

BUILDING ENVELOPE PEER REVIEWS – TIPS AND TECHNIQUES

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Photo 1 – Peer reviews are often beneficial at the beginning of the project.

Peer reviews of building envelopes are becoming more common as a technique to catch potential problems while they are still on paper rather than during the course of a project or after construction. This article will discuss successful techniques that can be employed when performing a peer review of drawings and specifications for roofs, waterproofing, and exterior wall systems.

Comments and recommendations that are provided during the different phases of a project will vary. Often it is beneficial to begin the peer review early in the design process rather than at the end of the construction document phase, when certain decisions that have been made by the project team may be difficult to revise. This includes the selection of roofing and wall systems, insulation, vapor barriers, and

other decisions that will affect cost and/or the project schedule (*Photo 1*).

A peer review follows a different procedure, with a different set of deliverables, than other forms of design consultation and building commissioning. The differences between these types of projects will also be evaluated.

PROFESSIONAL SERVICES

Peer reviews have been provided for many years in the structural design arena as a means of preventing catastrophic structural failures. The state of Connecticut and the city of Boston were among the first jurisdictions to mandate peer reviews for major projects within the structural discipline.¹ These reviews are often performed after completion of the contract documents phase, but may also be performed earlier in the design process so that structural

concepts may be reviewed as they are developed.

Peer reviews are often confused with other types of professional services, such as design assistance or building commissioning. A building envelope peer review can be limited to providing an independent overview of a particular component or may involve the complete design of the exterior building envelope. It culminates in written comments and/or graphic notes for the designer-of-record's consideration. The goal is to improve the overall performance of the building envelope with regard to air and water penetration resistance, durability, and future maintenance requirements. Structural components of the exterior building envelope can also be reviewed by a professional engineer who is familiar with this domain.

The American Heritage Dictionary, Third



Photo 2 – Preconstruction water testing of wall mock-up used to identify problematic details prior to installation.

Edition, defines a peer as “one who has equal standing with another or others, as in rank, class, or age.” Therefore, a peer review should not be performed by a person who does not possess the same experience and skill set as the designer. That being said, the peer review process provides an opportunity for professionals with differing perspectives and areas of specialization to collaborate in an effort to create a more successfully detailed set of documents. Greater

diversity in the experience and skill sets between the designer of record and the reviewer will often lead to a more rewarding experience and a better end product.

A project peer review is conducted by professionals working independently of the design team, providing additional attention to detail beyond the routine procedures performed on typical projects. A peer review has a specified purpose, scope, format, and duration, all of which should be clear-

ly identified in the proposal for services. The review can be a one-time event, or it can consist of a series of separate reviews. A peer review report should not be presented as a reflection on the abilities or judgment of the design team. It should also not be considered a substitute for the application of normal checks and balances, or as a compliance review of construction documents on behalf of the owner or the building code official.² Due diligence remains the responsibility of the designer of record.

Another method by which the peer reviewer can add value to a project is to provide design assistance services. Design assistance providers can aid the designer of record in the development of a particular component of the project or in the establishment of guiding principles. As discussed earlier, a diversity of skill sets can be extremely beneficial in this situation. A successful design assistant should be able to apply his or her experience and expertise in specific areas of focus, such as sustainability, high-performance envelopes, complex cladding or glazing systems, and new or developing trends in construction technology. The work product can vary widely, depending on the reviewer’s level of involvement and the preferences of the individual client. Some projects involve only the establishment of design parameters and the review and mark-up of certain critical or complex details. Others may include the responsibility of devising details to help the architect develop his or her design intent. Some of the more involved

design assistance projects involve the design and production of construction documents (drawings and technical specifications) for the exterior building envelope.

A peer review is only one portion of the complete building envelope commissioning process. Building envelope design commissioning (BEDCx) involves a predesign phase to establish the performance objectives of the project and a design phase to ensure that these objectives are properly main-

tained throughout the development of the design and construction documents. There is also a preconstruction phase to verify the design through detailed and effective submittal review and performance testing of full-scale preconstruction mock-ups (Photo 2). During construction, the work is observed, and technical guidance and field quality assurance testing are provided at critical stages of the project. BEDCx may also include a postoccupancy evaluation program that can analyze the actual performance of the building systems in a manner that is quantifiable and can be accurately measured against the performance objectives established at the outset of a project.

CLIENTS

The client is almost always the entity who will benefit most directly from the peer review process. These clients can be the actual owner of the building, including but not limited to developers, public entities, or institutional clients. Other types of clients who have a vested financial interest in the project may be insurance companies, real estate managers, legal professionals, and lending institutions. These types of clients are seeking assurances that the building envelope will perform as intended and will not leak. Many owners have already constructed buildings with air and water infiltration issues and do not want another leaky building. Owner clients may elect to commission a peer review at any stage of the project delivery process.

An architect, engineer, or other type of designer of record may also request a peer review. Schedule and budget constraints often leave the design architect with insufficient time to fully explore and develop all of the technical constraints of a given project. By focusing efforts on these issues, the peer reviewer can provide a valuable service that allows the architect to deliver a more thoroughly considered product. In other cases, architects may seek verification and/or guidance from the peer review team for details they have already developed or to explore a particular cladding material or product with which they lack experience. Some architects possess a good understanding of the technical components of the exterior building envelope, while many others do not. The latter group of architects will often look to expand the advisory role of the peer review team to include the provision of design assistance services. Many architects believe that a peer review includes the com-

pletion of construction details for the project. While this arrangement is not typical, these services can be provided by the peer review team. Architects often recognize the value of obtaining review comments early in the project, and they are the client type that is most likely to engage a peer review prior to the completion of the construction documents.

Peer reviews can also be conducted on behalf of the general contractor or construction manager who seeks to avoid the incursion of added liability or simply wants to ensure delivery of a quality construction project. Many contractors have also found that independent peer reviews can help to identify problematic systems and elements that may not be properly developed by the designer of record.³ The peer review often commences after the contract for construction has been awarded, but prior to the preparation of the various shop drawings for the exterior building envelope. The project may involve the review of a particular wall or roof system, but often involves a complete review of the entire building envelope. Contractors are typically concerned with material and geometric transition areas, where the various components of the building converge. Contractors can realize many benefits by identifying potential problems and conflicts before they occur in the field. Contractor-led peer reviews are used to work out these issues and present solutions and/or modifications to the owner and designer of record.

POTENTIAL LIABILITY

The peer review is intended to enhance the overall quality of the project by providing an independent review of the design criteria and/or final work product. However, the responsibility for the project design remains with the designer of record. A written agreement to this fact should be executed prior to the start of work.⁴ Some projects are performed with just a simple statement to this effect in the proposal, while others include a formal limitation-of-liability agreement that is executed by both parties prior to commencing work. Design professionals considering the provision of peer review services should consult their legal counsel and insurance agent prior to performing these types of services.

The peer reviewer must always be aware of scope creep, as it is often a temptation to completely redesign a particular detail. In addition to adding potential exposure to

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liability, this practice can also take more time to deliver the final work product than was intended when the fee proposal was originally executed.

ESTABLISH A COLLABORATIVE ENVIRONMENT

It is important that all parties have an open mind and are receptive to constructive comments and differing viewpoints. The peer reviewer should place a high priority on effective communications with his or her client and the remainder of the project team. No matter what credentials, no one person or firm is better than the others associated with the project. The designer of record also needs to be open and receptive as his or her work is critiqued. Many times the peer reviewer has positive comments or innovative ideas based on practical experience. As a designer, it is difficult to have work analyzed, especially in front of a client. There is a natural tendency to be defensive. However, the design team should seize the opportunity to improve the work product and/or avoid costly mistakes prior to the building's being constructed.

The peer reviewer must also realize that

the design team may have already considered his or her comments. The reviewing professional should strive to provide objective observations; opinions that are well reasoned and defensible will be less likely to encounter opposition. Face-to-face meetings with the design professionals are very helpful. These meetings allow the designer of record the opportunity to explain his or her approach to the work and to respond to the peer review comments. Meetings also allow the peer review team an opportunity to explain its comments and concerns and to gather additional information that cannot be obtained by simply reviewing the project's drawings and specifications.

Review comments should be delivered solely to the client, who will then be able to decide which of the other team members should be included in the decision process. This is especially important to consider when working for an architect because the reviewer has no contractual relationship with the owner, and the architect may wish to control the flow of information to his or her client for various reasons.

PEER REVIEW COMMENTS AT VARIOUS STAGES OF THE DESIGN

As stated earlier, building envelope peer reviews can be provided at many different stages of the design process. I prefer to mark comments directly on the design drawings. The work product becomes annotated drawings and specifications with a letter that further explains the major comments. A meeting with the designer of record and owner also occurs after they each have a chance to digest the review comments.

During the review, refer to established guidelines that may be available, such as, but not limited to, technical notes from the Brick Industry Association,⁵ and design guidelines from the National Roofing Contractors Association,⁶ ASTM International,⁷ and the American Architectural Manufacturer's Association.⁸ This gives the review comments more credibility as they are reinforced by accepted industry standards rather than personal preferences and biased opinions.

The following sections explain the stages of development through which architectural projects are typically delivered and include a suggested methodology for the review process, as well as comments that may be provided as the project progresses towards completion.

CONCEPTUAL DESIGN

The Conceptual Design process serves as a prelude to the typical project within the architect's office. During these formative steps, the project comes to life and the building's program (space and planning requirements) is established. The scale and massing of the building begin to take shape as the architect seeks to integrate the aesthetic and organizational concepts of the design with the chosen site. The architect may develop several conceptual designs for review and selection by the owner.

This is a good time to establish guidelines for the development of the design and the ground rules of the project. Universal initiatives to be pursued, including sustainability and passive energy reduction approaches, may be tentatively identified at this stage. The review professional should confer with the design team in order to gain an understanding of the various exterior building envelope systems that will be developed, including wall insulation, cladding and glazing systems, roofs, and subgrade waterproofing. The potential use and suit-

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ability of computer-aided visualization tools, including thermal modeling and hygrothermal analysis software (WUFI⁹ or others), may also be considered at this time. The provision of these services may be proposed by the peer reviewer as value-added options.

SCHEMATIC DESIGN

During the Schematic Design phase, the conceptual design is refined, and many critical decisions are made regarding the building enclosure. The Schematic Design phase is often the most productive time to review a project, because there is usually ample time for the design team to incorporate suggested revisions. If a Conceptual Design review has been provided, the reviewer should first verify that the review comments have been addressed, then review the Schematic Design as a whole in an attempt to anticipate challenging or complex detailing issues that may arise as the project moves forward. If possible, work with the designers in an attempt to reduce or ease areas of complex geometry; however, care should be taken to remain true to the architect's design concept. Ensure that complicated roof sur-

faces are sloped to drain properly and that potential snow and ice accumulation issues are addressed before it is too late to move entrances or modify the shape of the roof.

During the Schematic Design phase of the project, the exterior wall assembly should be considered in holistic terms; details will be developed later in the Design Development and Construction Document phases. During this phase of the project, the peer review should focus on the architect's material and system selections and their ability as a functional assembly to deliver the following performance criteria:

- Prevent the ingress of water through the building envelope
- Seal off air flow between the interior and exterior environments
- Minimize heat loss and gain by effectively controlling radiation and conduction
- Allow for vapor diffusion while preventing condensation within the wall assembly
- Transfer wind, seismic, and gravity loads to the building structure
- Accommodate differential movement

between wall assembly components and the building structure

- Resist weathering, fading, and premature maintenance requirements
- Achieve the architect's intended aesthetic vision as the exterior face of the building

Depending on the scope of the peer review, structural considerations such as wind loads on cladding elements, wind uplift for roofs, and a review of the soil report and boring logs for subgrade waterproofing may be included. In addition, the reviewer may recommend that groundwater and soils be tested for the presence of deleterious substances. Once the wall systems have been reviewed, a similar global review should be conducted for the remainder of the building and site. The reviewer may include commentary on the following components of the building:

- Dimension between structural framing and outside face of building envelope
- Roof slopes
- Drain locations

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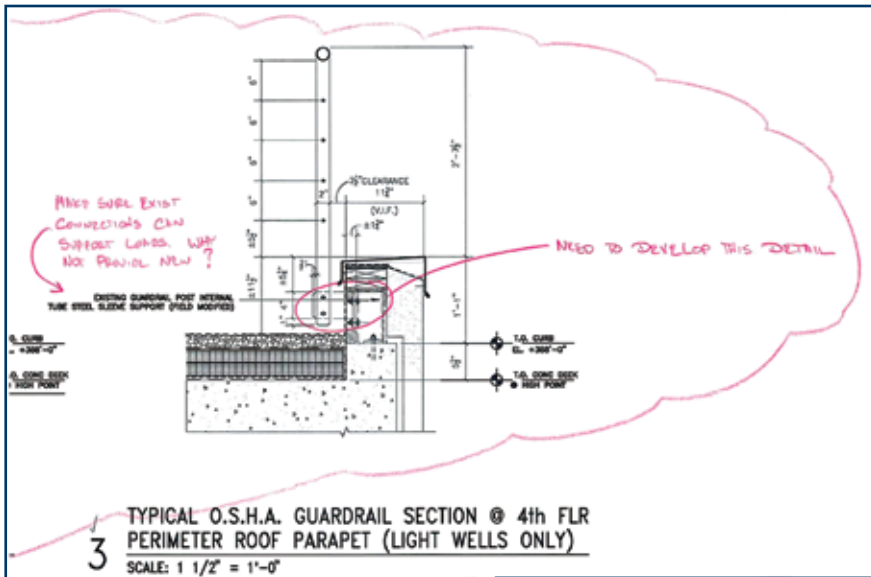


Photo 3 – Review comments on drawings help to illustrate potential issues.

Photo 4 – Identify problematic geometries and potential thermal and moisture bridges.

- Location and shape of rooftop penetrations
- Location of vapor retarder, if required
- Subgrade drainage, if required
- Site drainage as it affects subgrade waterproofing

DESIGN DEVELOPMENT

During the Design Development phase, the project evolves from the schematic concept into a more fully developed design that will eventually form the basis of a complete set of working drawings. The civil; structural; and mechanical, electrical, and plumbing (MEP) designs are also evolving. Critical components of the building are now being established that will likely be difficult to revise later on, including floor-to-floor heights, exterior wall patterning and dimensions, and the shape of steep-sloped roofs.

The reviewer should again seek to simplify detailing by omitting or reducing difficult details that may produce constructability issues, while still attempting to carry the architect’s design concept forward. Exterior walls that terminate directly above occupied spaces can be problematic and must be detailed carefully if they are unavoidable. The flashing systems of these walls need to be thoughtfully designed and carefully constructed in order to mitigate the potential for water infiltration. Verify that earlier review comments have been addressed. At this time, exterior wall systems will likely have been selected. Ensure that the systems selected meet the design parameters of the project. An outline specification is usually available and should be reviewed at this stage of the project.

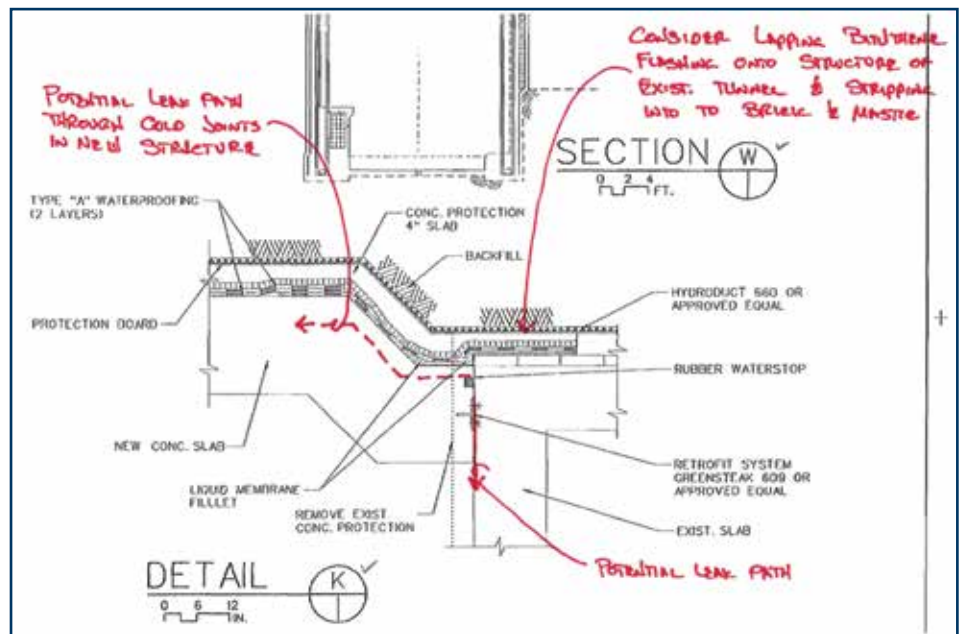
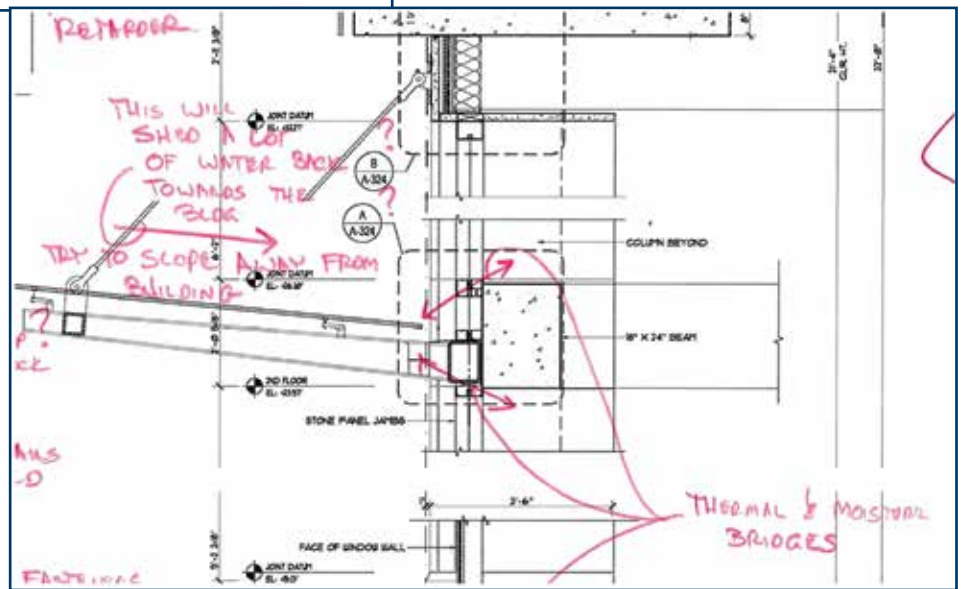


Photo 5 – Illustrations are used to identify potential water leakage paths through tunnel structure.

CONSTRUCTION DOCUMENTS

A peer review that is conducted during the Construction Documents phase should consist of a thorough examination of all drawings and technical specifications pertinent to the exterior building envelope components. However, it is often too late to make major changes to the project without affecting the cost, schedule, and/or aesthetics of the project.

This phase of the project is usually the first opportunity to review technical specifications. Look at the building as a contractor would. Review all of the details and try to anticipate and simplify constructability. Simpler, more straightforward details are often easier to construct with a greater degree of success; however, the most effective detail is seldom the easiest or quickest to build. Water infiltration problems arise when the details are not thoroughly considered in three dimensions, when details are overly complicated and difficult to construct, or if insufficient room is provided for the mechanic to perform his or her work (Photos 3, 4, and 5). Verify that complete and concise details are provided at all transitions between differing building components and at corners, parapets, inter-sections, and joints. Verify that materials

are properly identified and are to be used within the manufacturer's published design parameters.

CONSTRUCTION

Unless peer review services are being requested by the construction team, services requested at this late stage of the project are often initiated due to problems that manifest during construction (Photo 6). Contractors are looking to ease and/or simplify constructability issues. However, design changes are often not accepted if they lead to changes to cost, schedule, and/or aesthetics. The Construction Documents are a set of legal documents that the contractor is obligated to follow. Any design change must be reviewed and accepted by the designer of record.

If the project is already under way, the design and construction team will look for the development of site-specific details to address various portions of the project, including transitions and complicated details (Photo 7). Services may include the review of shop drawings and other project submittals, participation in preinstallation conferences, on-site testing procedures (such as, but not limited to, water testing of window assemblies), adhesion testing of sealants, and review of other types of mock-ups. Often, mock-up performance testing reveals leakage issues that need to be investigated and corrected. These services often are quite productive. However, the scope is beyond that of a typical peer review, and the professional should understand that he or she is now helping to design the project.

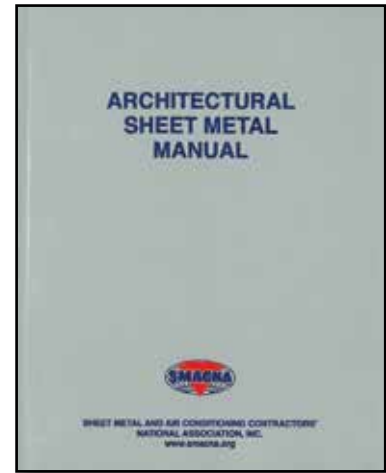
COMPLETED BUILDINGS

Peer reviews are not limited to new work. Many times, as buildings with problems are investigated, an owner may request a second opinion to verify the findings of the initial investigation team, particularly if the repair work to be completed is substantial or if the recommendations are controversial. A peer review may include a cursory review of the building or a complete second investiga-



Photo 6 – Major changes are usually not possible during construction.

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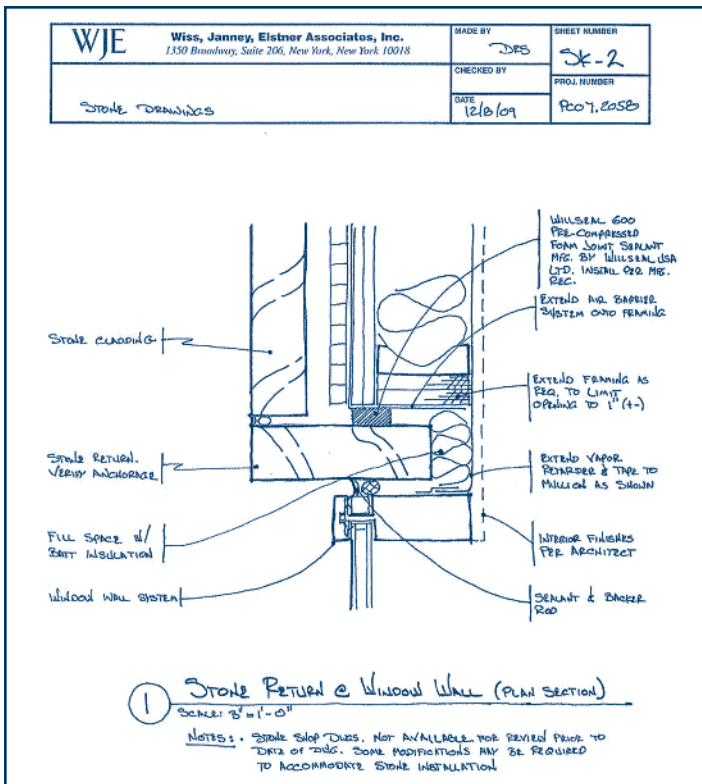


Photo 7 – Interface detail between stone cladding and window wall that was developed during construction.

tion. The second investigation can be performed parallel to the first investigation. However, it is helpful to collect new data and to perform other tests that may reveal different conditions that were not evident to the original investigation team.

CONCLUSION

Building envelope peer reviews can be quite beneficial to a project, as well as its financial stakeholders. All parties involved should realize the benefits of a better-designed and constructed building, whether the review is commissioned by the owner, designer of record, or contractor.

Structures are becoming more complex and energy-efficient. Both the design and construction industries have also developed to a point where many design consultants are working with the architect. Most building envelope work is now subcontracted.

pleted building—a benefit to the entire project.

REFERENCES

1. Council of American Structural Engineers (CASE) - Document 5-2004.

Exterior wall systems are designed and engineered by their manufacturers and installed by specialty contractors as the work is further fragmented. This creates many potential pitfalls that often do not manifest themselves until construction. Who is making sure that all of the parts and pieces fit together and work as a whole?

An experienced and competent third party who is charged with review of the exterior building envelope can mitigate constructability problems and improve the performance of the com-

2. *Project Peer Review Guidelines*, American Consulting Engineers Council, American Society of Civil Engineers, 1990.
3. D. Slaton, “The Value of Peer Review in Avoiding Failures,” *The Construction Specifier*, August 2004.
4. *Project Peer Review Guidelines*.
5. Brick Industry Association; 1850 Centennial Park Drive, Suite 301, Reston, VA 20191; (703) 620-0011; www.gobrick.com.
6. National Roofing Contractors Association; 10255 W. Higgins Road, Suite 600, Rosemont, IL, 60018; (847) 299-9070; www.nrca.net.
7. ASTM International; 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959; (610) 832-9585; www.astm.org.
8. American Architectural Manufacturer’s Association; 1827 Walden Office Square, Suite 550, Schaumburg, IL 60173-4268; (847) 303-5664; www.aamanet.org.
9. Wärme und Feuchte instationär; Fraunhofer Institute of Building Physics; Nobelstr. 12, D-70569, Stuttgart, Germany.

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