

Peer Review in SE Practice

Assisting in Innovation, Development, and Progress

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Over the last three decades, structural design standards have clearly grown more prescriptive and complex. Some engineers argue that this has stifled structural engineering innovation. While this may be true to some extent, our codes and standards have always left the door open for engineers to design structures that do not fully meet the letter of the prescriptive codes and standards via demonstrating equivalent performance. In fact, ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, and the *International Building Code (IBC)* both now have specifically recognized performance-based design procedures (see Section 1.3.1.3 of ASCE 7-16, e.g.).

Commonly referred to as *Peer Review* (ASCE 7 uses the term *Independent Design Review*), it is a key element of implementing performance-based designs and projects that incorporate high-performance elements or are more sophisticated analysis procedures. This article summarizes some of the key aspects of this review process via the “Who, What, When, Where, Why, and How” of structural peer review, hoping to encourage our profession toward more widespread application. In addition, a series of references that include more detailed information on implementing peer reviews are included in the online version of the article.

Who Does the Review?

Peer reviews are typically done by a panel that includes a practitioner and an expert in the establishment of the hazard(s) being designed to resist, generally either earthquake or extreme wind. Many panels also include an academic with expertise in the structural system proposed for the design. Various documents identify the required qualifications to act as a peer reviewer, with language such as “...having the necessary expertise and knowledge to evaluate performance, the structural and component behavior, the particular load considered... to determine structural resistance and component behavior...” (ASCE 7-16 Section 1.3.1.3.4). Peer reviewers are independent engineers without conflicts of interest for the project under review who have previously designed similar structures and/or have participated in developing design standards and performance-based design guidelines documents.

What Projects are Reviewed?

Independent Design Review has been required for many cycles of ASCE 7 for the implementation of base isolation and viscous damping on seismic designs and for projects designed using nonlinear response history analysis. The other prevalent project type that implements peer review is where the design proposes to demonstrate equivalent performance to take exceptions to some elements of the prescriptive requirements of ASCE 7 or the material design standards. On the West Coast, this is often done to exceed structural system height limits specified in Table 12.2-1 of ASCE 7 for high-rise residential, office, or mixed construction, or where the structure’s architectural expression results in a hybrid or undefined structural system. Peer

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reviews are also performed outside of building code compliance for government agencies, corporations, and other entities for numerous reasons, including implementing designs intended for higher than code-level performance.

When are the Projects Reviewed?

A critical element is to start the review as early as possible, preferably during the conceptual design phase when major decisions (such as structural system, configuration, etc.) are made. Reviewer input at this early stage can significantly impact the ultimate structural design and performance. Starting the review too late in the process can result in disagreements on major design issues that could cause project re-design and subsequent delays. The reviews continue throughout the design process at milestone submittals, with the focus changing from more global/general issues and topics to more detailed and specific. At the completion of the review, it is customary for the review team to issue a letter(s) summarizing the results of the review and confirming that the design intent has been met, with multiple letters being issued for fast-tracked designs.

Where Do Peer Reviews Occur?

Peer reviews occur all over the country, though a preponderance is for tall buildings on the West Coast to allow structural systems such as special reinforced concrete shear walls and buckling restrained braced frames to exceed the ASCE 7 height limits. For over thirty years, peer reviews have been required for many projects in the State of Connecticut for code-level prescriptive designs depending on parameters such as building height, area, occupancy, etc. In addition, federal agencies such as the Department of Affairs, the General Services Administration, and the State Department require peer review for major projects since they are not bound to local jurisdiction plan review and permitting. It is expected that this practice will increase across the country as performance-based design for wind becomes more commonplace.

Why is Peer Review Important?

Peer reviews provide a mechanism for structural engineers to innovate and extend boundaries of construction through the application of advancements in materials, modeling and analysis capabilities, research results, etc. With peer review as a means of ensuring that these extended boundaries are within reason, this type of innovation pushes the profession forward, allowing us to better serve our clients and communities.

How are Peer Reviews Performed?

The reviews start with the establishment of the project design criteria. This document becomes the de facto "code" for the project, setting the rules for demonstrating that the design intent has been met. It also describes the project and intended performance objectives, and defines the design loading parameters, proposed code exceptions and design assumptions for key structural elements, identifies which elements of the lateral force-resisting system will be permitted to yield in a controlled fashion and which will be protected from yielding, discusses the design approach for any unique elements in the structural system, and lists all the reference codes, standards, and guidelines to be used in the project design. At the same time, since virtually all these projects include some form of response history analyses, a parallel document is prepared to establish the loading criteria, such as seismic response spectra and ground motion time histories or a wind hazard assessment and wind loading time histories. For many projects, a more detailed supplementary document on the nonlinear modeling analysis input parameters is developed

for review and acceptance prior to the analyses being performed. Review of analysis and design submittals, and construction documents, occurs throughout the process. Typically, a *comment log* tracks all review comments and helps manage the resolution process. By getting the design team and peer review team on the same page at the outset and throughout the execution of the project development, analysis/evaluation, and final design stages, the review process can be accomplished providing the most value to the project design and without undue impact to design schedules.

Summary

The profession widely uses peer review as a mechanism to allow unique and innovative projects within the context of demonstrating performance at least equivalent to that of prescriptive designs. When properly implemented, for a small additional cost to the project (and hopefully no schedule impact), significant benefits can be realized by extending the boundaries of engineering practice and construction applications via a collaborative process of independent assessment and review. Engineers are encouraged to embrace this process when they face unique challenges or desire to push forward an innovative approach. ■



References are included in the PDF version of the online article at STRUCTUREmag.org.

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