CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: 8th U.S. National Conference on Earthquake Engineering
Sponsored by the Earthquake Engineering Research Institute
100th Anniversary Earthquake Conference—Commemorating the 1906 San Francisco Earthquake
Project Nos. 20.06002.01.332 and 20.06002.01.342
AI No. 20.06002.01.332.614

DATE/PLACE: April 18–22, 2006
San Francisco, California

AUTHORS: Luis Ibarra and Asad Chowdhury

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BACKGROUND AND PURPOSE OF TRIP:

The 8th U.S. National Conference on Earthquake Engineering was organized by the Earthquake Engineering Research Institute as part of the 100th Anniversary of the 1906 San Francisco Earthquake. The Seismological Society of the America Centennial Annual Meeting and the Disaster Resistant California Conference were also part of this convened meeting. The program featured joint multidisciplinary plenary sessions, technical sessions, seminars, poster sessions, technical committee meetings, and field trips. The three technical programs were fully coordinated throughout the conference to optimize the program content.

The objectives of the 8th U.S. National Conference on Earthquake Engineering were (i) to present the state of the art in earthquake engineering research, (ii) assess the current level of earthquake risk, and (iii) discuss how to manage earthquake risk by applying modern earthquake engineering principles and practices.

SUMMARY OF ACTIVITIES AND PERTINENT POINTS:

The conference, attended by about 4,000 professionals from about 60 countries, addressed a broad range of earthquake engineering topics such as seismic hazards, seismic engineering, ground response, liquefaction, lessons learned from recent earthquakes, and performance-based design. Because of about 15 concurrent oral sessions at a given time, the Center for Nuclear Waste Regulatory Analyses (CNWRA) staff could attend only a selected number of oral sessions in addition to attending the plenary and poster sessions, exhibits, and a technical committee meeting. The focus of this trip report is related to the response of structural systems to seismic excitations (particularly performance-based design), advances in seismic provisions, and analytical and experimental performance of shear walls. These subjects are also directly related to the activities developed by staff in supporting the U.S. Nuclear Regulatory Commission (NRC) on the prelicensing activities of the potential geologic repository at Yucca Mountain, Nevada.

Seismic performance-based design was the subject of several articles presented at this conference. This topic is relevant for the review of the potential geologic repository at Yucca Mountain because the structural systems and components included in this project should

be evaluated according to a risk-informed, performance-based philosophy. In fact, some of the conference papers presented the advantages of using performance-based methodologies to evaluate the seismic behavior of existing nuclear facilities. For instance, S. Gallocher, C. Robertson, D. Kourepinis, and A. Manafpour (Paper 8NCEE–1825) indicated that these methods are nonprescriptive in terms of the design strength and detailing, allowing the system response to be significantly enhanced by strengthening at a component level based on analysis results. Also, A. Whittaker (Paper 8NCEE–273) described the general performance assessment methodology for structural components, and A.H. Jafarieh and M.A. Ghannad (Paper 8NCEE–1328) included the effect of soil-structure interaction on this methodology.

The development of fragility curves is often required in performance-based design. For this conference, C-H. Pai and Y-M. Tien (Paper 8NCEE–401) generated fragility curves based on recent earthquakes for the 1999 Taiwan earthquake. Fragility curves were also developed for estimating damage in nonductile reinforced concrete columns by H. Aslani and E. Miranda (Paper 8NCEE–1201), and A. Ayoub and M. Chenouda (Paper 8NCEE–754) conducted a seismic fragility analysis for multi-degree-of-freedom structures that presented strength and stiffness deterioration within the performance-based design framework. Also, I. Sato, H. Yashiro, K. Ohta, and S. Fukushima (Paper 8NCEE–1895) reported fragility curves for any damage state based on a capacity index. K. Nasserasadi, M. Ghafory-Ashtiany, S. Eshghi, and M. Zolfaghari (Paper 8NCEE–693) created fragility curve functions for structures using a stochastic approach, and H. Aslani and E. Miranda (Paper 8NCEE–1123) considered propagation of epistemic uncertainty from the engineering demand parameters to the lost estimation stage. In addition, P. Tothong and A. Cornell (Paper 8NCEE–505) applied nonlinear static analyses to probabilistic seismic demand analysis.

The current design of geologic repository operations area facilities at Yucca Mountain considers using a reinforced concrete building, in which thick shear walls with a small aspect ratio (height-to-length ratio) are the main structural components, to withstand the lateral loads that may be generated by seismic events. In this area, T.D. Kohli, O. Gurbuz, and F. Ostadan (Paper 8NCEE–996) presented a paper about a methodology to integrate the seismic analysis and design of structural systems made of shear walls. As part of the Network for Earthquake Engineering Simulation research efforts, P. Brown, J. Ji, D. Kuchma, D. Lehman, L. Lowes, P. Oyen, A. Sterns, and J. Zhang (Paper 8NCEE–532) evaluated the seismic behavior and analysis of reinforced concrete shear walls. Also, A. Lepage, S. Neuman, and J. Dragovich (Paper 8NCEE–1065) proposed a practical method for modeling the nonlinear response of this type of system. Experimental tests carried out in large-scale shake tables also focused on shear wall performance. For instance, M. Panagiotou, J. Restrepo, J. Conte, and R. Englekirk (Paper 8NCEE–1494) obtained the seismic response of reinforced concrete wall buildings, and W-I. Liao, C-H. Loh, Y.L. Mo, and J. Zhong (Paper 8NCEE–166) experimentally evaluated the nonlinear response of low-rise shear walls. In a related topic, T. Wang and T. Hutchinson (Paper 8NCEE–447) presented one of the few papers in this conference related to the potential cracking in reinforced concrete shear walls when subjected to lateral loads. Based on experimental information about shear wall seismic performance, S-J. Hwang, Y-S. Tu, and H-W. Yu (Paper 8NCEE–472) computed the load deflection response of squat (low aspect ratio) shear walls.

An important aspect of performance-based design, especially for systems performing close to the limit state of collapse, is the assessment of cyclic deterioration. In this direction, J. Mohle and S. Kunnath (Paper 8NCEE–639) modeled cyclic deterioration for reinforced concrete

structures, whereas F. Zareian, H. Krawinkler, and L.F. Ibarra (Paper 8NCEE–1579) proposed a method for predicting the probability of the collapse of buildings and emphasized the importance of strength deterioration, as well as cyclic deterioration, for an accurate representation of collapse. Implementation and validation of cumulative damage models for structural performance assessment was the main topic of the paper by A. Altoontash, P. Cordova, and G. Deierlein (Paper 8NCEE–1540).

All these advances in performance-based design and analytical and experimental studies of structural systems under seismic excitations resulted in revisions of several seismic guidelines. For example, S. Ghosh and N. Hawkins (Paper 8NCEE–899) presented an overview of Chapter 19 of the International Building Code and addressed the most important updates for the design of reinforced concrete structures. An analytical evaluation of earthquake performance according to the current seismic guidelines was presented by K. Cobeen and J.D. Dolan (Paper 8NCEE–611). The CNWRA staff need to keep track of the modifications and trends of the seismic guidelines, especially those that may be used in the design of Yucca Mountain facilities.

Several papers at this conference were directly related to the potential geologic repository. W. Silva, I. Wong, J. Ake, R. Quittmeyer, and C. Costantino (Paper SAA–563); I. Wong, W. Silva, P. Thomas, R. Quittmeyer, M. Dober, C. Pattanapong, R. Lee, G. Toro, K. Stokoe, and J.C. Stepp (Paper SSA–1420); and S. Upadhyaya, I. Wong, R. Kulkarni, K. Stokoe, M. Dober, W. Silva, and R. Quittmeyer (Paper SSA–389) reported the characterization of extreme ground motions at Yucca Mountain and the seismic design ground motions derived from this characterization. Regarding the development of ground motions for engineering design, C. Haselton and J. Baker (Paper 8NCEE–461) investigated ground motion intensity measures that may be useful for predicting collapse capacity. They selected the optimal spectral period and the effect of the spectral shape as intensity measures. Also, P. Bazurro and N. Luco (Paper 8NCEE–1029); and J. Watson-Lamprey, N. Abrahamson, and R. Bachman (Paper SSA–42) made some recommendations for selecting and scaling ground motion time histories for building code applications.

CONCLUSIONS:

Attendance at the conference fulfilled the objective of keeping the CNWRA staff abreast of the state of the art in structural and earthquake engineering. The presentations provided insight on the new designs and methodologies that researchers and engineers are performing on structural systems similar to those evaluated by NRC and CNWRA. An electronic copy of the proceedings is available in the CNWRA library.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

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