October 2013

SeismicWaves

How the National Earthquake Hazards Reduction Program Is Advancing Earthquake Safety

NEHRP Technical Briefs Reach Five-Year Milestone

Serving the Needs of Seismic Design and Construction Practitioners

No one, even if he devotes a large part of his time to it, can keep up with the literature . . . not even in a single narrow line of engineering.[1]

Although the statement above may have a contemporary ring, it was actually voiced more than a century ago. Suffice it to say that since then it hasn't gotten any easier to keep up with the literature, including that related to earthquake engineering.

As described in an earlier issue of *SeismicWaves,*[2] the concept of "technical briefs" (techbriefs) originated in response to this predicament. Embracing the concept as a means of hastening and broadening the application of research-based best practices in earthquake engineering, the National Institute of Standards and Technology (NIST, a NEHRP agency) began publishing NEHRP technical briefs in 2008. Over the 5 years since, NIST has produced an initial collection of eight techbriefs that are helping to transfer many of the latest advances in earthquake engineering into practice.

The Collection to Date

Each techbrief synthesizes the latest requirements contained in the Nation's model building codes and industry standards—along with best-practice information, methods, and technologies—that are relevant to a specific seismic design topic of substantial interest to practicing structural engineers. Averaging about 35 pages in length, the documents are concise, well-illustrated presentations of practical, actionable content. To develop the first eight publications, NIST contracted with the NEHRP Consultants Joint Venture, a partnership between the Applied Technology Council (ATC) and the Consortium of Universities for Research in Earthquake Engineering (CUREE). They recruited leading practitioners and academics, including many of the most directly and highly qualified experts on each topic, to serve as techbrief authors and reviewers.

In selecting topics, NIST has largely sought to clarify the design and analysis of structural systems and elements that are among those most commonly used by practicing engineers involved in seismic design (see box on next page). Usually, as suggested above, clarification is needed due to the large volume of comprehensive yet dispersed research and standards literature available on a topic, information that has typically not been organized expressly for practitioners. In some cases, however, clarification has been needed due to gaps in available knowledge or documentation.

Spurring Use through Dissemination

NIST and the NEHRP Consultants Joint Venture have employed several strategies to ensure that, once they are published, NEHRP techbriefs reach the community of practicing structural engineers. First, they have made the documents easy to access; all can be downloaded in electronic form without charge from the NEHRP website at www.nehrp.gov/library/techbriefs.htm. Second, with the assistance of the academic authors and reviewers, they are introducing the documents into graduate-level coursework on earthquake-resistant design to reach a new generation of practitioners. Third, the authors have recorded webinars about several of the techbriefs, which practicing engineers have been able to access for continuing education credit through the National Council of Structural Engineers Associations and ATC. And finally, the authors have delivered conference papers and presentations describing the techbriefs.

NIST will continue to expand the NEHRP techbrief collection in coming years. While the topics will change, the hallmarks of this series will be maintained: (1) content and formatting that meet the evolving needs of seismic design and construction practitioners, and (2) authoritative content that practitioners can use with confidence.

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[1] Excerpt from a December 1906 speech entitled "Engineering Education" delivered by Arthur J. Rowland, which was subsequently printed in the January 1907 issue of the *Proceedings of the American Institute of Electrical Engineers* (accessed via http://books.google.com/).

[2] NEHRP, "Funneling Seismic Design Knowledge to Those Who Can Apply It: NEHRP Technical Briefs," *SeismicWaves,* March 2010.

NEHRP Technical Briefs, 2008–2013, *Guides for Practicing Engineers*

No. 1: Seismic Design of Reinforced Concrete Special Moment Frames (2008)
Describes how to comply with relevant code and standard provisions to meet the special proportioning and detailing requirements that enable these frames to safely undergo extensive inelastic deformations.

No. 2: Seismic Design of Steel Special Moment Frames (2009)
Discusses the use of such frames and principles underlying their design, related analysis and design guidance, and detailing and constructability issues. *Winner—2010 Excellence in Structural Engineering Award of Merit from the Structural Engineers Association of Northern California*

No. 3: Seismic Design of Cast-in-Place Concrete Diaphragms, Chords, and Collectors (2010)
Many aspects of diaphragm design are left open to interpretation and engineering judgment. The authors of this guide consulted widely with code writers and practicing engineers to gather good practices applicable to common diaphragm design conditions.

No. 4: Nonlinear Structural Analysis for Seismic Design (2010)
Summarizes what engineers need to consider in using both static and dynamic nonlinear analysis in the course of retrofitting existing buildings, designing new buildings with structural attributes not addressed in current code requirements, and determining whether designs will meet special performance needs.

No. 5: Seismic Design of Composite Steel Deck and Concrete-filled Diaphragms (2011)
Builds upon the guidance in Technical Brief No. 3; addresses the ambiguities that practitioners face in integrating and applying the various steel- and concrete-related standards and guidance relevant to composite diaphragms composed of steel decks with concrete fill.

No. 6: Seismic Design of Cast-in-Place Concrete Special Structural Walls and Coupling Beams (2011, revised 2012)
Tells how to efficiently navigate the numerous interrelated code and standard requirements applicable to special structural walls, the main alternative to special moment frames (Technical Brief No. 1) in reinforced concrete buildings.

No. 7: Seismic Design of Reinforced Concrete Mat Foundations (2012)
These foundations are commonly used where earthquake ground motions may produce differential soil settlement under spread footings, but a deep foundation is not required. Their design requires close collaboration between structural and geotechnical engineers.

No. 8: Seismic Design of Steel Special Concentrically Braced Frame Systems (2013)
These systems are intended to maximize inelastic drift capacity (by means of ductile diagonal braces) while providing high strength and stiffness. How the braces are connected to the frame is of critical importance, and this new guide discusses both old and new connection design strategies.

For more information, visit www.nehrp.gov or send an email to info@nehrp.gov.

FEMA

NIST National Institute of Standards and Technology U.S. Department of Commerce

NSF

USGS science for a changing world