How to Give Owners What They Want Through Performance Specifications

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There are numerous sources of potential building enclosure failures. These failures have caused building repairs and litigations to become a billion-dollar annual industry and are one of the main reasons why the industry needs performance specifications. This article will explain building owners' directives and discuss properly executing the project requirements as part of the performance specifications.[1] Clear, concise, correct, and complete performance specifications help mitigate risk for all parties involved.

BUILDING AN UNDERSTANDING

The reality of a project outcome is typically different from what an owner expects due to budget, time, and other constraints. So how can the design team, building enclosure consultants, and commissioners minimize the gap between owner expectation and reality? Just because it looks good on paper, and just because we specify it, does not necessarily mean the contractor can build it and meet the owner's performance expectation. We must ask ourselves several questions:

- How do we guide the contractors so that they can succeed?
- Are design professionals giving the construction team designs that work?
- Are designers specifying assemblies and systems that have been tested?
- Are the specified materials compatible?
- Should more direction be provided so contractors are not missing critical components as part of their sequencing?
- Are we directing the construction team on how to control the performance of the building and even how to control their quality assurance and quality control during construction?

As design professionals, we must clearly define what the owner expects in "Division One" of the project manual so the contractor clearly understands the design intent and can fully envision the building enclosure performance as defined by the owner's expectations. If the design is not clear, the contractor may not understand it, and may construct it differently than expected. We need to take the entire building enclosure system into consideration and comprehensively describe not only assemblies of components, but the system as a whole. Methods to clearly define the project requirements often begin with concise performance specifications.

The scope of the Building Enclosure Performance Requirements includes quality assurance and quality control (QA/QC)[2] covering all materials and systems comprising the building enclosure. This section includes specific requirements for project management, coordination between the trades, scheduling and sequencing of the work, preconstruction and preinstallation meetings, inspections, tests, and related actions (including reports) performed by contractor, manufacturer, and independent third-party consultants.

Let us look at some of the challenges that often lead to building enclosure failures and how we can help prevent them.

BUILDING ENCLOSURE FAILURES/ CHALLENGES

Legal fees, rework, and all the forensics involved in investigating building failures account for billions spent in the construction industry annually. Over 90% of these failures occur in 1% of the enclosure.[3] These failures are related to issues typically observed at penetrations, fenestrations, roof-to-wall transitions, and dissimilar material transitions, most of which

could have been avoided by requiring the construction team to: construct mock-ups, conduct performance testing, conduct preconstruction and preinstallation meetings, document the verification and validation of installed assemblies, and implement construction QA/QC. These requirements can be defined in both Part One – General and Part Three – Execution, as part of Section 01 83 16 - Building Enclosure Performance Requirements Specification.

Quality Assurance and Quality Control

QA and QC processes, in the form of testing and construction observations throughout the entire construction process, play an important role in ensuring that the project requirements are met. It is crucial to consider how the construction manager (CM) and/or general contractor (GC) are managing the construction observations and installation inspections of the various enclosure trades. Are the installing trades educated on the installation processes and following the manufacturer's requirements? Who is observing the installation of the building components and how they transition? These are items that the contractor needs to build into its QA/QC program. In addition, onsite observation by the manufacturer, and installation inspections by a third-party consultant or building enclosure commissioner are also critical items that the contractor should incorporate as part of their QA/QC process. Walk-throughs, systems testing, and verification of installations should be conducted during the construction phase to ensure performance criteria are met. It should be noted that the stated protocols can also be defined in Section 01 83 16 to ensure these risk management steps are carried out during construction.

QA/QC should be clearly defined within Section 01 45 00, "Quality Requirements;" however, additional enhanced QA/QC should be clearly defined in Section 01 83 16, "Building Enclosure Performance Requirements" as they relate to the building enclosure. Most CMs and GCs have their own QA program, but no two QA programs are created equal. To meet the defined owner's performance expectations for a given project, the design team should include provisions in the project manual to clearly outline the QA/QC protocol to be followed as part of the construction phase and explain the required collaboration throughout the construction phase to include and involve a third-party consultant and/or building enclosure commissioning protocol paid for by the owner. Simply said, if it is specified, it is contractually understood that the CM/GC is required to follow the defined quality of construction in order to attain the given building enclosure performance.

Designing to Code (or Not)

When designs, building codes, and the owners' requirements are in conflict, how are these conflicts resolved? We need to educate owners and help them understand the conflict resolution process. Keep in mind that a code contains the bare minimum requirements for structures. We should be aiming higher than what the code is offering us if we truly want high-performance structures.

Water and Air Management

Water intrusion and air leakage[4,5] are issues that frequently lead to project callbacks. Designers should understand the effects of water intrusion and air leakage on the performance of a building as a whole. The contractor should implement the provisions in the specifications to minimize the risk of these two phenomena during construction, and for the life-cycle performance of the structure. With large projects, various trades, and different product technologies and systems, installation deficiencies can wreak havoc on projects and get missed. So how are we controlling risks? Are we giving sufficient drawing details to go along with our performance specifications? We need to make sure that the trades understand exactly what is expected of them. We can test to ensure that we do not have air leakage or water intrusion; we should require it in the specification. Environmental hazards and site conditions, of course, are inevitable, but water management during construction is something that the contractor is really in control of. We should be making sure that we give installers the precise details and transitions they are going to be encountering in the field in the project documents, along with providing the proper information in the specifications so that the installer understands the performance expectation of the specified systems. By dictating clear expectations, we can mitigate the chance of moisture intrusion and air leakage within our buildings after construction.

Lack of Skilled Labor and Training

There is a huge labor shortage right now.[6] We do not have as many skilled laborers in construction, and many in the workforce are retiring. Due to the speed of construction, labor shortage, and turnover, the industry is challenged with adequately training the younger

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generation as they enter the workforce. We need to focus on continually educating tradespeople to give them the tools and knowledge they need to do proper installations. If not addressed, this can lead to poor quality of work and deficient installation of the building components. To complicate matters, manufacturers are coming out with new products all the time. These new products may not necessarily be something contractors or tradespeople are experienced in, or have had time to train in. It is difficult for installers to keep up with the new products and systems available or specified. Maybe product manufacturers have shifted how to install system components or the sequencing of components. By specifying manufacturer participation at preconstruction and preinstallation meetings, we can help ease that burden; by requiring manufacturers to follow up with manufacturer audits during the installation phases, and inspecting the work along the way, installation deficiencies can be minimized.

Lack of Coordination

Between the contractor, tradespeople, architects, consultants, and engineers, there can be a large disconnect in the coordination of a project. We must ask ourselves, "Is there enough collaboration going on so that we are mitigating the risks by looking at the design as a whole, not just one piece at a time?" The CM or GC is responsible for construction sequencing, and all subcontractors need to be cognizant of which trades are going to follow up behind them. What are those trades doing to an already installed or maybe already inspected system? For example, additional penetrations to an existing air-barrier membrane that was tested and approved could severely damage the integrity of the air barrier. So how is the contractor managing those potential risks? This process should be outlined in the performance specification, and the contractor should include coordination protocols on the agenda for discussion of coordination expectations during the preconstruction and preinstallation meetings.

HOW DO PERFORMANCE SPECIFICATIONS HELP?

The only way that we can resolve water intrusion, air leakage, construction deficiencies, and even poor quality control, is by providing and following specifications that effectively describe performance and clearly translate the owner's project requirements into a low-risk and leak-free building. So how can we accomplish this within the specifications?

The Owner's Project Requirements

The owner's project requirements (OPR) should be a product of collaboration between the owner and the architect of record. The OPR clearly defines the requirements of a project and the expectations of how the building will be used and operated, and should include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.[7] Defining what the owner wants will determine exactly what the QA will be. We need to provide specifications that define the performance and functionality of the building and ensure that all technical requirements are being met. This communication reduces risk for the owner and everybody else, including the designer, specifier, contractor, and installing trades, for the lifecycle of the building—not just during construction.

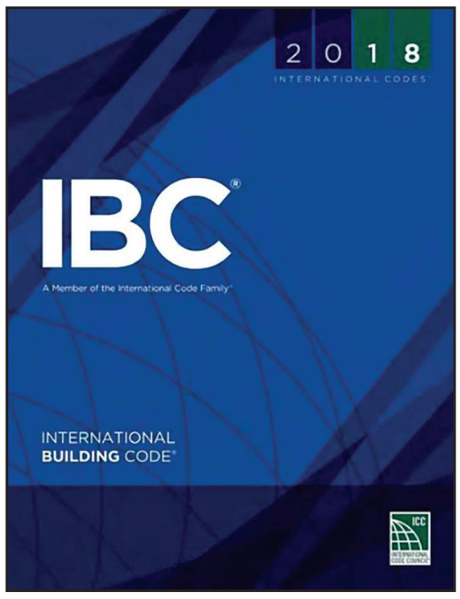
So, these are the "Four Cs"[8] that we are after: Clear, Concise, Correct, and Complete. Performance specifications should embody the Four Cs. From there, we must look at the actual execution of the OPR and the coordination of design intent to construction execution. Does the owner want construction observations? Does the owner want a third-party inspector? Will the owner hire their own third party? What is required of the contractor? Will testing be required to meet the performance specified? All those components need to be documented.

In addition, what does the maintenance protocol look like for the owner? Will the owner, for example, be taking mechanical systems offline during non-peak hours, such as at a school? And if so, are there provisions available so that that the designed enclosure is not compromised, and does not prematurely fail because of these set points? Are there test requirements, such as a whole-building air leakage test to ensure the mechanical system is functioning properly in conjunction with the building enclosure? Is the contractor required to test the systems for both peak hours and non-peak hours to ensure the performance of the mechanical system and the building enclosure will work as designed?

The building enclosure performance specification should provide all enhanced QC and testing required to meet the desired performance the owner is seeking. By understanding how the owner will use and operate the building, the architect can clearly define the requirements of a project, and provide a basis of design which is clear, concise, correct, and complete. This project-specific building enclosure specification will serve to guide the contractor to construct a building which will meet the owner's expectation for the lifecycle of the structure and its system components.

Communicating Building Codes

We need to make sure that we are following current codes adopted by the local authorities having jurisdiction for the location of the project. But because local codes are the bare minimum, we should strive to exceed those requirements. The *International Building Code*



(IBC) dictates that "the supporting documentation shall fully describe the exterior wall system, which was tested, where applicable, as well as the test procedure used."[9]

According to "code," manufacturer's specifications and installation instructions are also part of what should be included in the project manual. We should clearly outline and explain that all manufacturers' requirements for testing will need to be followed to ensure that the installation is done properly. By interpretation of code, a tested exterior wall system should be described, as well as the testing procedure used. Because we do not engineer wall systems that have been tested for water intrusion and/or air leakage, we must require the contractor to test the wall systems to ensure the performance the owner is seeking.

The architect of record should clearly define any enhanced measures required to meet the desired performance as defined by the OPR. Any enhanced performance testing required to attain the design intent and the desired performance should be considered, identified, and included in the performance specification. The key is to provide a comprehensive specification so that construction can be verified to ensure we are getting the specific performance that is in the OPR.

Quality and Testing Requirements

QA and QC of the building enclosure can reduce many of the risks resulting in lawsuits and insurance claims[10] in the construction industry due to water intrusion. Clearly specified quality requirements and performance testing also help the contractor by reducing rework.[11]

Within the quality requirements, the design and construction teams' responsibilities should be clearly defined in the specification. Who is going to manage performance testing and installation inspections/observations? Who is going to do the lab and in-field testing and when? Are they doing mock-ups? What defines "failure?" If there is a "failure" in the testing, who is going to conduct the retesting, and who is responsible for the cost of retesting? What are the repairs and modifications needed to correct the "failure" identified? How is the contractor documenting their "lessons learned" and communicating the results to the other trades? Lessons learned from the construction and performance testing of a mock-up are paramount in mitigating risks on a project. Requiring the contractor to include these protocols as part of their QA/QC program is a very beneficial aspect of the specification.

The specifications can also identify transitions that need to be observed by the contractor and how often they should be witnessed. Connections to be reviewed include:

- below-slab barriers, penetrations, and terminations;
- foundation wall penetrations and transitions;
- walls and windows or doors, and other openings;
- adjacent wall systems;
- walls and roof;
- walls and decks;
- walls, floors, and roofs across construction, control, and expansion joints;
- penetrations at all walls, floors, and roofs with systems functioning as the primary weather barrier; and
- walls and roofs over conditioned space.

Each environmental separator, including the substrates and transitions from below grade, the superstructure, and the exterior building enclosure, should be inspected regularly to verify quality. The contractor should

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be required to observe and document construction and installation at these junctures at 10%/50%/100% completion, at a minimum.

The contractor should document all observations as part of their QA/QC protocol. The report should include details of the components or systems found to be non-compliant with the drawings and specifications or with the manufacturers' installation specifications. It should also denote adjustments or alterations required to correct the system operation and should identify which trade is responsible for making the corrective changes. This report is a living document that should be regularly updated to reflect the progress on the building enclosure components and systems, and all items noted as a deficiency should be corrected and closed prior to covering the condition and prior to substantial completion of the project.

The construction quality assurance process should always be defined in the project manual. By incorporating risk mitigation, the design team can aid in reducing the owner's risk, and in turn, everyone's risk.

PRECONSTRUCTION AND PREINSTALLATION MEETINGS

Preconstruction (precon) and preinstallation (preinstall) meetings should not be confused, one with the other, or skipped. The specification can detail which parties should be present for which meetings and provide an example agenda of what those meetings should address.

Preconstruction Meeting

The building enclosure precon meeting is, in essence, an opportunity for all parties to sit down and talk about the construction before it even happens. The design team, construction team (including the leads for all the installing enclosure trades if known at the time of the meeting), and the owner should attend. Manufacturers should also be present because the team is covering everything from the design that is on paper and trying to figure out exactly how it is going to be constructed. Sequencing, compatibility, cure times, manufacturing lead time, testing, mock-ups, and the like, all need to be taken into consideration, as these factors can affect the project schedule. Discussing those items during the precon meeting with every trade is going to help identify potential problems and minimize risk for all the parties.

The precon meeting should be held on site and prior to the submittal of the shop drawings, after the product selection has been completed so that the manufacturer can attend. The contractor's responsibility is to organize the precon meeting with all trades involved in the whole building's enclosure barrier systems to discuss where each trade begins and ends; the responsibility and sequence of installation of all the air- and weathertight joints; and junctures and transitions between materials, products, and assemblies of products specified. It offers the opportunity to go through every single step of the construction process and discuss the specific sequencing, compatibility concerns, and testing requirements, and promotes collaboration and project ownership with the installing trades. Can a given installer apply the specified products/systems onto the substrate as designed? Are there dissimilar or incompatible materials? And if there is a change that needs to be made, then that is the time for the design professional to be made aware of the concerns, and ensure that the shop drawings and the resubmittals, if any, can reflect what has been discussed.

The contractor should hold this meeting once they have conducted a constructability review[12] to identify sequencing for construction, and the meeting should be scheduled such to bring in

the building enclosure trades when their area of construction will be covered. The purpose of this meeting is to simulate construction from the ground up and to review the construction documents for constructability concerns, sequencing, and review of transition details—the "by others" transitions—between systems.

Why should the design team go to the extent of specifying a preconstruction meeting? Simply put, not all contractors conduct precon meetings, and this process will minimize the owner's risks and aid in ensuring that the performance of the constructed building will meet the owner's expected performance.

Preinstallation Meeting

The preinstall meeting should happen about two weeks prior to the actual installation. This is the time to fill in the gaps and make sure that everything is covered. If there were any missing trades during the precon meeting, that can be noted and then addressed at the preinstallation meeting. Completeness of the submittals is the goal. Remember, if you do not specify something, it may not happen.

Industry standards suggest that several meetings may be conducted throughout the construction phase as construction progresses. Preinstall meetings give the construction team a chance to discuss installation to ensure the transitions happen per the shop drawings and meet the owner's project expectations. Every preinstall meeting offers the opportunity to eliminate or minimize mistakes during construction that could result in rework. Below grade, above grade, and roofing meetings can be conducted at different times of construction depending on the size of a project. Keep in mind that the preinstallation meeting(s) serves as the contractor's QC point and provides an opportunity for the building enclosure trades to review the substrate and project conditions, and to discuss lessons learned prior to commencing work. This meeting should include all trades who will be part of the construction team to make sure that the quality of the installation can be provided in accordance with the performance specification. As part of this meeting, submittals of shop drawings should be reviewed to verify they reflect what was discussed in the precon meeting. The specification should require the contractor to include that the lead installer(s) for each trade should attend the meeting related to their scope of work. The success of this meeting is largely dependent on the installing trades being included in the meeting.

To ensure that all trades are included, the specification can even go to the extent of requiring that each person in attendance sign off that they have been at the preinstallation meeting and have observed the condition of the building prior to installation of the components. For example, a waterproofing installer must look at the substrate and confirm that they are ready to conduct the installation and ensure a weathertight installation can be accomplished by accepting the substrate. If conditions are not such that the installer can guarantee a weathertight installation can be accomplished, they should let their contractor know what repairs are needed prior to returning and commencing work.

CONCLUSION

With so many complicated factors and competing needs through the duration of a commercial construction project, a cohesive team and clear, concise, correct, and complete performance specifications are a must to reduce the risk for all stakeholders. Remember that specifications are part of a legal document that carries legal ramifications. Identify the OPRs and desired performance, and specify the expected performance once, in the right place within the project manual.

Specify what should be covered at the preconstruction and preinstallation meetings and clearly define when these meetings should be held. Define the expectations for a QA/QC plan for the construction team. Outlining the sequencing, testing, and QA/QC requirements during the preconstruction and preinstallation meetings will minimize many of the design and application challenges contractors are faced with during construction. Have a plan, and execute that plan in the building enclosure performance specification, and require this plan be followed in the field.

Together, we can create leak-free buildings, but it is through performance specification that we can aid in this process by clearly detailing the expectations and responsibilities for each team. IIBEC

REFERENCES

1. Building Enclosure Performance Specifications should be defined in Section 01 83 16 – "Building Enclosure Performance Requirements." This section is used to define the required performance of the building enclosure as a whole and should be in accordance with the OPR for the building enclosure. The specification is intended to incorporate all enhanced performance not noted in other related sections of building enclosure components as required to attain a whole building enclosure enhanced to meet the owner's needs. This section should not duplicate what is specified in other sections. Construction Specifications Institute. Alexandria, VA. https://www.csiresources.org/.
2. According to CSI, quality assurance "refers to the procedures for guarding against defects and deficiencies before and during the execution of the work," and quality control "refers to the procedures for evaluating completed activities and elements of the design for conformance with the requirements." Patrick Reicher, REWC, REWO, SE, CCS, CCCA and Jacob Arnold, CDT. "Specification Strategies for Field Testing Success." *Proceedings of the Building Envelope Technology Symposium*. IIBEC. Raleigh, NC. November 16-17, 2018. https://iibec.org/wp-content/uploads/2018-bes-reicher-arnold.pdf.
3. The 90%/1% Principle: As much as 90 percent of all water intrusion problems occur within 1% of the total building or structure exterior surface area. The 99% Principle: Approximately 99% of waterproofing leaks are attributable to causes other than material or system failures. Michael T. Kubal. *Construction Waterproofing Handbook*. The McGraw Hill Companies Inc. 2000.
4. By putting assemblies, penetrations, and transitions to the test during construction, water intrusion and air leakage can be rectified during construction and avoided. Sarah K. Flock, CDT, AIA, and Andrew Dunlap, AIA, CDT, LEED AP, NCARB. "Put Penetrations to the Test: The Effect of Cladding Attachments on Air and Water Barriers." *Construction Specifier*. Construction Specifications Institute. Alexandria, VA. July 12, 2018.
5. S. Molleti, A. Baskaran, P. Beaulieu, D. Ban Reenen. "Air Intrusion and Its Impact on Energy Performance of Roofing Assemblies." *Proceedings of The First International Conference on Building Energy and Environment*. July 13, 2008. National Research Council Canada. https://nrc-publications.canada.ca/eng/view/object/?id=b2e-a29c1-afcb-4778-a286-1b4b39be0c84.
6. The Associated General Contractors called for measures to rebuild the workforce in 2018 because 80% of contractors reported difficulty finding qualified craft workers to hire. "Eighty Percent of Contractors Report

Define the expectations for a QA/QC plan for the construction team. Outlining the sequencing, testing, and QA/QC requirements during the preconstruction and preinstallation meetings will minimize many of the design and application challenges contractors are faced with during construction.

Difficulty Finding Qualified Craft Workers to Hire as Association Calls for Measures to Rebuild Workforce." Associated General Contractors. August 29, 2018. https://www.agc.org/news/2018/08/29/eighty-percent-contractors-report-difficulty-finding-qualified-craft-workers-hire-0.

7. Owner's Project Requirements (OPR) definition. ASHRAE/ANSI/IES Standard 202, *Commissioning Process for Buildings and Systems*. ASHRAE. Peachtree Corners, GA. 2018. https://www.techstreet.com/ashrae/standards/ashrae-202-2018?product_id=2025517#product.
8. CSI's Four Cs for specifications are as follows. Clear: Use proper grammar and simple sentence construction to avoid ambiguity. Concise: Eliminate unnecessary words, but not at the expense of clarity, correctness, or completeness. Correct: Present information accurately and precisely. Carefully select words that convey exact meanings. Complete: Do not leave out important information. "4 Cs To Improve Construction Document Communication." Construction Specifications Institute. Alexandria, VA. https://www.csiresources.org/.
9. Construction documents for all buildings shall describe the exterior wall envelope in sufficient detail to determine compliance with this code. The construction documents shall provide details of the exterior wall envelope as required, including flashing, intersections with dissimilar materials, corners, end details, control joints, intersections at roof, eaves or parapets, means of drainage, water-resistive membrane, and details around openings. The construction documents shall include manufacturer's installation instructions that provide supporting documentation that the proposed penetration and opening details described in the construction documents maintain the weather resistance of the exterior wall envelope. The supporting documentation shall fully describe the exterior wall system that was tested, where applicable, as well as the test procedure used. *International Building Code* 2018: [A] 107.2.4 "Exterior Wall Envelope." International Code Council. August 2017. https://codes.iccsafe.org/content/IBC2018/chapter-1-scope-and-administration.
10. Zurich US construction property data for losses occurring between 1/1/2007 and 12/31/2016 show that nearly 50% of all builders risk claims resulted from some form of weather or escape-of-water event. This includes damage from events such as rainstorms, snow, flooding, and hurricanes. Zurich states that water intrusion issues on a project are not limited to the builders risk policy, and water intrusion-related issues can also lead to claims under general liability, professional liability and environmental liability policies well after project completion, with the majority of construction defect claims being water-related. *Construction Defects Claims Data*. Zurich Insurance Group. Schaumburg, Illinois. https://www.zurichna.com/-/media/project/zwp/zna/docs/kh/const/water-intrusion-mitigation-program-for-construction-fs.pdf.
11. Around 30% of the work performed by construction companies is actually rework. Mohammad Miri and Mahsa Khaksefidi. "Cost Management in Construction Projects: Rework and Its Effects." *Mediterranean Journal of Social Sciences*. December 2015. Doi:10.5901/mjss.2015.v6n6s6p209.
12. "An independent and structured review of construction bid documents by construction professionals to make certain that the work requirements are clear, the documents are coordinated, and that they assist the contractor in bidding, construction, and project administration to result in reduced impacts to the project." Although constructability reviews are conducted during the design phase, the awarded contractor should conduct a constructability review to identify sequencing scope prior to conducting a preconstruction meeting. Stephen R. Pettee, PE, CCM. "Constructability Reviews—an Introduction." Construction Management Association of America. Vienna, VA. June 2012. https://www.cmaanet.org/sites/default/files/resource/Constructiblity%20Reviews.pdf.

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