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Seismic Retrofit of End-Sway Frames of Steel Deck-Truss Bridges with a Supplemental Tendon System: Experimental and Analytical Investigation

by G. Pekcan, J.B. Mander and S.S. Chen, 7/1/00, MCEER-00-0004, 182 pages, $30.00

This study investigates an alternative seismic retrofit approach that can be employed in the main sway frames of steel deck-truss bridges. The approach provides various modified bracing configurations that include supplemental damping systems. The effectiveness of the retrofit configurations is demonstrated experimentally and analytically on the shaking table at the University at Buffalo. The tested configurations include pairs of tendon elements in two directions in the plane of sway-frames with/without supplemental systems. The supplemental system consisted of mechanical fuse-bars and/or elastomeric spring dampers. Experimental results are compared to analytical results using an enhanced version of the nonlinear time history analysis program Drain-2DX.

Sliding Fragility of Unrestrained Equipment in Critical Facilities

by W.H. Chong and T.T. Soong, 7/5/00, MCEER-00-0005, 140 pages, $25.00

The objective of this research is to develop fragility information and rehabilitation strategies for nonstructural components in critical facilities. A discrete system model, an analytical model for two-dimensional sliding under two-dimensional excitation, is developed and analyzed for specific base motions. Shaking table testing with a range of excitations and system parameters is used to define stability bounds for pure sliding motion. A comparison of the analytical and experimental results is then performed to further verify the validity of the analytical model. Future improvements and discrepancies in the model assumptions are also discussed in this report.

Seismic Response of Reinforced Concrete Bridge Pier Walls in the Weak Direction

by N. Abo-Shadi, M. Saiidi and D. Sanders, 7/17/00, MCEER-00-0006, 348 pages, $35.00

The research presented in this report consists of an experimental and an analytical study. The experimental study focused on the evaluation of out of plane seismic behavior of representative bridge pier walls that exist throughout the U.S. Seven pier wall specimens were tested, and failure was due to either compression of concrete or fracture of vertical reinforcing bars.

In the analytical study, a model to determine the seismic response of bridge pier walls was developed and calibrated. The model showed good agreement with the experimental results. A parametric study was conducted to extend the seismic response study to bridge pier wall cases that were not tested experimentally using the computer program "PIER." Based on the results of this study, a practical approach to relate the confinement reinforcement in the plastic hinge zones of bridge pier walls to the displacement ductility capacity was developed.

Low-Cycle Fatigue Behavior of Longitudinal Reinforcement in Reinforced Concrete Bridge Columns

by J. Brown and S.K. Kunnath, 7/23/00, MCEER-00-0007, 126 pages, $25.00

The overall objective of this highway project task was to develop a performance-based approach to the seismic design, retrofit and repair of reinforced concrete bridge columns, which is intended to supplement the current AASHTO design procedure. This report focuses on Phase 2 of the project, which involved using data obtained in Phase 1 to evaluate and calibrate existing analytical damage models for reinforced concrete columns, derive improved damage models, and develop methods of using these models in practical design applications. This report describes an experimental set up for low-cycle fatigue testing of reinforcing bars, and provides an analysis of the experimental results. The study indicates that proposed fatigue-life relationships can be used in conjunction with Miner's linear damage accumulation law to identify ductile fracture and failure of reinforcing bars subjected to random strain histories resulting from seismic loading.

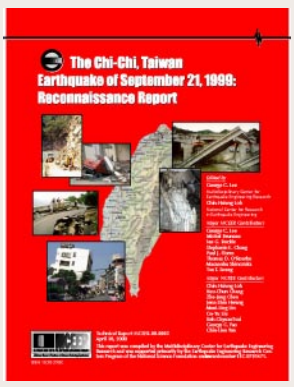
Soil Structure Interaction of Bridges for Seismic Analysis

by I. PoLam and H. Law, 9/25/00, MCEER-00-0008, 134 pages, $25.00

This report documents the current state-of-practice in soil-structure interaction analysis, and synthesizes the latest approaches for analyzing large pile groups for bridge design. Issues such as ground motion aspects for seismic design and soil-structure interaction for typical foundations are discussed. The substructuring technique and applications of kinematic soil-structure interaction in bridge engineering, and an alternate substructuring method based on inertia interaction are described. Much of the material is based on experience gained during the seismic retrofit and new design programs for major toll bridges in California.

The Chi-Chi, Taiwan Earthquake of September 21, 1999: Reconnaissance Report

Edited by G.C. Lee and C.H. Loh, with MCEER Contributors: M. Bruneau, I.G. Buckle, S.E. Chang, P.J. Flores, G.C. Lee, T.D. O'Rourke, M. Shinozuka, T.T. Soong; NCREE Contributors: K-C. Chang, A-J. Chen, J-S. Hwang, M-L. Lin, G-Y. Liu, C-H. Loh, K-C. Tsai, G.C. Yao and C-L. Yen, 4/30/00, MCEER-00-0003, 176 pages, $30.00



In the early morning hours of September 21, 1999, a devastating earthquake struck the central region of Taiwan. Shortly after the earthquake occurred, MCEER arranged to visit the devastated area through the National Center for Research on Earthquake Engineering (NCREE), located at the National Taiwan University in Taipei, Taiwan. NCREE hosted a workshop for MCEER researchers and others to identify short-term strategies/actions for post-earthquake restoration and research needs. MCEER researchers were paired with NCREE researchers with similar specialties, and the joint reconnaissance teams examined the earthquake's impact on critical facilities, buildings, bridges and electric power systems, as well as geotechnical issues, potential applications of remote sensing, economic impacts, emergency response and short-term restorations, and human and institutional perspectives. Their initial observations and impressions are presented in this report.

More comprehensive studies have since been carried out, most notably by members of the NCREE team. The resulting reports, together with other available materials about the earthquake, are included in a selected bibliography section. Additional information is also available from the MCEER web site at: *http://mceer.buffalo.edu/research/taiwaneq9_99/default.asp*. The observations and conclusionsherein form a springboard for future collaborative research efforts between MCEER, NCREE and other colleagues, in our common goal to create earthquake resilient communities throughout the world.