BUILDING ENCLOSURE COMMISSIONING: PAST, PRESENT AND FUTURE

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LEARNING OBJECTIVES

- learn the current trends in commissioning certification and accreditation;
- understand changes in the practice of building enclosure commissioning;
- discuss new technologies to evaluate building enclosure performance;
- identify future problems for our industry to solve.

INTRODUCTION

Though the practice of Building Enclosure Commissioning (BECx) is still in its early stages (only a few institutional projects prior to 2006), there is an important history to understand and analyze so that we can better predict the future of this practice area. Following the path of Mechanical, Electrical and Plumbing Commissioning (MEPCx), BECx has begun to define its own identity and is developing into a practice area and profession. As with any new practice area in the construction industry, there are many challenges and significant industry confusion surrounding BECx. This paper explores several of the critical topics that are shaping BECx by studying the past, acknowledging the present and working toward predicting the future. Specifically, this paper discusses the new versus existing building commissioning, the impact the commissioning process has on project schedules, the evolution into commissioning sub disciplines, certification versus accreditation and the next frontier of building enclosure performance verification.

DISCUSSION

Existing Building Commissioning

Owner Project Requirements (OPR's) for Existing Building Commissioning (EBCx), often referred to as "retro commissioning", work to enhance building energy usage and operating cost with a focus on improvements to the MEP systems. However, most EBCx OPR's exclude modifications to the enclosure's overall performance including air leakage, U-factor or Solar Heat Gain Coefficient (SHGC) and EBCx represents a significant percentage of all commissioning practiced throughout the United States. The percentage of project costs directed to BECx on existing buildings remains quite small. Challenges to implement BECx on existing buildings include the following: (1) perception that the return on investment is not equitable to that identified with MEP systems; (2) belief that repairs are invasive and not conducive to an occupied building; and (3) the lack of a formal standard of practice or guide. ASTM E 2813[2] is intended to work for both new and existing structures, but the foundation was based on a new construction process and the anticipated EBCx Annex has not be written to date. Existing buildings where water and air leak mitigation is typically the focus of the investigation are rarely scoped similar to commissioning projects with a holistic approach to performance. In most circumstances, the scope of work on the enclosure systems is not

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[2] ASTM E 2813 –12 Standard Practice for Building Enclosure Commissioning

defined, or is omitted, from the Existing Building Commissioning (EBCx) effort. The result is a standard of practice where only the occasional EBCx project includes the building enclosures, typically as a result of a well-educated Owner or MEPCx provider. Even when the enclosure is included in the scope of an EBCx project, the vital investigative phase, which should be the initial phase in the EBCx process for enclosures, is skipped meaning that the existing performance remains based on a series of purported observations, second hand data and stated assumptions.

So what is the current level of expectation of service for EBCx inclusive of the building enclosure? Too often, infrared thermography scans or similarly limited means are commonly used as the sole evaluation mechanism, which often leads to unsubstantiated performance opinions about the existing enclosure, as thermal anomalies are too quickly extrapolated to air or water leakage locations or thermal bridges. At best, these scans identify locations of thermal anomalies which cannot be quantified into air leakage rates or conductive losses without significant further confirmation, investigation and analysis. If there is a lack of understanding of a quantified baseline performance (e.g. whole building air leakage, measured SHGC of existing glazing or number of leak locations), then it is very difficult, if not impossible, to evaluate the effectiveness of a remediation protocol relative to these performance metrics.[3] Quantitative results should be sought over, or in conjunction with, qualitative results when Rate of Return (ROR) is a key factor.

A well-developed understanding of the existing building enclosure performance begins with a thorough review of existing documents and discussions/interviews with knowledgeable building staff similar to that defined in ASTM E 2128. Also, the development and execution of an effective functional performance testing plan is crucial to ascertaining existing building enclosure performance. When possible, testing that better simulates the natural exterior exposure should be preferred over testing that deviates substantially from naturally occurring conditions. Successful completion of this investigative phase provides a solid foundation and baseline for analysis of proposed remediation, repair and upgrade options, and evaluation of the final installation. More often than not, this depth of initial inquiry leads to building enclosure upgrades and improvements with a desired ROR that enhances the building enclosure performance and addresses the specific observations and concerns of the users. ASTM E 06.55 is currently working on an Annex specific to EBCx which should help fill the current standard void.

Schedules versus Commissioning

Over the last decade, perhaps more than any previous decade, construction schedules have shrunk to the point where time often trumps both cost and quality to avoid penalties such as Liquidated Damages outlined in the contract for construction. The impact of this constricted project schedule is often an underemphasized driver for the BECx process. Designs are completed without time or without a priority placed on the incorporation of commissioning review comments; submittals are approved or more commonly “Approved as Noted” by the architect prior to coordination with adjacent trades; free standing mock-ups are exchanged for in-situ “mock-ups” to remain in place; and “first install” observations are scheduled after the majority of the work is complete. These are all consequences of the constricting schedule that can be mitigated through a properly designed, integrated and prioritized BECx process. Free standing performance

[3] ASTM E 2128 – 12 Standard Guide for Evaluating Water Leakage of Building Walls

mock-ups with functional performance testing should be mandated for BECx projects with few exceptions (e.g. commercial construction budget below $5 million). Mock-ups should be tested prior to full scale construction, as mock-ups have proven their value in reducing construction changes and identifying performance, logistic and workmanship concerns which can be addressed prior to permanent installations. Shop drawings should be revised concurrently between BECx providers and the Architect with a submission of the BECx comments to the Architect for incorporation such that one set of comments is returned to the contractor. Finally, trade coordination meetings should be held with full participation of the parties involved or impacted by the sequence of work, ownership, testing/observation requirements and the condition resolution process.

Prefabrication of cladding panels and fenestration assemblies are on the rise as a result of the shrinking project schedules. A fundamental element of a BECx process is observation of the construction which has increasingly occurred away from the project site. Hence, the commissioning process should be modified to include fabrication plant observation and testing such that problems can be identified and resolved as early as possible. The impact of improper plant fabrication, if undetected, is increased on the numerous projects where fabrication plants are overseas with inherent long shipping durations. The BECx standard of practice is evolving to include plant fabrication site visits for fabrication observations, in-plant testing and a thorough review of the fabricator's quality control process. An emphasis on ascertaining performance values early has mandated the need to bring the value of the test lab to the fabrication plant rather than waiting for on-site verification. These changes in the practice are manifesting meaningful improvements to the quantifiable building performance.

Discipline Specific Commissioning

Throughout the 1990's and into the 2000's, whole building commissioning included a very select list of systems (e.g. mechanical, electrical, plumbing and controls), and MEPCx agents completed the vast majority of projects independent of other specialists. Starting in the mid 2000's, other systems started to be regularly added to whole building commissioning (e.g. life safety, security and building enclosure), and commissioning providers began morphing from individuals to teams. As with most changes to the practice of commissioning, the performance critical facility and large institution projects initiated this metamorphosis. Hence, until recently, BECx has traditionally been viewed as a high dollar service reserved for the elite institutes and performance critical projects. This view was reinforced when MEPCx agents began subcontracting BECx services with BECx fees that often dwarfed their own fees on projects, which created an initial rift between these professions. As client demand for building enclosure expertise increased, many MEPCx firms decided to self-perform BECx services. Unfortunately, a holistic dilution of the BECx profession began, to some degree, as providers outside of the building envelope profession began offering building envelope commissioning services.

Today, most commissioning projects now include building enclosure as a system to be commissioned, and a growing percentage of projects (particularly large institution projects) are now considering BECx as a separate contract from MEPCx.

Commissioning firms are now being selected more often on the strength of a team rather than solely the qualification of a lead commissioning firm, which has increased the technical expertise brought to bear on the average commissioning project. The commissioning industry (e.g. standards, associations, providers) is beginning to fundamentally view commissioning as discipline specific. Even MEPCx firms are regularly required to demonstrate separate mechanical and electrical expertise as they are rarely found in the same individual.

BECx has evolved from an afterthought to an Add Alternate and in the near future will be fundamental to the whole building commissioning process. Hence, MEPCx firms either need to subcontract the BECx or develop an in-house expertise specific to building enclosures to be competitive in the market place. Enclosure commissioning is just one of many disciplines under that commissioning umbrella, and many more will follow this same path. In the future, even the specific expertise (e.g. fire, blast, security and acoustical) within the enclosures umbrella will be sought. Already, documented abilities in distinct expertise (e.g. roofing, waterproofing, facades and fenestration) are regularly required to qualify as a BECx agent for a specific project. Sole practitioners of building enclosure commissioning are becoming more rare as the vast breadth of desired knowledge is expanding, which is most often found in a team rather than one individual.

Owners are continuing to seek discipline specific commissioning expertise (e.g. building enclosure) within their Commissioning (Cx) procurement process, and this trend will only increase. More relationships between MEPCx agents and enclosure specialists are being forged, and past successes of implementing cost effective building enclosure repairs are paving the way for more highly skilled commissioning teams.

Certification versus Accreditation

Many MEPCx agents appear to be stuck within an identity crises as the industry is clouded in confusion as to who is a qualified provider. The number of under skilled providers has surged with the flood of providers spawned by increasing industry demand and the recession of 2008, which left many MEP designers, Architects and builders looking for work. The lack of licensure and any substantial requirements to enter the Cx profession, combined with the relatively high fees, led to unqualified providers, poor performance and stakeholder questions about the value of the commissioning professional. The myriad of certification options for individuals only fueled the fire as there were large discrepancies in certification program requirements (e.g. experience, references, examinations and training). Too often individuals with little to no substantive commissioning experience on paper appeared equivalent to the true industry experts with years of experience in commissioning specific projects.

In 2013, faced with a concern for sinking industry reputation, many of the major commissioning associations began meeting to determine how to unify and raise the commissioning bar and regain prestige for the commissioning professional. Many of the association driven certification programs decided to pursue accreditation of their certification even though the accreditation process added significant cost with an

ambiguous timetable. At the same time, discipline specific accredited certification programs are being forged such as ASTM's certification for building enclosure individuals, which is nearing completion.

Commissioning teams will truly be teams in the future such that multiple discipline specific individuals, each with their own accredited certification, will be common on commissioning projects. Ultimately, the commissioning bar will be raised from this effort, but the stain from non-accredited certification programs will likely linger for years to come. All certification programs, whether accredited or not, are encouraged to increase participants, which create a challenge to find the balance between a fiscally viable certification program and one that truly represents only qualified individuals. All certification should require some level of demonstration of past experience, project references and a rigorous exam. As an industry, we must resist the temptation of labeling a multi-day commissioning training course with a review exam as certification. Commissioning is a profession, not a task or skill, and similar to Architecture and Engineering cannot be adequately learned by a novice in a few days.

More Sophisticated Testing

In the past, building enclosure testing lagged behind the industry needs in every major category. Little attempt was made to correlate testing with actual conditions experienced on a specific site. Field testing at actual project sites was limited to air and water and rarely found its way to projects outside of major metropolitan areas. Testing procedures have historically been adopted and modified from the fenestration industry and applied to opaque assemblies as there were no, or very limited, industry standards for field testing of most of our current construction systems and assemblies.

The typical field air and water testing of the recent past has transcended into thermal, acoustical, structural, security and durability testing at the project site. One of the few frontiers within the testing spectrum is field energy testing, which can be used to verify energy models and ascertain actual enclosure energy performance. A more conscientious approach to monitoring actual Solar Heat Gain Coefficient (SHGC) in the field is emerging, and field U-factor testing is under development by industry professionals. Major advancements in the way we perform and evaluate air leakage are on the horizon. Specifically, measurement of whole building air leakage in buildings without traditional masking such that the dampers and other elements that have been sealed and excluded from leakage numbers will now be included. These new testing capabilities and approaches could have far reaching industry influence such that energy modeling and traditional calculations will likely be modified based on the learning afforded by this testing. Significant work is needed to advance the industry's testing capabilities for durability of systems, and the continued effort of bringing the test lab to the project site needs to continue.

CONCLUSIONS

The BECx industry and practice has changed considerably in its short tenure and will continue to permeate to more new and existing buildings throughout the world.

Through the industry recognition of discipline specific commissioning and corresponding development of accredited certification programs, enclosure commissioning is gaining a position of a stand-alone profession. Inevitably, commissioning will continue to grow with increasing code and sustainability standard drivers. Also, shrinking project schedules have generated an increased need for building enclosure quality assurance and a change in the way professionals execute the commissioning process. Testing and commissioning continue to be tied hand and hand, and the industry needs to continue to push for new and innovative testing methods to best simulate actual performance and the durability of our buildings.

REFERENCES

ASTM. 2012. *ASTM E 2813 – 12, Standard Practice for Building Enclosure Commissioning.* West Conshohocken: American Society for Testing and Materials.

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