

Seismic Vulnerability of New Highway Construction Project Concludes

In 1992, MCEER commenced work on a Federal Highway Administration (FHWA) project entitled "Seismic Vulnerability of New Highway Construction." The objective was to perform a series of special studies related to the seismic vulnerability of highway bridges, tunnels, and retaining structures, in order to develop technical information on which new seismic design specifications could be based in the future. It is anticipated that current specifications for the seismic design of bridges will be revised, and that new seismic design guidelines will be prepared for other highway system components, in part on the basis of this work.

Research Areas and Tasks

The results of the research from this project are intended to provide the basis for developing new design criteria and specifications, particularly for highway bridges. Secondary products resulting from this work include task and synthesis reports describing the advances made in design for bridges and other highway transportation systems and components. Many of these reports address important issues that should be considered during the development of future seismic design codes; some provide design procedures and discuss computer programs that will be useful as design aids to the profession; and others provide background information and research documentation. An independent assessment of the results and potential impacts of these studies was performed, and the results are presented in *Impact Assessment of Selected MCEER Highway Project Research on the Seismic Design of Highway Structures*, MCEER 99-0009 (see report review on page 11). A list of all reports produced under this project, organized by subject, is provided below.

Future Work and Research Implementation

It is anticipated that much of this work will be considered in future design specification development work. Specifically, the National Cooperative Highway Research Program (NCHRP), sponsored by AASHTO and coordinated by ATC and MCEER, initiated NCHRP Project 12-49, "Development of Comprehensive Bridge Specifications and Commentary" in the fall of 1998. The objective of NCHRP Project 12-49 is to develop new bridge seismic design specifications, commentary, and design examples, which will be incorporated into the *AASHTO LRFD Bridge Design Specifications* in the near future. Much of the basis for the specification changes that will be made in NCHRP Project 12-49 are expected to be drawn from the results of the work conducted under this FHWA contract.

Acknowledgments

The work on this contract was conducted by MCEER. Ian G. Buckle was the project principal investigator and Ian M. Friedland was the project manager. MCEER was assisted by the following key subcontract institutions: the University at Buffalo, the Applied Technology Council, Brigham Young University, Dynamic Isolation Systems Inc., Earth Mechanics Inc., Geomatrix Consultants Inc., Imbsen & Associates Inc., Modjeski and Masters Consulting Engineers, Princeton University, Rensselaer Polytechnic Institute, University of Nevada Reno, and the University of Southern California. ❖

Seismic Hazard, Exposure, Bridge Performance, and Structural Importance

Proceedings of the FHWA/NCEER Workshop on the National Representation of Seismic Ground Motion for New and Existing Highway Facilities, edited by I.M. Friedland, M.S. Power and R.L. Mayes, NCEER-97-0010, \$40.

Site Factors and Site Categories in Seismic Codes, by R. Dobry, R. Ramos and M. Power, MCEER-99-0010, \$30.

Effect of Spatial Variation of Ground Motion on Highway Structures, by M. Shinozuka and G. Deodatis, *.

Effects of Vertical Ground Motions on the Structural Response of Highway Bridges, by M. Button, C. Cronin and R. Mayes, MCEER-99-0007, \$30.

Evaluation of Structural Importance, by A. Thomas, S. Eshenaur and J. Kulicki, MCEER-98-0002, \$30.

Structural Analysis, Design and Response

Application of Simplified Methods of Analysis to the Seismic Design of Bridges, by J.H. Kim, M.R. Button, J.B. Mander and I.G. Buckle, *.

Establish Representative Pier Types for Comprehensive Study: Eastern U.S., by J. Kulicki and Z. Prucz, NCEER-96-0005, \$15 and *Establish Representative Pier Types for Comprehensive Study: Western U.S.*, by R.A. Imbsen, R.A. Schamber, and T.A. Osterkamp, NCEER-96-0006, \$15.

Seismic Resistance of Bridge Piers Based on Damage Avoidance Design, by J.B. Mander and C.T. Cheng, NCEER-97-0014, \$25.

Seismic Design of Bridge Columns Based on Control and Repairability of Damage, by C.T. Cheng and J.B. Mander, NCEER-97-0013, \$35.

Capacity Design and Fatigue Analysis of Confined Concrete Sections, by A. Dutta and J.B. Mander, MCEER-98-0007, \$35.

Capacity Design of Bridge Piers and the Analysis of Overstrength, by J.B. Mander, A. Dutta, and P. Goel, MCEER-98-0003, \$30.

Seismic-Energy-Based Fatigue-Damage Analysis of Bridge Columns: Part I – Evaluation of Seismic Capacity, by G.A. Chang and J.B. Mander, NCEER-94-0006, \$20.

Seismic-Energy-Based Fatigue-Damage Analysis of Bridge Columns: Part II – Evaluation of Seismic Demand, by G.A. Chang and J.B. Mander, NCEER-94-0013, \$15.

Ductility of Rectangular Reinforced Concrete Bridge Columns with Moderate Confinement, by N. Webbe, M. Saiidi, D. Sanders and B. Douglas, NCEER-96-0003, \$15.

Capacity Detailing of Members to Ensure Elastic Behavior, by R.A. Imbsen, R.A. Schamber, and M. Quest, *.

Capacity Detailing of Members to Ensure Elastic Behavior - Steel Pile-to-Cap Connection, by P. Ritchie and J. M. Kulicki, *.

Structural Steel and Steel/Concrete Interface Details, by P. Ritchie, N. Kahl and J. Kulicki, MCEER-98-0006, \$25.

Structural Details to Accommodate Seismic Movements of Highway Bridges and Retaining Walls, R.A. Imbsen, R.A. Schamber, E. Thorkildsen, A. Kartoum, B.T. Martin, T.N. Rosser and J.M. Kulicki, NCEER-97-0007, \$30.

Derivation of Inelastic Design Spectrum, by W. D. Liu, R. Imbsen, X. D. Chen and A. Neuenhofer, *.

Summary and Evaluation of Procedures for the Seismic Design of Tunnels., by M. S. Power, D. Rosidi, J. Kaneshiro, S. D. Gilstrap, and S.-J. Chiou, *.

Foundations and Soil-Structure Interaction

Foundations and Soils - Compile Data and Identify Key Issues, by I.P. Lam, *.

Centrifuge and Numerical Modeling of Lateral Response of Pile-Cap Systems and Seat-Type Abutments in Dry Sand, by A. Gadre and R. Dobry, MCEER-98-0010, \$35.

Modeling of Abutments for Seismic Design, by I.P. Lam and G. Martin, *.

Seismic Analysis and Design of Bridge Abutments Considering Sliding and Rotation, by K.L. Fishman and R. Richards, Jr., NCEER-97-0009, \$25.

Modeling of Pile Footings and Drilled Shafts for Seismic Design, by I.P. Lam, M. Kapuskar and D. Chaudhuri, MCEER-98-0018, \$30.

Development of Analysis and Design Procedures for Spread Footings, by G. Gazetas, G. Milonakis and A. Nikolaou, *.

Synthesis Report on Foundation Stiffness and Sensitivity Evaluation on Bridge Response, by I. P. Lam, G. R. Martin, G. R., and M. Kapuskar, *.

Liquefaction and Soil Behavior

Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils, edited by T.L. Youd and I.M. Idriss, NCEER-97-0022, \$35.

Development of Liquefaction Mitigation Methodologies / Ground Densification Methods, by G. Martin, *.

Design Recommendations for Site Response and Liquefaction, by G. Martin, *.

* Indicates unpublished reports.