of the limitations and risks of focusing only on one or two of the known layers (water, air, thermal, vapor) while the remaining, unvetted control layers are not part of the BECx process.

TEAMWORK MAKES THE DREAM WORK

Commissioning will always be a team-based quality process, and the makeup of the project team will be a key driver of the level of services needed to provide BECx. Projects that have a full project team that includes the owner; owner's representative; commissioning authority; building enclosure commissioning process provider (BECxP); architect; building enclosure consultant; mechanical, engineering, and plumbing consultant; general contractor; and third-party testing agency should allow for a greater stratification of roles and responsibilities than a project team limited to the owner, BECxP, architect, and general contractor only.

BECxPs should be mindful that other team members might assume that traditional building enclosure consultant activities are the BECxP's responsibility. And while the BECxP should have the technical acumen and experience to take on the consultant's roles and responsibilities, it is important that the project team understand what dual responsibilities the BECxP may be taking on. It is helpful in these situations for the BECxP team to be separate staff from the building enclosure consulting team when the same firm provides both services. There have been times when a project team has believed that this combination of duties does not fit the intent of third-party commissioning. There certainly is potential for conflict between commissioning and consulting roles. On the other hand, having an integrated firm fill both roles may be more efficient .

The keys to success are that the project owner and team are aware of the intersection of duties and that the firm filling multiple roles outlines how they plan to mitigate the potential issue of a conflict. For example, a building enclosure firm that provides design and construction consulting, BECx services, and building enclosure performance testing can provide a plan that outlines how separate personnel from their team will manage each role and that the BECx provider will engage and communicate with each team individually to avoid any conflict.

BECx STEP BY STEP

The road map for a successful BECx process will be as simple or as complex as the project

BECx commissioning benefits the entire project team by reducing risk, improving durability, providing vetted designs, validating performance, and reducing long-term costs, including maintenance costs.

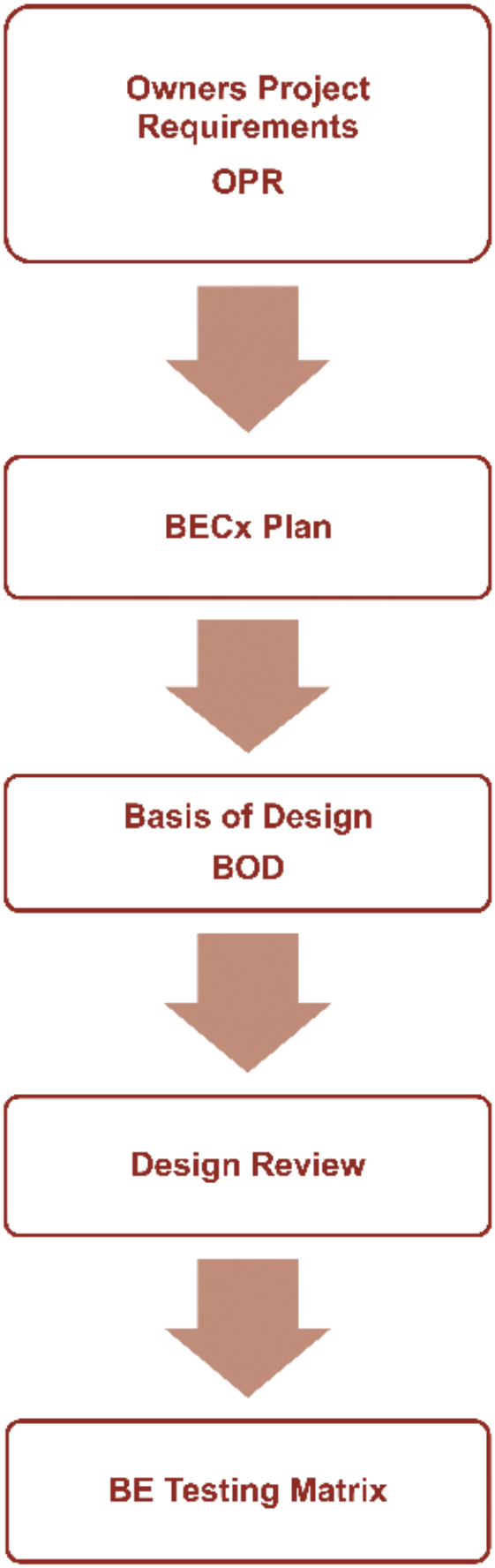

Figure 1. An example of the building enclosure commissioning (BECx) process "key to success" work flow.

that it is being used to benefit. Available guidelines have this flexible, expandable approach built into them. ASTM E2813, *Standard Practice for Building Enclosure Commissioning*,[3] and ASTM E2947, *Standard Guide for Building Enclosure Commissioning*,[4] define the fundamental (minimum) level of BECx involvement and provide guidance on enhanced levels of involvement. The National Institute of Building Sciences' NIBS Guideline 3-2012, *Building Enclosure Commissioning Process BECx*,[5] and ASHRAE Guideline 0-2019, *The Commissioning Process*,[6] both recommend that stakeholders define the scope and budget of the BECx process very early in the project; the scope should include plans for meetings and activities, details about the design peer review and validation reviews, and an outline of mock-ups, oversight, and testing expectations. This basic planning task is often overlooked because it can be unclear which team member should prepare this scope and budget. The owner, with the assistance of a commissioning provider (CxP) or BECxP, is best suited for this task.

Many BECxPs have been asked to define the scope and fee for BECx services for a project without having a document that defines the expectations of the owner and the team. In these situations, the BECx firm usually ends up in a dance with the owner and the commissioning agent about whether they intend to use fundamental/baseline BECx, some degree of enhanced BECx, or a focused (assembly or phase) approach.

The following sections offer a road map of critical deliverables that must be provided if the intent is truly BECx—that is, if BECx starts near the beginning of the project design phase (see also **Fig. 1**). If, however, BECx services are to begin at a later milestone in the project timeline, it is a good idea for the owner to share with the BECxP the documents and deliverables that were expected earlier in the process for retroactive review.

The Owner's Project Requirements

The first and most essential step in the commissioning and BECx process is the creation of an OPR, either by the owner alone or by the owner with the assistance of commissioning professionals. According to the Whole Building Design Guide:[8]

> The OPR defines the Owner's project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information for the project. The OPR must be developed with significant Owner and/or Owner's representative input and ultimate approval. The CxP typically facilitates the process for the Owner in identifying the facility's requirements regarding such issues as energy efficiency measures, environment and sustainability issues, security, and operation and maintenance of the building. An effective OPR incorporates input early from the design team, operation and maintenance staff and end users of the building and is updated throughout the project.

ASTM E2813-18[4] Annex A1 provides a guideline to assist Cx and BECx teams in creating an OPR by providing a two-page questionnaire. NIBS Guideline 3-2012[6] Annex J.1 provides a comprehensive checklist of factors that can be evaluated to establish the OPR.

The most critical aspect of the OPR is that the requirements are pertinent, project specific, and defined as early in the design process as possible. Like most design-phase BECx deliverables, the OPR document is intended to evolve and expand during the design phase. Failure to get substantive input on the OPR from the owner early in the design phase can lead to inaccurate and counterproductive basis of design and design review inputs. The owner's input should be substantive enough to allow the project architect and the building enclosure consultant (if the consultant is part of the team) to define the BOD systems and generate typical details for the building enclosure section (roof, floor, soffit, and wall) that represent most, if not all, locations of control layers within assemblies on the project.

BECx Plan

As explained in Section 3.2.6 of ASTM E2947,[5] the BECx plan outlines the BECx process to meet the OPR. It should describe the organization, sched-

CASE STUDY: Focused Assembly Consulting

Our firm was approached during the design process to provide BECx services. After meeting with the project team, we ascertained that the owner and commissioning agency were looking for focused assistance with air barrier design and testing requirement determination. Project specifications required BECx services; however, the BECx services provided for the OPR, BOD, design review, and building enclosure testing matrix were focused on only the air barrier.

Fast-forward to the construction phase: The project was negatively affected by the lack of BECx services related to anything other than the air barrier and the uncoordinated building enclosure details and specifications. Changes to the air barrier were required.

ule, and allocation of resources for the process, identify the responsibilities of stakeholders, and include testing and documentation requirements (checklists and logs). This document can become a part of the project's overall Cx plan.

ASTM E2813-18[4] Annex A1 provides a guideline to assist Cx and BECx teams contributing to the creation of an OPR by providing a two-page questionnaire. NIBS Guideline 3-2012[6] Annexes D and F provide tables and matrices to assist in the development of a BECx plan.

A BECx plan should match the size and scale of the project for which it is created. The draft should be reviewed by the project stakeholders for confirmation that each party has the scope (and budget) to provide the BECx plan deliverables. This document could be provided by the CxP and reviewed by the BECxP. The requirements for BECx participation should meet at least the minimum requirements outlined in ASTM E2813 for fundamental BECx. The plan should also reflect any enhanced participation required by any LEED, energy code, or air barrier—specific commissioning requirements.

Building Enclosure Basis of Design

NIBS Guideline 3-2012[6] defines the BOD as follows:

> A document that bridges the objectives conveyed in the Owner's Project Requirements (OPR) and the contract documents (construction drawings and project specifications). It records through narrative the technical concepts, performance, assumptions, decisions and product selections that fulfill the requirements of the OPR and authorities having jurisdiction.

The BOD provides the technical backbone to the OPR. It should provide adequate information such that a design review can be done using it as context. ASHRAE Guideline 0-2019[7] Informative Appendix K and NIBS Guideline 3-2012[6] Annex K offer the following (combined and simplified) list of contents:

- Specific codes, standards, and guidelines considered during design of the facility, and designer interpretations of such requirements

- Information regarding ambient conditions (climatic, geological, structural, existing construction) used during design
- Thermal performance requirements and relevant compliance pathways
- Sustainability requirements (energy, LEED, etc.)
- Performance criteria for each building enclosure assembly and how that system was designed to meet OPR requirements

When a building enclosure consultant is part of the project's design team, the design team should do the heavy lifting of generating the BOD and then the BECx should review the document to ensure that it aligns with the OPR. If the project does not have a building enclosure consultant, the BECx can offer to provide enhanced services that include assisting the architect in generating a BOD that aligns with the OPR. Some architectural firms have technical architects who have the experience and technical acumen to provide this information internally.

Design Review

In the International Code Council's *Performance Code for Buildings and Facilities*,[9] peer review is defined as:

> An independent and objective technical review of the design of a building or structure to examine the proposed conceptual and analytical concepts, objectives and criteria of the design and construction. It shall be conducted by an architect or engineer who has a level of experience in the design of projects like the one being reviewed at least comparable to that of the architect or engineer responsible for the project.

The BECx process requires that a building enclosure specialist provide a design review of the documents, but the scope and comprehensiveness vary depending on which standard is being followed. As noted previously, it's important for the project team to establish the scope and frequency of reviews as well as which parties will be providing them.

When a building enclosure consultant is part of the design team, it can be assumed that the high-level design review will be part of that consultant's scope of work and that they will have the role as BECxS (S = specialist). At a minimum, the BECx can take a "trust but verify" approach to the design review and provide the minimum amount of verification needed to confirm that the design documents meet the OPR requirements. In the most comprehensive approach, the BECx is providing a detail-by-detail review of each building enclosure transition as well as identifying additional details required to be provided within the final design documents.

Key considerations for the BECx team are the experience level and depth of knowledge of the team member or members providing the design review.

However, when a building enclosure consultant is not involved with design, or the project has a risk level such that the owner requires dual design reviews, the BECxP will need to take on the role of the BECxS and provide the design review. The frequency and depth of the design reviews will vary by project.

Key considerations for the BECx team are the experience level and depth of knowledge of the team member or members providing the design review. The ASTM E2947[5] and NIBS[6] BECx guidance documents indicate that a competent and knowledgeable person should provide the design reviews. This author further recommends that building enclosure specialists in roofing, exterior walls, glazing and fenestration, air barriers, thermal enclosure, and any distinctive project-specific enclosure assemblies or conditions review those details and applications that require such expertise.

Building Enclosure Testing Matrix

One of the clearest responsibilities of the BECxP, regardless of the level comprehensiveness of BECx services, is the establishing of building enclosure performance testing requirements. This task can be quite difficult because it requires buy-in and budgeting from the owner. The total cost for building enclosure testing—spanning laboratory tests, mock-ups, first works, progress testing, and completion testing for the various building enclosure assemblies on a project—can be substantial. Owners who are unaware of the potential price tag associated with a conservative or enhanced testing protocol may end up with severe sticker shock when presented with these cost estimates in construction. Sometimes, owners do not realize that their project manual obligates them to provide third-party testing services on behalf of the project.

ASTM E2813-18[4] Annex A2 (**Table 1**) provides a guideline and a table of fundamental and enhanced requirements to assist Cx and BECx teams in creating a building enclosure testing matrix. However, the team should carefully review the guideline and table before they incorporate the requirements into a project specification; it is important to ensure that the specification does not require unneeded testing of enclosure assemblies that are not part of the project.

The key to the success of the building enclosure testing matrix during the design phase is that the matrix only includes testing for those building enclosure assemblies that require performance verification to meet the OPR. The testing matrix must be assembly specific and incorporate any building enclosure testing required by:

- building code (whole-building air barrier testing),
- sustainability requirements,
- standard or enhanced manufacturer's warranty requirements (electronic leak detection or sealant adhesion),
- relevant industry organizations (Air Barrier Association of America Quality Assurance Program[10] testing; Fenestration and Glazing Industry Alliance's AAMA specifications 501,[11] 502,[12] and 503[13]),
- insurance carriers (FM Global wind uplift), or
- the owner (flood testing).

Table 1. A portion of Table A2.1 from ASTM E2813-18, **Standard Guide for Building Enclosure Commissioning**[4]

Property	Standard Designation	Title	Lab System Testing	Enhanced		Fundamental	
				Field Mockup Testing	In-Situ Field Testing	Field Mockup Testing	In-Situ Field Testing
Water Penetration							
Water penetration	ASTM E331	Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference	L (M)	–	–	–	–
	ASTM E514/ E514M	Test Method for Water Penetration and Leakage Through Masonry	OL	(OF)	(OF)	(OF)	(OF)
	ASTM C1601	Test Method for Field Determination of Water Penetration of Masonry Wall Surfaces	–	(OF)	(OF)	(OF)	(OF)
	ASTM D5957	Guide for Flood Testing Horizontal Waterproofing Installations	–	(OF)	✔ (all horizontal surfaces)	(OF)	✔ (all horizontal surfaces)
Static water penetration	ASTM E1105	Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference	–	✔ (1X)	✔ (2X)	✔ (1X)	✔ (2X)
Dynamic water penetration	AAMA 501.1	Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure	OL (M)	(OF)	✔ (1X)	(OF)	(OF)
	ASTM E2268	Test Method for Water Penetration of Exterior Windows, Skylights, and Doors by Rapid Pulsed Air Pressure Difference	OL	(OF)	(OF)	(OF)	(OF)
	AAMA 501.2	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems	–	✔ (1X)	✔ (1X)	✔ (1X)	✔ (1X)

In addition to confirming the extent and scope of testing, it is important to establish who is expected to provide (pay for) the testing because this helps determine where in the documents the testing requirements will be placed. Sometimes, an owner, general contractor, subcontractor, or manufacturer is surprised to find that they are considered the responsible party for various building enclosure performance verification tests because responsibilities are not otherwise clearly identified in the specifications. One thing is for sure: If the project team's budget does not have the capacity to handle the building enclosure testing, the tests will be omitted or scaled back.

The building enclosure testing matrix is a BECx deliverable, but it should be reviewed and the information incorporated into the proj-

CASE STUDY: Generic Building Requirements and Early Coordination of Testing

We were approached by a client to provide air barrier testing based on a testing requirement in the project specifications. The project was located in a state that does not require whole-building air barrier testing. Project specifications identified air leakage rate as a performance requirement and required use of ASTM E779, *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization*,[15] to confirm performance; however, the commissioning team allowed a substitution of ASTM E1186, *Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems*.[16]

The commissioning team reached out to provide the specified testing at a point in construction where most air barrier elements were complete. The contractor was concerned about the potentially subjective nature of ASTM E1186 testing methods (infrared scanning or smoke tests). If such testing were to identify any air leakage pathways, repairs to the air barrier might be needed that would not have been required if ASTM E779 testing were provided. The building enclosure consultants also expressed concerns that infrared scanning might not be possible because of a lack of a temperature difference between the interior and exterior. There were also concerns about access to the air barrier based on the progression in construction—it was possible that any interior or exterior smoke penciling would not outline the locations of the breaches.

The building layout was reexamined, and a comprehensive testing plan was created. This gave the commissioning agent and team sufficient confidence that ASTM E779 testing could be conducted.

Testing goal:	Confirm adhesion
Standard:	ASTM C1521, *Evaluating Adhesion of Installed Weatherproofing Sealant Joints*[14]
Where:	Each unique substrate type, primed and/or unprimed
Size:	Per standard
When:	Mock-up, first works, and in-progress
Frequency:	Every 1000 linear ft
Provided by:	Third-party by owner, installer by general contractor
Conducted by:	Installer and/or manufacturer at mock-up and every 1000 linear ft Third-party at mock-up, at first works, and twice during installation
Witnessed by:	None required
Failure criteria:	Per standard
Failure resolution:	Examine installation and provide input on failure reason. Retest 2 ft away from failed specimen. If results of adjacent retesting are acceptable, repair 4 ft of sealant. If adjacent retesting fails, continue to expand testing area until acceptable results are found or entire length is remediated.

ect specifications by the design team. The project-specific building enclosure testing matrix may conflict with a standard or templated specification. A common example of this conflict is fenestration testing requirements for curtainwalls. Most specification templates outline field-testing requirements in field QC and provide non-project-specific requirements (**Fig. 2**). However, these templated requirements do not provide sufficient detail to allow a third-party testing agency to provide accurate pricing for a testing scope that meets the OPR.

In contrast to the inadequate specification template, the following is an example of information that should be provided to the team for the purposes of planning and executing the building enclosure testing requirements for exterior joint sealants; it can be updated for most types of testing.

Two building enclosure testing requirements that should be carefully considered during the design phase are laboratory mock-up testing for curtainwalls and whole-building air leakage testing. These tests provide an enormous amount of value, but they also require a considerable amount of coordination and cost.

Construction-Phase Services

When the project transitions to construction, the BECxP's role shifts toward verification. At this point, the project contract documents should meet the OPR and the general contractor is responsible for managing their team and to execute the work outlined therein. The BECxP, in accordance with the BECx plan, reviews some or all of the project documents to verify that those documents are in line with the OPR. The documents include shop drawings, requests for information, field installation checklists, and third-party testing reports of laboratory and field testing results.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.

C. Field Quality-Control Testing: perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    a. Perform a minimum of two tests in areas as directed by Architect.
2. Air infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.45 ibf/sq. ft. (75 Pa).
    a. Perform a minimum of two tests in areas as directed by Architect
3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 ibf/sq. ft. (300 Pa), and shall not evidence water penetration.

Figure 2. An example specification section outlining field testing requirements taken from our firm's archives.

Challenges can arise when the BECxP is brought into the project at this phase, without involvement in the design phase. When this happens, projects usually fall into one of two categories. In the first category are projects where the design team has not formally followed a commissioning process, but they have created a set of contract documents that generally outline the owner's project requirements and have provided acceptable building enclosure design details and specifications. These projects usually have a strong design team that includes a building enclosure consultant and a preconstruction general contractor. In the second, and more likely, category are projects where the design team has captured the owner's general project intent, but the design documents require minor or significant adjustment to meet some of the owner's specific performance requirements within the specifications.

When beginning work on projects in either category, the BECxP will need to review their scope of services with either the owner or general contractor after reviewing the project and documents to determine what is feasible.

Construction Checklists

Prefunctional checklists are a huge part of mechanical system commissioning. The requirements for checklists and logs have found their way into the BECx process as well. BECx checklists are intended to communicate the key installation requirements for meeting the OPR. They are not intended to be an installation guide for the installer's foreperson or to replace the QA or QC processes, but they are intended to help the subcontractor and general contractor verify that they are providing the work in accordance with construction documents.

Like the other BECx documents discussed previously, checklists must be updated to reflect the building enclosure assemblies and not just the products identified for the project. Quite a few manufacturers have created product-specific installation checklists. These documents are helpful but should be edited and updated to reflect the critical requirements for the project-specific assemblies. For example, a water-resistant barrier checklist should cover the actual project substrate(s), transition membrane, and cladding attachment detailing, and they should be customized to reflect the window opening detailing and any enhanced air leakage detailing requirements.

CASE STUDY: CHECKLISTS, UGH

The general contractor and project team engaged us to provide the BECx services outlined in the project manual. The specifications required BECx, but the general contractor was brought on board after the bid phase. However, engaging a team to provide BECx services at the construction phase does not allow the entire BECx process to unfold as intended.

A focus was then placed on the specific QA/QC checklists that were outlined in the specification. Unfortunately, those checklists were not derived based on window integration and roofing, which were the project's riskiest assemblies; instead, they reflected historically challenging assemblies such as the exterior insulation and finish system (EIFS) and the air barrier. Therefore, our team diligently reviewed the 500 ft^2 of EIFS that contained the air barrier coating, while noting weeks of issues with low-slope roofing that went unobserved and were not documented through checklists.

CONCLUSION

As noted in the foreword to ASHRAE Guideline 0-2019,[7] the intent of the commissioning process is to provide a "quality-focused process for enhancing the delivery of a project by achieving, validating, and documenting the performing of facility elements that meet the objectives and criteria of the Owner." Therefore, those who venture to provide BECx services should be mindful of the overall intent of the commissioning, which is to define what the owner's expectations are for the building enclosure, to create verification mechanisms to ensure that the performance expectations are met during design and construction, and possibly to participate in the verification process. BECx must be done on a project-by-project basis with the understanding that the BECx and Cx processes are intended to be flexible to expand or contract to meet the needs of the OPR.

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special interest

LinkedIn: Where Weak Is Greater than Strong

If you're using LinkedIn for job hunting, you can boost your prospects by broadening the network of "weak ties" (acquaintances or "friends of a friend") with whom you interact on the site.

Using LinkedIn's "People You May Know" algorithm, researchers assessed five years' worth of data to determine that weak ties lifted one's prospects for finding a new job while the strongest ties had the least impact on job mobility.

The researchers highlighted three findings:

- Weaker ties increased job mobility, but only to a point.
- Moderately weak ties (measured by mutual connections) and the weakest ties (measured by interaction intensity) were associated with the most job mobility.
- The more digital the industry, the greater the job mobility associated with weak ties. Stronger ties work better in industries with less of a digital focus.

Source: science.org, tanuha2001/shutterstock.com