

Funneling Seismic Design Knowledge to Those Who Can Apply It

NEHRP Technical Briefs

The gap between engineering and scientific knowledge and its practical application (for design and construction of economical, earthquake-safe structures) has dramatically widened.¹

This was the consensus reached in a 2002 gathering of national leaders from the fields of earthquake engineering design, practice, regulation, and construction. Brought together by the National Institute of Standards and Technology (NIST) to assess the state of earthquake engineering knowledge and practice, these leaders affirmed the significant expansion of earth science and engineering knowledge that the National Earthquake Hazards Reduction Program (NEHRP) had helped bring about. They concluded, however, that the potential benefits of this knowledge were not being fully realized.

With support from NIST and the Applied Technology Council (ATC), a nonprofit corporation working to advance engineering applications for risk mitigation (www.atcouncil.org), the leaders formulated a broad plan of action through which NEHRP could strengthen “the informational link between theory, research results, and practice.”¹ One of the important ideas from this influential plan is that of technical brief (TechBrief) publications.

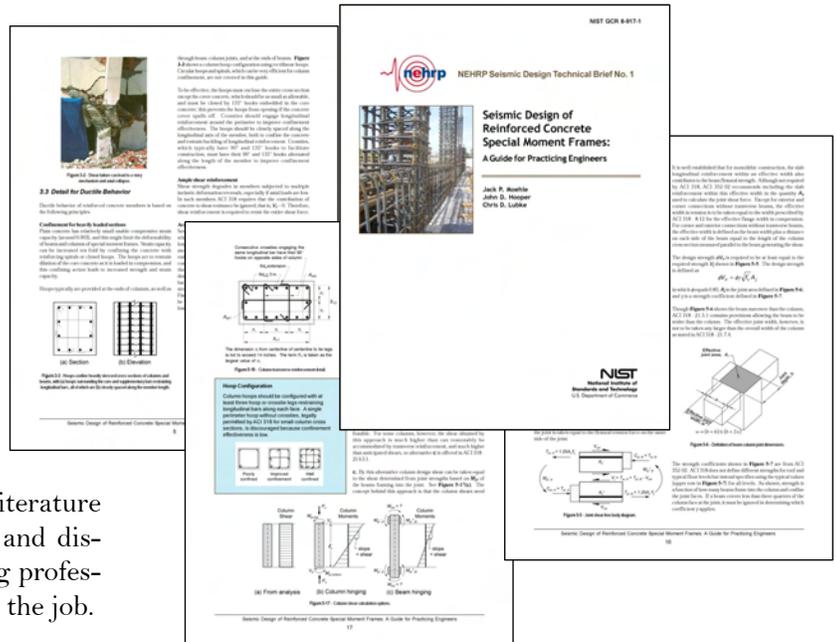
The TechBrief Concept

ATC had pioneered the TechBrief format in response to an unintended consequence of NEHRP’s success in expanding the body of technical literature, particularly that of research reports, related to earthquake engineering. The literature had become so voluminous, technically complex, and dispersed that it was difficult for individual practicing professionals to access, review, and evaluate it for use on the job.

The idea behind TechBriefs is to assist practitioners by doing some of this legwork for them. The publications “evaluate and synthesize available seismic-hazard mitigation data, information, and technology”² that are of practical relevance to many engineering design and construction practitioners. They are intended to be “topical, tightly written, and well-illustrated discussions”² focused on a single topic with actionable content. Target audiences include project engineers, designers, and detailers as well as building regulatory and construction personnel and related students and educators.

Consolidating What Has Been Learned

NIST inaugurated an ongoing series of NEHRP technical briefs in August 2008 with the publication of *Seismic Design of Reinforced Concrete Special Moment Frames: A Guide for Practicing Engineers*.³ This was followed in 2009 by *Seismic Design of Steel Special Moment Frames: A Guide for Practicing Engineers*.⁴ These publications showcased several hallmarks of the series.



¹ Applied Technology Council. (2003). *The Missing Piece: Improving Seismic Design and Construction Practices*, ATC 57, p. 1, <http://www.nehrp.gov/pdf/atc57.pdf>.

² ATC. *The Missing Piece*, pp. 17–18.

³ Moehle, Jack P., Hooper, John D., and Lubke, Chris D. (2008). "Seismic design of reinforced concrete special moment frames: a guide for practicing engineers," *NEHRP Seismic Design Technical Brief No. 1*, NIST GCR 8-917-1, www.nehrp.gov/pdf/nistgcr8-917-1.pdf.

⁴ Hamburger, Ronald O., Krawinkler, Helmut, Malley, James O., and Adan, Scott M. (2009). "Seismic design of steel special moment frames: a guide for practicing engineers," *NEHRP Seismic Design Technical Brief No. 2*, NIST GCR 09-917-3, www.nehrp.gov/pdf/nistgcr9-917-3.pdf.

Practitioner needs drive topic selection

According to Dr. John R. (Jack) Hayes, Jr., the Director of NEHRP, concrete and steel special moment frames were chosen as the focus of the inaugural TechBriefs because these systems are often used in practice, have received a lot of attention from researchers, and are addressed extensively in industry standards developed through the American Concrete Institute (ACI) and the American Institute of Steel Construction (AISC). Although it is easy to see why engineers would need information about systems they often use, the existence of copious research and standards documentation might suggest that they already have this information. In fact, it points to the very need that TechBriefs were conceived to address—the need for help in organizing, evaluating, interpreting, and synthesizing large volumes of potentially useful technical information.

Both of the initial NEHRP TechBriefs help practitioners navigate and understand the detailed industry standards applicable to special moment frames, standards that are referenced in the applicable seismic provisions of the Nation's model building codes. Such frames are constructed in areas where earthquakes are more likely to place high seismic demands on buildings. The publication on reinforced concrete frames comments on the need for this navigational assistance as follows: "The numerous inter-related requirements [for special moment frames] are covered in several sections of ACI 318, not necessarily arranged in a logical sequence, making their application challenging for all but the most experienced designers."⁵

Authoritative writing

NEHRP's TechBriefs are developed by the NEHRP Consultants Joint Venture under a contract with NIST. The joint venture is a partnership between ATC, which contracts extensively with highly qualified consulting professionals from the spheres of academia, research, and professional practice, and the Consortium of Universities for Research in Earthquake Engineering (CUREE), which represents the earthquake engineering programs and faculty of more than 20 universities nationwide.

This partnership is able to secure, as TechBrief authors and review panelists, some of the most directly and highly

qualified experts on the topics addressed, ensuring that practitioners can use the publications with confidence. The authors and reviewers selected for the first two TechBriefs included prominent academics and practitioners who have been heavily involved in the ACI, AISC, American Society of Civil Engineers, and Building Seismic Safety Council committees responsible for developing related national industry standards and model seismic code provisions. Several of these experts were also prominently involved in the SAC Joint Venture research, conducted in response to the 1994 Northridge earthquake and principally funded by the Federal Emergency Management Agency, which underpins current AISC standards and building code requirements for steel special moment frames.

An Ongoing Series

Two more NEHRP TechBriefs are now being developed for publication over the coming year. One will focus on the design and analysis of reinforced concrete diaphragm (floor and roof) systems, a subject that is not well documented in engineering publications. The other will address guidelines for performing nonlinear structural analysis; as use of performance-based seismic design methods has grown, such analysis has become ever more important to engineers for accurately predicting the seismic performance of structures.

NEHRP Director Hayes has been encouraged by the reception given the first two TechBriefs. "Practitioners are very positive about both, and are distributing them in their firms. Professors are also using them as references in graduate classes on earthquake-resistant design." These publications can be downloaded at no charge from NEHRP (www.nehrp.gov) or the NEHRP Consultants Joint Venture (www.nehrp-consultants.org). NIST plans to continue publishing NEHRP TechBriefs at the rate of one or two per year for the foreseeable future, and Hayes welcomes suggestions for future topics from practitioners involved in all areas of seismic design and construction.

⁵ Moehle, Hooper, and Lubke. "Seismic design of reinforced concrete special moment frames," p. 1.

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