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# Peer Review: Effective, Efficient, and Educational

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Today's Vision...Tomorrow's Reality

## Abstract

The authors of this paper will discuss the three "Es" of peer review and provide tips for the professional consultant for performing effective, efficient peer reviews, and useful tools in the education of both the designer and expert alike. Drawing from their combined 45 years of peer review experience, as well as from direct interviews with leading architectural designers, they will explore peer review contracting, the exchange of complex yet minute ideas and concepts, the pace of modern design, deliverables, and final construction phase follow-up.

## Speaker

*Andrea L. Baird, NCARB, PE, CCCA, BECxP, CxA+BE, LEED AP BD+C – Raths, Raths & Johnson, Inc., Chicago, IL*

ANDREA BAIRD has over ten years of architectural and engineering experience. She specializes in the evaluation and repair of building enclosure components and systems, field testing of air/water infiltration, and architectural and structural design for new and existing buildings. Her building enclosure expertise includes architectural peer review, remedial design, performance testing, and construction quality assurance programs. Baird has extensive knowledge in THERM, WUFI, and other types of computer simulations to perform the analysis of building enclosure performance.She has provided litigation support services in the areas of investigation, depositions, and document review on related failures.

## Nonpresenting Coauthors

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DR. ROBERT KUDDER is a principal with his firm. During his 43-year forensic engineering career, he has specialized in structural forensics and investigation, testing, and repair design of building wall systems and enclosures. Kudder is a nationally recognized expert on exterior wall leakage and condensation performance problems. He was chairman of the ASTM E06.55.15 task group that developed the E2128 standard for evaluation of building wall leakage, and chaired ASTM international symposia on building wall performance issues.

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CAROLE CEJA has been investigating and repairing building enclosures for more than ten years. She works closely with owners, design architects, and contractors to provide optimal designs with real-world value. Her understanding of construction documents, and more importantly, how construction documents are interpreted in the field, shapes her practice and influences others through peer design work.

# Peer Review: Effective, Efficient, and Educational

## WHAT PEER REVIEW IS AND IS NOT

The peer review process discussed in this paper is separate and distinct from the consulting, review, checking, internal audit, and approval inherent in normal design procedures that are integral to services of the designer-of-record (DOR). The "peer" implied in a peer review is a person with status, experience, and ability comparable to the original designer. That person provides a "review" ancillary to normal design processes, which means performing a formal assessment of something with the possibility or intention of instituting change if necessary.[1]

Preferably, the person or team performing the peer review (Reviewer) was not a part of the original design team and is often not even employed by the same firm as the DOR. This distance from original design is purposeful to gain fresh perspective and to overcome the concept of "inattentional blindness," which will be described in greater detail later. Intention of change is an important point to consider, as well. A peer review is intended to change the design for the better by identifying inconsistencies, missing or conflicting information, unclear direction, and conceptual errors. An example of a description of a peer review from a federal manual of public works provides a clear idea of what the concept of peer review is intended to be:

> A peer review is a technical quality assurance/quality control process performed by a professional who is independent of the work performed. It emphasizes a review of the basis of the technical approach, procedures used, and the validity and suitability of the design. The peer review does not normally include a check of calculations, tests, and methods, but it does verify that review and checking have been completed by others and are adequately documented. The peer reviewer must possess technical qualifications, practical experience, and professional judgment to properly conduct a peer review and must be an experienced practitioner in the relevant discipline with recognized and verifiable credentials.[2]

A thoughtful discussion of conducting a peer review specifically tailored to engineering projects has been published by *Professional Engineers Ontario*[3] and contains discussion on several key exchanges, such as tone of comments, communication between parties, and detailed limitations of review.

There are situations in which internal senior staff or independent third parties under the direction of the DOR are engaged to generate, review, and comment on design documents that are part of basic design services and not a peer review. Supervisory or management reviews occur when senior staff oversees the work of less experienced staff as part of a formal mentoring or internal managerial or quality assurance protocol. These types of reviews are excellent to help teach young designers and propel them on the path to career success, as well as serving as appropriate in-house quality assurance measures, but they are not peer reviews.

Peer review is also not a substitute for expert review or consulting on specific components or aspects of a design. For example, if a designer intends to use a complex and sophisticated curtainwall system or a structural system that is technically beyond his or her in-house design capabilities and expertise, it is prudent to engage an expert to consult on the design and integration with other building components. In this situation, the level of expertise of the DOR and the consultant are disproportionate, and, as it concerns a specific component or aspect of a design, they are not true peers. The success of the project relies on collaboration and exchange between the DOR and consultant throughout the design rather than review and comment at static points during design.

Peer reviews, by definition, involve one professional evaluating and reporting on the work of another professional. In some cases, the Reviewer might be directly engaged by the owner or the contractor rather than by the DOR. In the interest of objectivity and independence, it may be considered desirable not to have the Reviewer engaged by and under contract to the DOR. A peer review has the potential for conflict and resentment between parties unless handled in an ethical and professional manner. For peer reviews to be of benefit to a project and worth the effort and cost, they must be conducted by the Reviewer with absolute integrity and without prejudice, self-promotion, the imposition of personal preferences, or attempts at pirating of client or staff. The results must be received by the DOR without defensiveness, resentment, or denial. The code of ethics of most professional societies, such as those published by the American Institute of Architects (AIA)[4] and the National Society of Professional Engineers,[5] contain clauses prescribing how one professional should evaluate and report on the work of another professional, and compliance with ethical constraints and guidelines is essential for an effective peer review.

Any discussion of peer review should include a response to this question: Why peer review at all? How can an outside party be of service to the project when they are not privy to all the day-to-day details, decisions, and coordination by the DOR? Besides the generally accepted fact that no individual designer is perfect and no design is flawless, there are very practical reasons to pursue peer review.

To really answer why peer reviews are helpful, one must think beyond the construction industry and learn from the world of behavioral psychology. Christopher Chabris and Daniel Simons published *The Invisible Gorilla*,[6] in which they explore the illusory nature of human attention. Their research demonstrated that humans can do a very good job of watching for one set of circumstances and completely miss another set of circumstances extremely out of place and unexpected but immediately adjacent to and concurrent with the first set. The classic experiment involves watching a movie where teams of players pass each other bas-

ketballs. If an observer focuses intently to count the number of passes made by each team, the observer is likely to entirely miss the fact that a man dressed in a gorilla suit enters the frame, waves to the audience, and walks off. Inattentional blindness is the technical term for this phenomenon, where focus on one aspect of a task blinds you to the items outside of that narrow task.

Perhaps a more relatable example may be the feeling one gets when, safely in the driveway after just ending a (albeit hands-free) cell phone call or listening to a favorite piece of music, one cannot recall the details of the drive home. It is not clear if a yellow Camaro sped by or if children were selling lemonade in the front yard six blocks away. Attention to the phone call or music rendered the attention to the other conditions as suboptimal.

Peer reviews are an excellent tool to counteract inattentional blindness. While the DOR is concentrating on the complicated geometry, LEED points, and award-winning aesthetics, some fundamental design considerations such as continuity of the air barrier, proper termination of flashing, or the correct location of the vapor retarder may succumb to inattentional blindness. In the authors' experience, errors such as these and other unintended omissions or missed design concepts are the result of inattentional blindness and not the result of a lack of knowledge or skill. Far from the stereotypical egocentric designer, these catches are often met with gratitude by the DOR when presented in a professional manner. Being aware of the kinds of missed information that occur due to inattentional blindness can aid the Reviewer the next time they are the DOR producing a set of documents.

## PEER REVIEW PROCESS

Systems for quality control continue to be critical to the design process. In the context of building design and construction, the objective of a peer review is to avoid unintended problems or catastrophes, as well as contribute to an optimal construction process and outcome.

Peer reviews can be initiated by and contracted through a variety of interested parties. The DOR can engage a Reviewer to supplement an internal audit and quality assurance program. The owner can mandate a peer review to crosscheck and validate the work of the DOR. Municipalities, governmental owners, and other regulatory bodies can have the legal right and may even have a mandatory requirement to initiate peer reviews, which are often seen as part of their fiduciary duty in the expenditure of public money. Contractors can engage peer review services to evaluate construction documents as they prepare bids or while they are actively constructing a building. For the purpose of this paper, the term "Initiator" will be used to represent the party whom the Reviewer will contract with and report to, which may be different from the party that mandated the peer review.

Regardless of who initiates the review, it is generally accepted that early participation in the design process yields the best results for the project as a whole. Having a peer review team in place—even as early as schematic design—can identify easily corrected issues and areas that require more thought and development before problems are compounded with the detail clutter of the complete design. AIA recommends at least three phases to a peer review program, including review at the end of schematic design, the end of design development, and at 75% or 90% construction documents.[7] The American Society of Civil Engineers (ASCE) also promotes peer reviews to provide additional evaluation of design concepts early in the design process.[8] As a peer review is intended to reveal items that require change, an initial review at the completion of construction documents may necessitate change orders, construction directives, or addenda to act on the comments of the Reviewer.

Once a peer review has been initiated by a member of a project team, potential Reviewers are located and vetted. The credibility of the peer review depends directly on the credibility and integrity of the peer reviewer and the acceptance and recognition of the reviewer by all of the project parties. The peer review process can be fraught with challenges when the scope is not clear or deliverable requirements are ambiguous or are not produced in a timely way. Several items should be clearly defined in the peer review contract and spelled out in the scope of work:

1. The entity that will directly receive the peer review deliverables must be identified. Generally this will be the Initiator, who may, in turn, distribute it to other parties. This may be different than the party who will be responsible for paying the Reviewer's fees, which also must be identified.
2. The frequency of review rounds, such as the three suggested by AIA, as well as a general schedule when these reviews should be established (especially if the progress of the project is contingent on the results of the peer review by legal regulation) must be established.
3. The specific deliverables and time allowances for deliverables at each step in design should be clearly described.
4. Any face-to-face or remote meetings that will be required between the Reviewer and the DOR should be quantified and roughly scheduled, if possible. A note of caution should be raised if there are to be mandatory face-to-face meetings between the DOR and Reviewer. Even the most professional members of the team can respond defensively to direct, in-person criticism. However, the benefits of quickly resolving misunderstandings or clarifying details can outweigh the challenges in the right situation.
5. Peer review comments can reduce errors and the impact of revisions if received by the DOR in a timely manner. However, the time and fees required by the DOR to address peer review comments should be addressed up front. The cost and time expended by the DOR in response to peer review comments should be comparable to, and no more onerous than, responding to comments from their own in-house quality assurance reviews. The only difference is the source of the comments.
6. Assumptions by the Reviewer or additional information that must be provided by the DOR as it becomes available during the course of the project should be enumerated.
7. Finally, and most importantly, a statement on the limitation of design responsibility for the Reviewer must be included. It is essential that all parties recognize that the Reviewer does not have design responsibility and that the DOR has final authority and responsibility on the action or inaction in response to any comment or observation of the Reviewer. Specific language to this

point could look like, "The services offered by Reviewer as outlined here should not be construed as replacing or otherwise altering the contractual responsibilities of the design and construction team members. As such, the DOR shall remain solely responsible for final review, approval, and coordination of all the Reviewer's recommendations accepted by the Owner for incorporation into the contract documents for this project."

Documenting these relationships and responsibilities up front will help to avoid future confusion, misunderstandings, resentments, and will hopefully limit disputes. Reviewers' design review comments should be considered advisory only. All final design decisions should always be made by the DOR. The Reviewer should not assume any responsibility for the design or construction of the project through a peer review contract or through their actions.

When it comes to the nuts and bolts process and products of peer review, each professional will develop personal strategies to effectively review the documents. A good first step is to understand what phase of development has been completed. The principles for reviewing schematic design will look slightly different than those at a 90% construction document (CD) set. At every stage of review, there are some basic principles that should guide the review process. Is the information clear and complete? Is it presented in logical progression? Are code requirements adequately addressed? Are the concepts presented technically accurate? These are all questions that should steer a review, regardless of the phase of design. A more specific, but not exhaustive, list of questions to consider for different steps along the way during review includes the following[9]:

### Schematic Design

1. Have the main points of the program been incorporated?
2. Are design intentions clear?
3. Will the project include special regulatory or aspirational considerations, such as LEED? Have coordination efforts begun to meet these requirements?
4. Are the materials and assemblies selected appropriate for the climate of the site and each other?

### Design Development

1. Is there sufficient information provided on adjacent sites, structures, and utilities to connect to the new facility, or does the design exist as if on an island?
2. Where are the challenging interfaces between materials?
3. Are adjacent materials chemically compatible?
4. Have all appropriate specification sections been identified?
5. Is there sufficient language within the specification to ensure desired warranties, testing, and quality control procedures?
6. Are there unique structural loading conditions to consider due to use, geometry, or location?
7. Are predictable volume changes and movements due to thermal or material properties addressed and accommodated?
   a. Are moisture, vapor, and air infiltration and migration paths addressed? Is condensation potential a design consideration, and has it been addressed?
   b. Have energy performance criteria been addressed in a rational and achievable manner?

### Construction Documents

1. Do the plan, section, and detail views of components relate to each other in a logical sequence? Are drawing callouts present and accurate? Do detail references point to missing work?
2. Are there enough details of sufficient scale to capture the work at challenging interfaces, especially those involving more than one construction trade?
3. Are the components reasonably constructible? Construction means and methods as well as sequence will be the responsibility of the contractor, but consideration should be given to generally understood sequence of installations. Critical substrates should be identified as such for coordination by the DOR.
4. Is the mundane still clear? A simple brick building wall should still have expansion joints shown and tie backs to structure defined.
5. Do the consultant drawings integrate with the set as a whole? Are the structural and architectural drawings consistent? Does grade match between the landscape plans and the architectural wall sections? If a note includes "see structural," can you find additional information on the structural drawings and vice versa?
6. Do materials identified on the drawings match the specifications?
7. Do materials not specifically identified on the drawings have a relevant specification section provided with sufficient written description provided?
8. Is there sufficient information provided so that contractors and suppliers can understand and respond to the requirements of the project?
9. Are quality assurance testing and inspections adequately integrated into the project?

The job of the Reviewer is to look with a critical eye to see what was otherwise missed by the design team. The peer reviewer must always keep in mind that just because they would do something differently does not necessarily mean that the DOR way is wrong. A Reviewer is analyzing the design of the DOR, not issuing a redesign. When omissions or errors are located, they can be called out as such, but recommended deviations from original design based on the experience of the Reviewer are opinions for the consideration of the DOR and should be presented as such if mentioned at all (*Figure 1*). As all codes of ethics mandate, peer reviewer comments on another professional's work must be offered in an objective and constructive manner without personal disparagement or ignominy.

Also, when pointing out an error or something that will not function properly, it can be helpful to suggest a concept for a solution rather than simply identifying the problem, while at the same time being careful not to assume design responsibility.

## TOOLS

While the effectiveness of a red felt-tip pen against real paper printouts should not be underestimated, recent advances in digital technology have created new tools that are ideally suited for peer reviews. Commercially available software suites have rendered construction documents digitized and searchable in many useful ways.

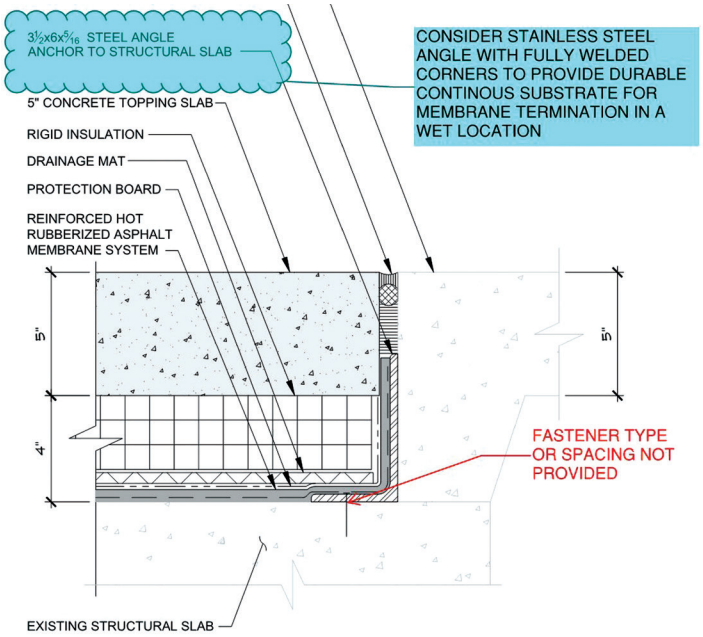



***Figure 1 – Example of peer review mark-ups differentiating between missing fastener information required for design clarity and an item for the consideration of the DOR to increase durability and watertightness.***

- **Optical character recognition (OCR)**: OCR software is incorporated into many platforms and is a tool which "reads" a large image and recognizes individual instances of text within that image.
- **Vector**: Vector images include embedded information that can be further analyzed by computer systems. A vector image of a line would include embedded information on length, direction, width, and layering among other lines for example.
- **Raster**: Raster images are a collection of pixels on the screen. They consist only of on or off dots of a given color.
- **File Transfer Protocol (FTP)**: FTP (sites) are generally set up to control the distribution of larger files to specific parties by allowing limited access to specific sections of the client's server. Controlling access to in-progress design documents is highly advisable, but the security is only as good as the host's main server.
- **The Cloud**: The cloud is a loose term for storage space on a remote server that is accessible by multiple parties through the internet. This concept is similar to a FTP site except that the digital data is no longer stored on the DOR's server. File security here is controlled by the sophistication of companies offering cloud storage.
- **PDF format**: An abbreviation for "Portable Document Format," this format is a widely accepted way to store information. It can be accessed by a wide variety of software and is a substitute for proprietary file formats.
- **DWG, DWF, and DXF format**: DWG and DWF are proprietary formats for AutoCAD documents. DWG files are fully functional AutoCAD base drawings; and DWF files are flattened versions of full DWG files, viewable to any user on freeware provided by AutoCAD. DXF (Drawing eXchange Format) files are 2 dimensional drawing files that can be imported as line work into several software products.
- **Flattened**: The process of flattening merges layers and mark-ups on vector-based images to a single background image. These are more difficult, but not impossible, to edit.

***Figure 2 – Definitions for digital tools.***

This capability is a powerful asset for evaluating a large volume of information, for tracking information through a set of documents, for managing comments and recommendations, and for presenting findings.

When drawings were created by hand, there was no need to consider the pros and cons of vector- or raster-based processes, editable and secure file formats, or cloud-based file sharing. There were also delays as one party waited for physical copies to be made and distributed. It also took more time for the DOR to process the review comments and incorporate changes as necessary. Today, the DOR and Reviewer must navigate a continuously evolving network of digital tools. The tools may be frustrating and aggravating until they are understood and mastered, but they are so effective and useful that even steep learning curves are worth the effort. A short list of digital terms that are helpful to understand when attempting to benefit from a digital approach to peer review work can be found in *Figure 2*.

Examples of how some of these terms can be put to use in an expanded digital review tool box are ever growing. Optical character recognition (OCR) within some portable document format (PDF) programs, such as Bluebeam® Revu, can be utilized to "read" a set of drawings for callouts and page titles, and further internal software code can take those newly identified pieces of text and hyperlink between pages. This creates a new document where the Reviewer need only click on a callout bubble and be instantly taken to the corresponding page in the set. No more flipping through full-size sets, endless scrolling, or recalling digital page numbers. If the Reviewer has concerns over a particular product selection for example, OCR can also be used to search for the product name and jump to its reference(s) within a large specification (*Figure 3*), rather than moving page by page or section by section. Cloud collaboration in platforms, such as OneDrive, can allow for real-time edits by multiple parties on a single document. A single spreadsheet can have six authors and editors all working simultaneously (*Figure 4*). "Track Changes" as implemented within the Microsoft Office suite can be an effective means of adding comments directly to a digital document, such as a specification, but it is limited to word processor files (*Figure 5*) and is not very secure because the base file can be easily altered without an obvious fingerprint. If a vector file format—rather than a raster file—is provided to the Reviewer, certain programs can perform additional calculations based on area take-offs or digital measurements that may assist the Reviewer in a complete analysis of the design. The tools selected should match the abilities and comfort levels of the Initiator and Reviewer alike. They should also be selected with the final deliverable in mind.

## DELIVERABLES

The type and format of the peer review deliverable should be clearly described in the engagement letter. Examples include letters with written descriptive lists of review items, hand or digital mark-ups of design documents, or spreadsheets of review items. The resulting peer review, its creation, and distribution must be trackable and identified by date on the continuum of documents created and modified for a project. During the course of a project, the type of peer review deliverable may change, or a combination of deliverables may be needed.

While often better suited for the earliest stages of design, a summary letter can be a clear method of transmitting the findings of a peer review. Descriptive language can address inconsistencies in the

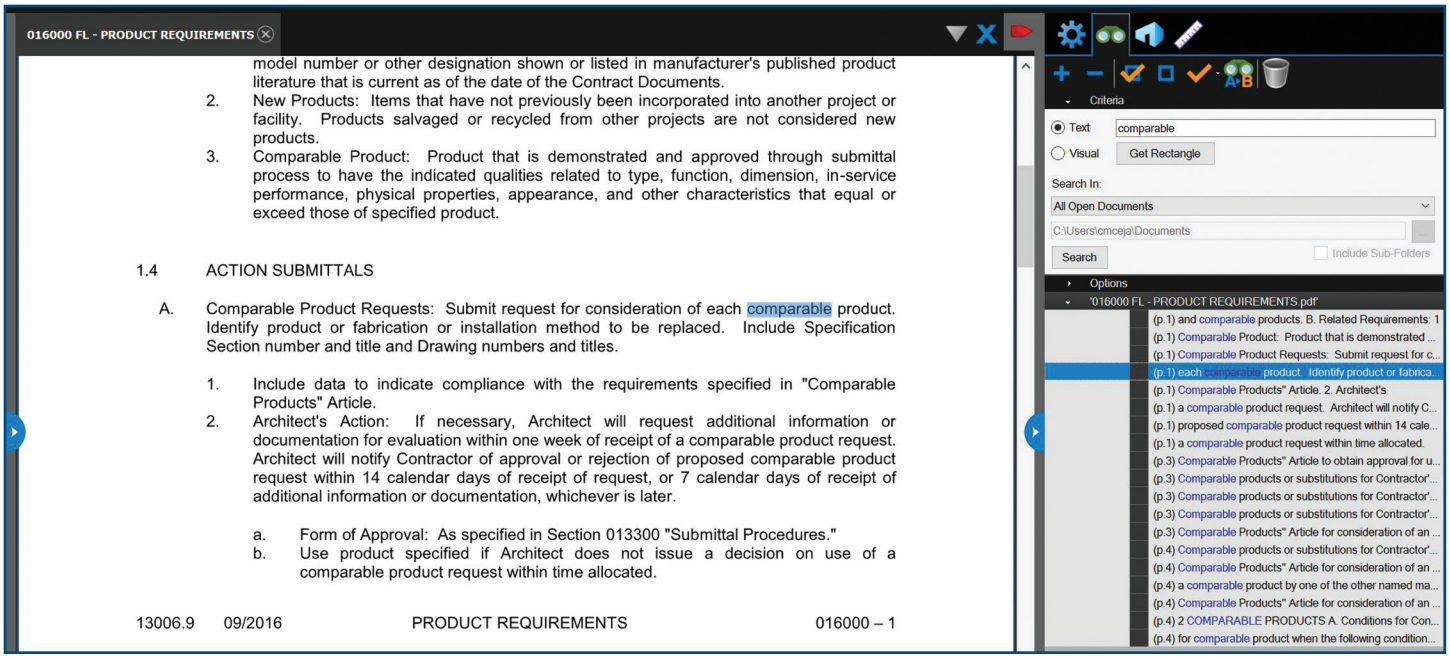



***Figure 3 – Example of OCR software in use to locate all instances of the word "comparable" within a specification section. Individual instances can be quickly navigated to and highlighted on the screen.***

basic concepts shown to date—even when there may not be actual graphics associated with these ideas yet. It is difficult to comment on missing information in any way other than prose. This method also may be more suitable when the Initiator is a building owner who does not deal daily with construction details and specifications. For this audience, additional graphics may only lead to additional confusion.

Flattened, PDF type, annotated, digital documents are an excellent way to transfer the results of a peer review. A page-by-page analysis is easily understood and has the advantage of closely linking the actual product reviewed to the comments of the Reviewer.

A spreadsheet approach to peer review deliverables provides flexibility to document action on the comments provided in the peer review. Spreadsheets of peer review results can become living documents shared and edited by multiple parties. Columns dedicated to the DOR's response to Reviewer comments can be added to provide point-by-point responses. Meta data or tags can be built into the spreadsheet entries so the Initiator or DOR can sort and distribute the comments as needed to the design team or assign relative values of importance (*Figure 6*). Certain software tools, such as Bluebeam® mentioned earlier, include subroutines that generate these spreadsheets simultaneously as the reviewer's comments are made on the digital drawing files. A sophisticated owner's representative may have peer review spreadsheet formats developed and contractually bind the DOR to at least provide a response, if not a definite action to, each point from the peer review process within given time frames. There should be a formal process wherein review comments are accepted, rebutted, or withdrawn and confirmation that action has been completed on those comments that are accepted. As these documents can evolve over time, the Reviewer must take care to preserve key snapshots to document their work product at certain stages in the review process for their internal files, as well as the project record.

## CASE STUDIES

What begins as a peer review can grow into something else entirely. While it is important to understand the differences between peer review and expert consulting described earlier, one can lead to the other. During the peer review process for a new hospital research facility in Maywood, Illinois, the Reviewer noted inconsistencies between owner expectations for below-grade waterproofing warranties and the language provided in the specification. As the peer review commenced during schematic design, there was an open exchange of ideas and comments between the DOR and the

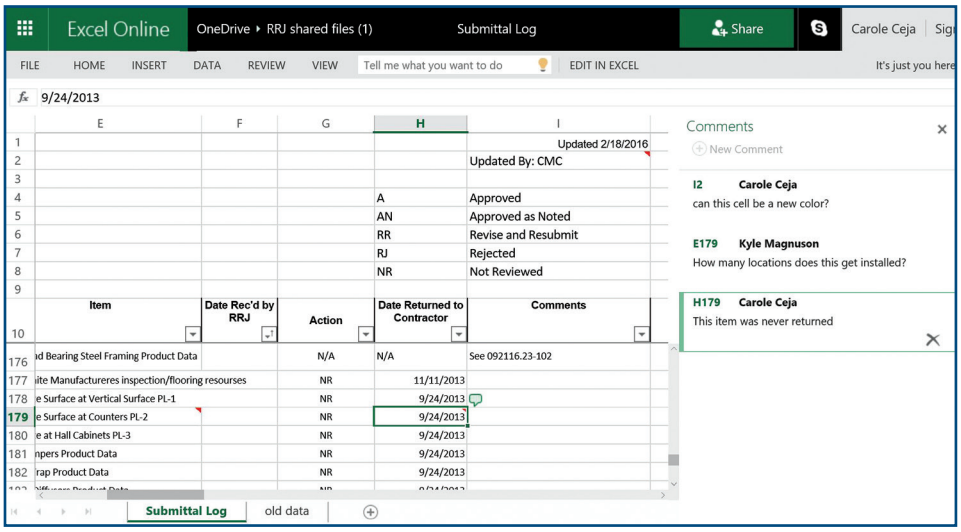



***Figure 4 – Example of cloud-based sharing and comments to a spreadsheet by multiple users.***

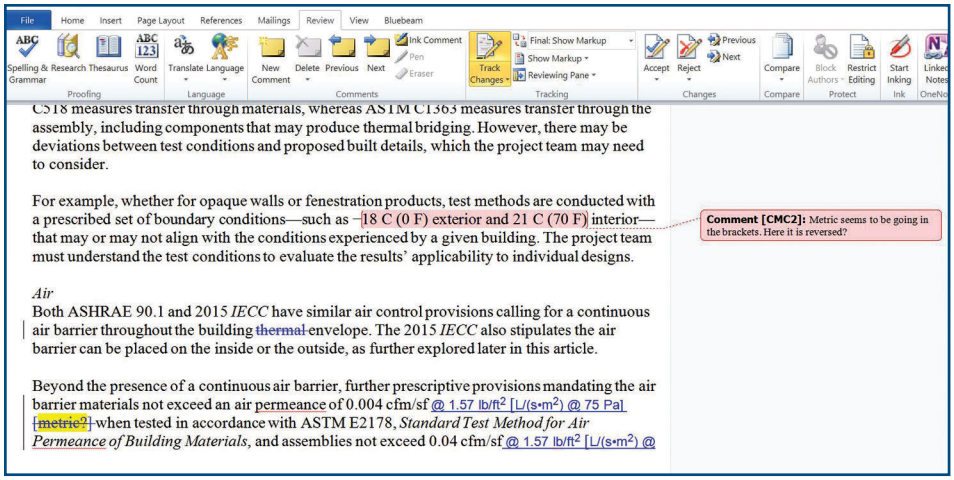



***Figure 5 – Example of track changes in a wood processing document. Deletions, additions, and comments can be added by several users to create a final document.***

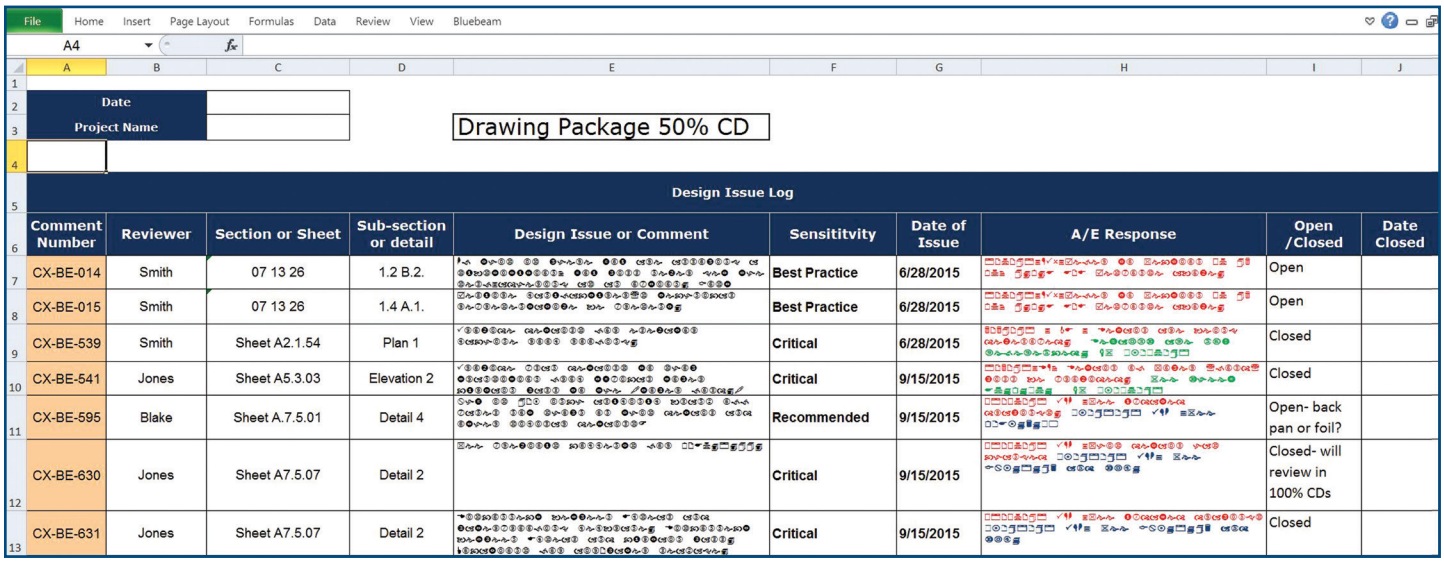
Reviewer in large meetings with several branches of the design team present early in the process. This inconsistency was highlighted while there was ample time to receive more clear direction from the owner and adjust the construction documents to match. However, this was not the end of the process for the Reviewer. The Reviewer was further engaged with an additional scope of services under a new contract to act as an expert consultant to the DOR. Coordination with manufacturers and additional presence on-site during the construction phase became new responsibilities for the Reviewer-turned-consultant. The results were a project that met the ultimate expectations of the DOR. The DOR was able to accept the criticism of his initial design and act on the comments and, ultimately, benefit from the expertise of the Reviewer prior to bidding so that no change orders were needed and the owner's needs were met.

Unfortunately, peer review does not always result in such positive outcomes for a project, as was the case for a low-rise office building in North Dakota. In this instance, the Initiator was the owner's representative, and the peer review was solicited after documents were out for bid. Due to access on the cloud-based project file sharing system, the Reviewer was able to determine that shop drawings for several components of the exterior envelope had been generated and approved by the architect before peer review comments were even returned to the Initiator. This conflict between the timing of the peer review and the construction schedule left little to no room for action by the DOR to improve the design. The peer review in this case was not initiated in a timely manner and the potential benefits were never realized by the project.

In another example, a modern hospital was designed for the harsh Minnesota climate. The insulation and vapor controls were adequate for the designer's home state in the south but could never have been executed to perform properly in the north. The contractor initiated a peer review specifically to address thermal and condensation issues. Information provided in the peer review process, together with case studies and references to published building science technical literature, lead to appropriate reconsideration of the design concept of the building envelope suited to the Minnesota climate. The originally designed batt insulation between metal studs and a sheet material vapor retarder fit between and around the stud framing, braces, columns, slab edges, and other obstructions, could not have been executed with the perfection needed to function properly. The DOR changed to a continuous insulation and vapor control concept on the exterior of the sheathing to the great benefit of the project's long-term function.

## PEER REVIEW IN A FORENSIC CONTEXT

A potentially overlooked benefit of the peer review process is in the forensic context of dispute resolution and litigation. In a forensic context, there are critical constraints on the work of designers, which are




| Comment Number | Reviewer | Section or Sheet | Sub-section or detail | Design Issue or Comment | Sensititvity | Date of Issue | A/E Response | Open /Closed | Date Closed |
|---|---|---|---|---|---|---|---|---|---|
| CX-BE-014 | Smith | 07 13 26 | 1.2 B.2. | [redacted] | Best Practice | 6/28/2015 | [redacted] | Open | |
| CX-BE-015 | Smith | 07 13 26 | 1.4 A.1. | [redacted] | Best Practice | 6/28/2015 | [redacted] | Open | |
| CX-BE-539 | Smith | Sheet A2.1.54 | Plan 1 | [redacted] | Critical | 6/28/2015 | [redacted] | Closed | |
| CX-BE-541 | Jones | Sheet A5.3.03 | Elevation 2 | [redacted] | Critical | 9/15/2015 | [redacted] | Closed | |
| CX-BE-595 | Blake | Sheet A.7.5.01 | Detail 4 | [redacted] | Recommended | 9/15/2015 | [redacted] | Open- back pan or foil? | |
| CX-BE-630 | Jones | Sheet A7.5.07 | Detail 2 | [redacted] | Critical | 9/15/2015 | [redacted] | Closed- will review in 100% CDs | |
| CX-BE-631 | Jones | Sheet A7.5.07 | Detail 2 | [redacted] | Critical | 9/15/2015 | [redacted] | Closed | |

***Figure 6 – Example of peer review spreadsheet style deliverable with the actual comments redacted. Important are the included columns to link to locations in the construction documents, a system for DOR response and the status of resolution to the comments, and a method to categorize items as critical to design or simply best practices.***

distinct from a new construction context. Most importantly, there must be no real or perceived conflict of interest, only objective findings; no confusion or mixing of preferences with principles; and no recommendations that are enhancements or are extraneous to correcting the deficiencies at issue. If any of these constraints are breached, it will be immediately identified and challenged by other parties during dispute resolution or litigation, and the credibility and legitimacy of an engineer's or architect's work is, rightly or wrongly, attacked.

The real problem, of course, is to objectively establish the necessity and reasonableness of a repair. Litigation or dispute resolution puts a spotlight on the repair process. Attorneys may attempt to impeach a repair approach, including unfairly asserting a conflict of interest by essentially accusing the design professional of designing unnecessary repairs for financial benefit. There is a school of thought[10] that suggests that one forensic entity should investigate a problem and recommend a repair approach and that another entity should then design the repairs. This necessarily creates a kind of peer review process because both professional entities must agree on the core elements of all significant findings. The concern is that if the investigation and the repair design are undertaken by the same professional, there can be an accusation of a conflict of interest that could result in more extensive repairs than necessary in order to benefit the repair designer and inflate the cost of resolution.

In the writers' experience, this potential conflict is rare and has never gone unnoticed or unchallenged. In a forensic context, repair designs are under constant and intense scrutiny. For competent and responsible professionals with integrity, the incentives to be objective far outweigh the incentives to be excessive. Repair designs proposed by a plaintiff's consultant are usually rebutted by the defendant's consultants. A rebuttal review is not the same as a peer review because the objectives are not necessarily the same, and therefore, the criteria used are not necessarily the same. One way to objectively establish the necessity and reasonableness of a repair design, as well as eliminate the appearance of a conflict of interest, and ensure concordance between the repair and rebuttal designs, is to undertake an independent third-party peer review of the proposed repair.

All of the standards and tools for a peer review discussed earlier in this paper apply. However, there are two features of a peer review in a forensic context that can differ from the new design/construction context. First, the peer review can be beneficially applied to the conceptual design phase rather than delayed until the actual schematic or design development phase of a project. The architectural program is by definition a repair to correct a problem for the resolution of a dispute, with the additional goal of returning the building to its original intended appearance and functionality. Anything beyond this program is remodeling, and anything less is not a repair. If the concept for a repair is peer reviewed and established as necessary and reasonable, then detailed design can be transparent and easily evaluated against the repair concept. Second, the criteria applied in the peer review are governed by the dispute resolution and not by the owner's or the repair designer's predilections. The peer reviewer must not only understand the building but also the necessary and reasonable scope of the dispute resolution. Constraints on the execution of the repair established by the owner, such as access, working hours, use of site, occupancy and occupant protection, staging, noise, security, etc., are also part of the repair design and the peer review.

## CONCLUSIONS

The peer review process has proven to be an effective and efficient quality assurance measure for construction projects. Avoiding a design problem and benefitting from the independent knowledge and experience of others is always preferable to repairing a problem or designing in an intellectual bubble. The peer review process supplements but does not substitute for normal in-house quality assurance and auditing measures. It provides an opportunity to learn, refine, optimize, and verify design decisions and avoid the pitfalls of "inattentional blindness." The tools utilized are adaptations of commonly available design software and procedures. The success of the process depends on the professionalism and integrity of the reviewer and the commitment of all parties of a project to a quality outcome.

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