Achieving and Executing a Successful Building Envelope

Best Practices, Roles and Responsibilities

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Statement of Purpose

Building enclosure systems include any component that is intended to keep outside air and water from entering a building. It includes roof assemblies, below grade waterproofing, exterior walls and glazing, skylights, air/vapor barrier systems , etc. When such elements are defective with respect to design or installation, a loss of building efficiency and water intrusion leading to damage may occur. Furthermore, repairs of defective building enclosure systems can be very challenging and costly.

For these reasons, it is important that building enclosure systems are properly designed and installed. Coordination and installation can be challenging since building enclosures include multiple trades and are often designed and field assembled from numerous materials (where chemical compatibility must also be considered) that include many interfaces.

The purpose of this document is to provide best practice guidance for all stakeholders associated with the building enclosure. Creating a clear definition of roles and responsibilities will help to assure the end result is a building enclosure that performs as intended.

The following best practices, relative to the building enclosure, are included as a guide. Building enclosures are designed by the Owner's Architect/Engineer or design-build team (depending on contract delivery method). Through coordinated and collaborative efforts with the Owner, Designer, General Contractor, Specialty Trades, and Building Enclosure Consultants, defects can be minimized or avoided.

Best Practice Role Matrix

Best Practice	Owner	A/E or Consultant	Contractor
1. Enclosure Peer Review of Design (3rd Party)	X	X	X
2. Constructability Peer Review	X	X	X
3. Mockups & Testing	X	X	X
4. In-Situ Testing	X	X	X
5. Checklists / Backwalks		X	X
6. 3rd Party Inspections	X	X	X
7. Onsite Training	X		X
8. Code Compliance (i.e. NFPA)	X	X	X
9. Material Substitutions	X	X	X
10. Periodic Reporting			X
11. Field Guide			X
12. Enclosure Systems Coordination Meeting		X	X
13. Compatibility Review		X	X
14. Responsibility Matrix (RACI)	X	X	X

Best Practice Responsibilities

Best Practice	Owner	A/E or Consultant	Contractor
1. Enclosure Peer Review of Design (3rd Party)	Once the documents referencing the envelope work are substantially complete. The Owner should engage a 3rd party enclosure consultant to perform a peer review to verify document completion, systems are appropriate for the building type, adequacy of details, VE opportunities, etc.	Once the A/E basis of design documents are reviewed by the Owner, Contractor, and 3rd party, the A/E should incorporate all finalized design changes into the contract documents. If possible, this should be done prior to GMP, however that's not always practical. The A/E should also consider a 3rd party enclosure consultant for any scope gaps not covered by the owner's 3rd party consultant and as a back-check.	As a subject matter expert, the Owner and the A/E may rely upon the Contractor to provide insight as to constructability and past experience with specified and or-equal products. This knowledge should be taken into account during the peer review process. The Contractor should also consider a 3rd party enclosure consultant to review scope gaps not covered by the Owner's or A/E's 3rd party consultant and as a back-check.
2. Constructability Peer Review (ref. example below)	Similar to the Enclosure Peer Review above. The Owner will have less input here but should be a part of the meeting as the party that bears the financial burden of any proposed changes.	Similar to the Enclosure Peer Review above. The A/E or Consultant for the Owner should be a part of the constructability review meeting. The A/E can offer input to the trades regarding changes that can be made to improve the system, construction efficiency, or ease of installation.	Similar to the Enclosure Peer Review above. The Contractor's responsible for successfully installing the building envelope and must perform a constructability review of the details. The Contractor can offer input to the A/E on proposed changes to improve the system, construction efficiency, or ease of installation.
3. Mock-Ups & Testing	The Owner should include mock-up design and testing in consultant scopes - either as a testing agent or as the observer / witness. The Owner should be copied on all test results, with designers and consultants' feedback for failed tests, retesting, etc.	The A/E should develop a mock-up and testing program suitable for the building and enclosure system. The test program should clearly identify responsibility of parties, test standards to be used for different enclosure areas, and what shall constitute a pass / fail / invalid test. The program should identify what actions and additional tests should be conducted when failures occur. The mock-up and testing program should cover multiple purposes (aesthetics, performance, constructability, etc.)	The Contractor should evaluate the adequacy of the building enclosure mock-up and testing program. If the specified program is deemed insufficient, the Contractor should consider additional mock-up(s) and testing to manage risk exposure. The Contractor should coordinate mock-ups and testing as early as practicable to avoid schedule impacts and conduct thorough root cause analysis when failures occur.

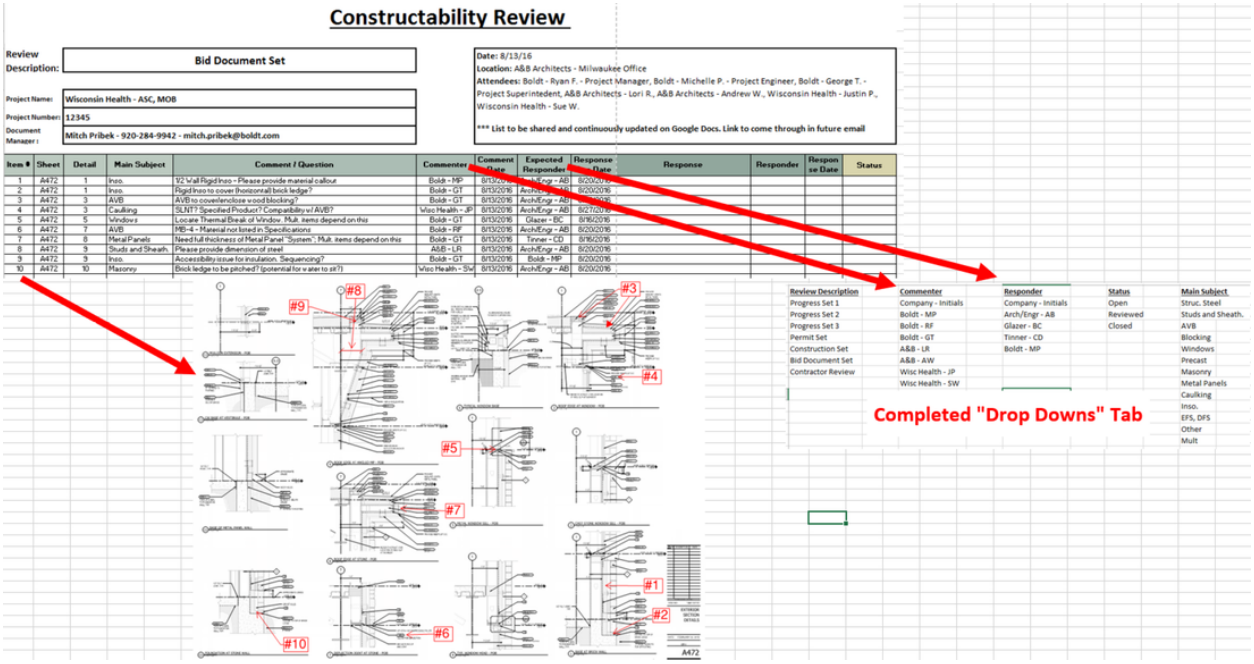
4. In-Situ Testing	The Owner should include in-situ testing in consultant scopes - either as a testing agent or as the observer / witness. The Owner should be copied on all test results, with the designers and consultants providing feedback for failed tests, retesting, etc.	Similar to mock-up and testing above. Recommended in-situ testing is at 10% (or sooner), 50%, 75%, and 95% for each type of system installation. Also recommended testing of each unique condition and at system interfaces / transitions. For glazed systems, recommended testing for both air and water.	Similar lo mock-up and testing above. Where a test fails for a specific condition, consider a more rigorous test program for that condition. Consider 100% water testing for systems that will become permanently obstructed (i.e where an interior wall is constructed in front of a glazed system).
5. Checklists / Back-Walks		The A/E spot checks the envelope installation against the contract drawing details during site visits.	Field supervision/QC review first in place checklists as work commences. Routine back-walks of work in place are necessary to confirm accepted installation methods are being maintained.
6. 3rd Party Inspections	The Owner should engage a reputable 3rd party to perform inspections on all building enclosure elements, from below-grade waterproofing to the exterior walls and glazing to the roof and skylights. The testing requirements and frequency should be vetted between the A/E and Consultant. Project specifications should be updated accordingly before the documents are issued for bid.	The A/E should recommend the frequency of 3rd party enclosure inspections suitable to the scale and complexity of the project.	The Contractor should establish roles and responsibilities of individual(s) for Deficiency List Management. Inspectors should walk with a representative of the Contractor, verbally notify the Contractor of any deficiencies, and should Issue reports not later than 48 hours after the inspection. Deficient items should be documented in a non-conformance log and must be resolved in a timely manner to avoid recurring issues and slow project closeout. One key is Trust but Verify: The Contractor should verify that when a subcontractor says they are ready for inspection that they truly are until a level of confidence is established. This should greatly diminish the deficiency item list and/or failed inspections. Special Inspections/Material Testing: This is a good agenda item for pre-installation meetings. Identify who is copied on reports (include GC's quality rep), contact information, scheduling of tests, etc.

7. Onsite Training	The Owner reviews the building enclosure with the Contractor to understand materials that require regular maintenance, such as caulk and window/door seals. Training should be video recorded when practicable, and documentation included with the Operations and Maintenance Manuals at project close-out.		The material representatives make visits to job sites to review installation best practices with contractors and review first in place workmanship to confirm proper installation methods.
8. Code Compliance	IBC Chapter 26 Plastic; Section 2603 Foam Plastics: When building exterior wall assemblies contain foam plastic insulation, the code requires that the overall exterior wall assembly comply with NFPA 285. The Foam Plastic Compliance flow chart in Section 2603 will help guide Owners / Designers / Contractors in determining exterior wall assembly compliance. Using the IBC Code and Commentary as a resource provides clarity to code language. Utilizing the International Code Council Evaluation Service Reports (ICC-ESR) for assemblies intended for use will also provide valuable information regarding assembly compliance for NFPA 285.	IBC Chapter 26 Plastic; Section 2603 Foam Plastics: When building exterior wall assemblies contain foam plastic insulation, the code requires that the overall exterior wall assembly comply with NFPA 285. The Foam Plastic Compliance flow chart in Section 2603 will help guide Owners / Designers / Contractors in determining exterior wall assembly compliance. Using the IBC Code and Commentary as a resource provides clarity to code language. Utilizing the International Code Council Evaluation Service Reports (ICC-ESR) for assemblies intended for use will also provide valuable information regarding assembly compliance for NFPA 285.	Take care regarding product substitutions and modifications to the exterior wall assemblies with respect to NFPA 285 compliance. Most ICC-ESR reports specifically state the products that are used in the NFPA 285 tested assembly. They are also specific as to how the assembly is constructed. Any deviation in products / construction may deem the assembly non-compliant. Contacting the manufacturer for clarification is recommended. If necessary, Chapter 26 Section 2603.9 Special Approval allows additional testing for determining compliance to NFPA 285. Such tests, however, can be costly and time consuming. Another alternative is obtaining an engineering judgement. Drawing Reviews: Review exterior wall details with Section 2603 in mind for constructability and NFPA 285 compliance. In general, get familiar with Chapter 26: Plastics and code compliance. WHEN IN DOUBT—ASK QUESTIONS of the Architect and/or local Authority Having Jurisdiction (AHJ).

9. Material Substitutions	The Architect should manage any proposed substitutions, but the Owner should be copied and should be informed of any and all cost or schedule impacts. The Owner should consider both short term costs / savings along with long term costs / savings. For example, revising an exterior glazed system may be less expensive in the short term, but may result in greater energy consumption and cost over the life of the building.	Prior to approval / rejection, the A/E and Consultants should understand the reasons behind proposed material substitution requests. The A/E and Consultants must participate in conversations with the GC and Subcontractors during material substitution reviews to address code compliance (including local Authority Having Jurisdiction) as well as to the specific design intent.	The GC / Subcontractor, suppliers, and/or manufacturers, must independently confirm compatibility and constructability with all system products the substitute material will come in contact with. The Contractor shall confirm availability of qualified installers, product customer service, lead times, etc. In the essence of time, recommend conversations with A/E for alignment on meeting specific design intent, code, and compatibility of substituted material PRIOR to submitting for approval. A note on NFPA Compliant Assembly substitutions: Most ICC-ESR reports specifically state the products used in the NFPA tested assemblies. They are also specific as to how the assembly is constructed. Any deviations may deem the assembly non-compliant.
10. Periodic Reporting			The GC should review progress and deficiency reports on a periodic basis, providing updates to the subcontractor team and, if requested, the Owner and A/E teams.
11. Field Guide (Ref. examples below)			Once all contract documents are complete, the Contractor should prepare a field guide for key building enclosure elements to be distributed to all enclosure trades. This should be reviewed during the Enclosure Systems Coordination meeting.
12. Enclosure Systems Coordination Meeting		Immediately prior to installation of any key building enclosure item, the Contractor should hold a coordination meeting for that work. The A/E and Consultant role in this meeting will be to verify that trades have met specified prequalification items, understand the systems involved, and answer any design / detail questions, etc.	Immediately prior to beginning installation of any key building enclosure item, the Contractor should hold a coordination meeting for that work. Items to be discussed, at a minimum, should include safety, verification that the limits of each scope are covered, trade sequencing, testing, and inspections. The Contractor should ensure that manufacturer(s) are present at this meeting.

13. Compatibility Review		The A/E will meet with the Contractor to review proposed materials to understand install details and its effects on adhesion, water sealing, and warranty.	The Contractor meets with subcontractors to review building enclosure materials to ensure that drawing details do not conflict with the manufacturer's recommended instructions. Verify compatibility of materials during product submittals / shop drawing reviews.

Constructability Peer Review Example

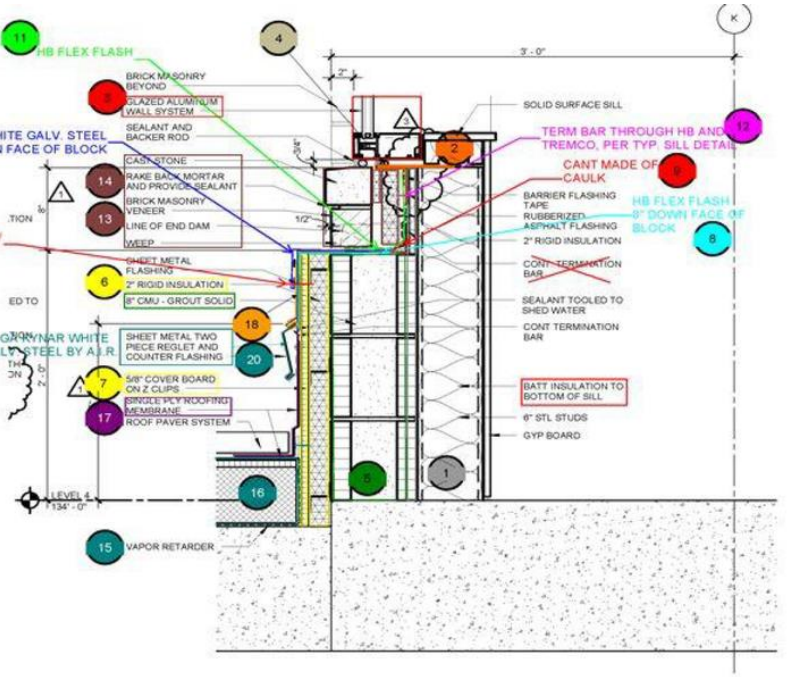


Virtual Mockup Examples

Field Guide Examples Based on Mock-ups &Testing

Sample Sequencing Plan

Done?	Step #	Description	Installer
☐	1	Install stud wall, sheathing goes down to deck	KHSS/ACP
☐	2	Tremco wrap around steel plate, down face of sheathing	United
☐	3	Install window	United
☐	4	Install primary sealant at sill	United
☐	5	Install CMU block, grout solid	Foti
☐	6	Install insulation and zee clips in front of CMU block	KHSS/ACP
☐	7	Install vertical cover board	KHSS/ACP
☐	8	HB Flex Flash over top of CMU block, 8" down face of CMU	Foti
☐	9	Install cant made of caulk at sheathing/CMU corner	Foti
☐	10	Slide in white steel piece over HB Flex Flash	Foti
☐	11	Install HB Flex Flash piece over Tremco wrap, down sheathing, over cant, and over steel piece	Foti
☐	12	Install termination bar through HB Flex Flash and Tremco wrap	Foti
☐	13	Install insulation, brick, cast stone and weeps. Weeps directly on HB Flex Flash.	Foti
☐	14	Rake back mortar between brick and cast stone	Foti
☐	15	Install vapor retarder	A.I.R.
☐	16	Install roofing system	A.I.R.
☐	17	Bring roofing membrane up and lap HB Flex Flash	A.I.R.
☐	18	Slide reglet piece under existing steel lip	A.I.R.
☐	19	Fasten self-tap screw through both layers of steel and cover board, using rubber washer	A.I.R.
☐	20	Finish two piece reglet and counter flashing system	A.I.R.



7.06/ **03** **SECTION DETAIL - CMU CURB AT LEVEL 4 SLAB**
1 1/2" = 1'-0"