

New MCEER Technical Reports

MCEER technical reports are published to communicate specific research data and project results. Reports are written by MCEER-funded researchers, and provide information on a variety of fields of interest in earthquake engineering. The proceedings from conferences and workshops sponsored by MCEER are also published in this series. To order a report reviewed in this issue, fill out the order form and return it to MCEER. To request a complete list of titles and prices, contact MCEER publications.

MCEER's web site offers a complete list of technical reports and their abstracts. The publications section allows users to search the report list by subject, title and author, and to place orders for these reports. Visit the site at <http://mceer.buffalo.edu/publications/default.html>.

Effect of Vertical Ground Motions on the Structural Response of Highway Bridges

by M.R. Button, C.J. Cronin and R.L. Mayes, 4/10/99, MCEER-99-0007, 186 pages, \$30.00.

In this report, a representative group of six bridges, with a range of input ground motions that include and exclude the vertical component of motion, were analyzed to determine when the vertical component can be safely ignored and when it should be included in the design or analysis of highway bridges. On the basis of results from linear and nonlinear analyses, recommendations are made regarding when to explicitly include vertical motions in design, when the effects of vertical motion can be adequately addressed by simple load combination rules, and when the impact of vertical motions is less than 10% and thus can safely be ignored. It is important to note, however, that this study was limited only to the six bridge types analyzed and generic or widely applicable recommendations should not

be drawn or interpreted from these results.

A large body of additional information, including response ratios computed from response spectrum analyses of all six bridges and for varying deck stiffnesses and foundation fixity in bridges 4 and 6, mode shapes with modal mass participation ratios greater than 10% for all six bridges, SAP2000 input files, and the ANSR-II input file for bridge 6, are not included in this report but are available from the publications section of MCEER's web site at <http://mceer.buffalo.edu/publications/default.html>, where they can be freely downloaded.

Seismic Reliability Assessment of Critical Facilities: A Handbook, Supporting Documentation, and Model Code Provisions

by G.S. Johnson, R.E. Sheppard, M.D. Quilici, S.J. Eder and C.R. Scawthorn, 4/12/99, MCEER-99-0008, 392 pages, \$35.00

This report summarizes a multi-year research effort to develop a detailed methodology to assess and improve the functional reliability of equipment systems in critical facilities following earthquakes. The emphasis was on performing a rapid assessment by regular facility staff, and consists of four major steps: systems definition, evaluation of individual components, systems evaluation, and risk management. The program is intended for use by engineers, building officials, owners and others interested in assessing and improving the capability of a facility to maintain its structural integrity. This report is divided into three parts. Part A is a handbook, written as an instruction for users. Part B contains supporting documentation and the technical rationale for the approach. Part C provides an example set of model code provisions using this approach. It is intended to demonstrate how the approach can be incorporated into a format that can be used by designers or to evaluate existing facilities.

Site Factors and Site Categories in Seismic Codes

by R. Dobry, R. Ramos and M.S. Power, 7/19/99, MCEER-99-0010, 118 pages, \$25.00

The overall objective of this highway project task was to provide a detailed evaluation and assessment of the site coefficients contained in the 1994 NEHRP provisions for the seismic design of buildings, in light of data provided by recent strong motion records obtained during the 1994 Northridge and 1995 Kobe earthquakes. It was found that site coefficients back-calculated from recordings of the Northridge earthquake validated the 1994 NEHRP values quite well. These site coefficients reflect a broad consensus of the geotechnical engineering and earth science communities and constitute a significant improvement over provisions contained in older codes and specifications. The authors recommend that the current AASHTO *Standard Specifications for Highway Bridges* and AASHTO *LRFD Bridge Design Specifications* be updated to be consistent with the 1994 and 1997 NEHRP and 1997 UBC provisions for site categories and coefficients.

Restrainer Design Procedures for Multi-Span Simply-Supported Bridges

by M.J. Randall, M. Saiidi, E. Maragakis and T. Isakovic, 7/20/99, MCEER-99-0011, 174 pages, \$30.00

The overall objective of this task was to review and compare the methods currently in use for the design of cable restrainers used to tie together simple spans in multiple-span, simply-supported bridges and to recommend improvements to provide better performance while maintaining ease and efficiency of design. Two existing methods, developed by Caltrans and AASHTO, respectively, were compared and evaluated. Three new methods were also proposed and evaluated. All five procedures were found to be effective in preventing spans from unseating in most bridges. However, the authors recommend that the procedure known as the

“proposed” method be used for future design, as it provided the best overall performance under moderate-to-large earthquakes. A companion MCEER report, *Design Procedures for Hinge Restrainers and Hinge Seat Width for Multiple-Frame Bridges*, by R. DesRoches and G.L. Fenves, MCEER-98-0013, provides similar evaluations and recommendations regarding the design of cable restrainers for multiple continuous span bridges.

Critical Seismic Issues for Existing Steel Bridges

by P. Ritchie, N. Kauhl and J. Kulicki, 7/20/99, MCEER-99-0013, 132 pages, \$25.00

This report provides an assessment of the performance of existing steel bridges in past earthquakes, including the 1989 Loma Prieta, 1994 Northridge and 1995 Kobe events. The components that were studied include steel columns, joints and connections, tower bents and superstructure details. Vulnerable areas and details are identified, and recommendations for improved designs and retrofit techniques are made. Research needs are identified where existing knowledge is incomplete or lacking.

Nonstructural Damage Database

by A. Kao, T.T. Soong and A. Vender, 7/24/99, MCEER-99-0014, 72 pages, \$25.00

This report describes a database which provides damage information for nonstructural components in buildings and other constructed facilities. It contains nearly 3,000 entries encompassing more than 50 earthquakes from the 1964 Alaska earthquake to the present. Information from various publications, including books, reports and periodicals, was gathered and recorded, including a description of the damage to the nonstructural component, information about the building where the damage occurred, and strong ground motion records, when available. The database is a work in progress, and will continue to be updated as new information becomes available.

The nonstructural components database, in Access format, can be downloaded from the publications section of MCEER’s web site at <http://mceer.buffalo.edu/publications/default.html>.

Guide to Remedial Measures for Liquefaction Mitigation at Existing Highway Bridge Sites

by H.G. Cooke and J. K. Mitchell, 7/26/99, MCEER-99-0015, 216 pages, \$35.00

The overall objective of this highway project task was to develop methodologies to assess liquefaction risk at existing highway bridges, select appropriate ground and/or foundation improvement methods to reduce the risk of damage, design the improvements, and verify that these improvements had been achieved in the field. The report describes the methodologies developed, which focus on assessing liquefaction risk at existing bridges. Procedures to assess liquefaction risk are presented in flowchart form, progressing from simple to more complex methods. A number of remediation methods are considered, including grouting compaction, vibro systems, surcharge and buttress fills, reinforcement and containment, vertical drains and underpinning. Relevant information is summarized from some numerical and laboratory (shaking table and centrifuge tests) studies conducted by other researchers on the performance of liquefaction remediation.

Recent Events...

October 1, 1999 - December 31, 1999

October 3-5, 1999

MCEER-NCREE Workshop on the 921 Taiwan Earthquake Taipei, Taiwan

October 15, 1999

NYCEM Program Meeting New York, New York

October 16, 1999

Earth Science Awareness Day Hamburg, New York

October 25-26, 1999

EERI/NSF Workshop on Research Needs Emerging from Recent Earthquakes San Francisco, California

October 29-30, 1999

MCEER Annual Investigators Meeting Buffalo, New York

November 6-9, 1999

NSF ERC Annual Conference Washington, D.C.

November 17-18, 1999

ERC Industry Liaison Officers Meeting Buffalo, New York

December 2-3, 1999

TEA-21 Highway Seismic Research Council Meeting Buffalo, New York

December 6-7, 1999

ERC Administrative Directors Meeting Buffalo, New York