Early in the morning on Tuesday, August 17, 1999, a magnitude 7.4 earthquake struck along the Anatolian fault in the northwestern region of Turkey. Epicentered approximately 11 km southeast of the industrial city of Izmit (Kocaeli), the earthquake lasted 45 seconds and was felt over thousands of square miles in Turkey’s most densely populated region. Commercial and residential buildings from Adapazari to Istanbul collapsed resulting in a large-scale loss of life. Within days, MCEER dispatched four researchers to the region — several as part of the Earthquake Engineering Research Institute (EERI) reconnaissance team — to examine the earthquake’s impacts. The team included: Michel Bruneau, Deputy Director of MCEER and Professor, Department of Civil, Structural and Environmental Engineering, University at Buffalo, who focused on building damage; John Mander, Associate Professor, Department of Civil, Structural and Environmental Engineering, University at Buffalo, who focused on damage to highways; William Mitchell, Professor of Political Science and Director of Middle East Studies, Baylor University, who focused on social, political and emergency response; and Charles Scawthorn, Senior Vice President, EQE International, who provided a preliminary report describing the overall event, with a focus on lifelines and fire following earthquake. In addition, a University at Buffalo civil engineering graduate student, Natali Sigaher, was visiting family in Istanbul when the earthquake occurred. She joined the team and provided an account of the hours and days immediately following the earthquake.

A number of briefings on the earthquake are planned in the coming weeks. The first was held September 10 at the University at Buffalo primarily for students in the Department of Civil, Structural and Environmental Engineering, to begin the department’s seminar series for 1999-2000. The speakers were Apostolos Papageorgiou, Professor of Engineering Seismology, Natali Sigaher, Michel Bruneau and John Mander. Additional dates and locations will be posted on MCEER’s web site (http://mceer.buffalo.edu).

The initial observations and impressions of the team are presented in MCEER Response, a 12-page special report, which is available via the web site. The web site also features a 28-page preliminary report of the earthquake by Charles Scawthorn, EQE International, as well as numerous photographs of the area taken by the reconnaissance team. Links to other sites containing information about the earthquake are provided, in particular, EQNet at http://www.eqnet.org, EERI’s site at http://www.eeri.org and EQE International’s site at http://www.eqe.com.

Additional post-earthquake reconnaissance trips by other investigators are planned in the coming weeks. A more detailed reconnaissance report will also be developed for publication later this year.
The Kocaeli (Izmit) Earthquake

These photographs were provided by MCEER reconnaissance team members Michel Bruneau, John Mander, William Mitchell, Charles Scawthorn and Natali Sigaher (see page 1 for more detailed information).

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Considering the magnitude of the fault rupture, damage to engineered structures on the highway system was slight. These photos show damage to sections of the E80 motorway near Adapazari.

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Much of the damage to reinforced concrete buildings was not surprising, nor unexpected. Engineered structures that had been built according to modern codes survived, while many non-engineered structures collapsed, causing large scale loss of life.

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Surface faulting was common near Golcuk (above); the fault rupture is visible next to this damaged manufacturing facility, under construction at the time of the earthquake.

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Many donations were sent to the affected areas, but there was no organized distribution effort (top). Aftershocks caused many people to camp outside (middle) and drinking water was obtained primarily via tanker trucks or bottled water (below).
Work Begins on Seismic Vulnerability of the National Highway System Project

After a long delay necessitated by required administrative activities, MCEER has finally started work on the first year’s research under the FHWA-sponsored project “Seismic Vulnerability of the National Highway System.” This 6-year, $10.8 million project was initiated by the Transportation Equity Act for the 21st Century, which was signed into law in July 1998. The overall objective of the project is to extend the work that is currently nearing completion on the design and retrofitting of standard highway construction in the U.S., and to conduct a series of special tasks related to highway bridge design, non-destructive evaluation, and transportation system performance.

Specific tasks included in this first year’s effort include:

- a review of the Seismic Risk Assessment (SRA) methodology and software prepared under the companion FHWA-sponsored Project 106, and its calibration and testing (Tasks B1-1 and B1-2);
- development of strawman manuals for the seismic design and retrofitting of long-span bridges (Task C1-1) and for the design and retrofit of bridges with earthquake protective systems (Task D3-1);
- research to quantify the effects of long-period ground motions and spatial variation on long-span bridges (Task C2-1);
- geotechnical studies on the design and performance of large pile groups, lateral foundation displacements due to liquefaction, and ground remediation for silty soils using stone columns (Tasks C2-2, E1-2, and E2-1);
- research on the behavior of steel truss bridge braced pier and substructure connections (Task C3-1);
- assessments and extensions for seismic isolation technologies including the development of “intelligent” isolation bearings (Tasks D1-1, D2-1, and D2-2);
- the review of potential technologies for the post-earthquake non-destructive assessment of retrofitted bridge components (Task F1-1); and
- the design and acquisition of hardware for the seismic instrumentation of the Cape Girardeau cable-stayed bridge (Tasks F2-1 and F2-2) (see article on page 4).

An independent advisory committee (the Highway Seismic Research Council) has been appointed to help guide the research being conducted under the project and to assist in the integration of these activities with and outreach to other Federal and state agencies, and practicing engineering groups, involved in earthquake mitigation activities. It is anticipated that the first meeting of this Council will be held in mid-November of this year.

Additional information on this project will be posted on MCEER’s web site.

The Nantou, Taiwan Earthquake

At 1:47am on September 21, 1999, an earthquake with a magnitude of 7.6 rocked Taiwan. This earthquake, following on the heels of the devastating Turkey earthquake only a month earlier, was epicentered in Nantou. The death toll has risen above 2,000, over 4,000 are injured and at least 100,000 are homeless. MCEER is currently organizing a reconnaissance effort. For more information, visit MCEER’s web site at http://mceer.buffalo.edu.

MCEER Hosts NSF Site Visit Team

On July 27-28, 1999, MCEER hosted a site visit team organized by the NSF’s Division of Engineering Education and Centers. The team was assembled to review MCEER’s second year activities and provide an analysis of the overall quality of MCEER’s program. The team was coordinated by Dr. Joy Pauschke, program director, division of engineering education and centers, National Science Foundation.

The site visit team heard presentations from MCEER management and investigators during the two-day review.

The meeting consisted of presentations by MCEER management and investigators, who provided an overview of our strategic plan for research and education, and discussed research thrust areas. Speakers were George Lee, M. Shinozuka, Thomas O’Rourke, Michel Bruneau, Kathleen Tierney, Ronald Eguchi, Andrei Reinhorn and Andrea Dargush.

Student poster presentations were displayed as part of the NSF site visit.

Following the presentations, site visit team members met with MCEER’s students and discussed their projects during a poster session (see photo). The team also met with and heard presentations by representatives from MCEER’s industry/user partners.
Applicants Sought for U.S./China Research Exchange Program

U.S. researchers in the fields of earthquake studies, earthquake engineering and earthquake hazard mitigation are invited to apply for participation in the U.S./PRC Research Exchange Program in Earthquake Studies. The program, designed to further cooperative research in earthquake hazard mitigation between the United States and People’s Republic of China (PRC), is jointly sponsored by NSF in the U.S. and the Ministry of Construction in the PRC. It is being coordinated by MCEER. Applications are now being accepted for placement during the 1999-2000 fiscal year.

The program enables selected U.S. researchers to visit host institutions in the People’s Republic of China for both short-term (1-2 weeks) and long-term intervals (3, 6 or 12 months). Successful applicants will engage in cooperative research activities as outlined in Annex III to the US/PRC Protocol for Scientific and Technical Cooperative Research in Earthquake Studies, Earthquake Engineering and Hazards Mitigation. Exchanges are expected to begin as early as January 2000. Deadline for application is November 1, 1999.

For an application and information packet, either visit MCEER’s website at http://mceer.buffalo.edu or contact Andrea Dargush via phone at (716) 645-3391 ext. 106; fax (716) 645-3399; or email: dargush@acsu.buffalo.edu.

MCEER to Design Seismic Instrumentation System for Cable-Stayed Bridge

Under the FHWA-sponsored Highway Project, MCEER is designing a seismic instrumentation system for the cable-stayed bridge currently under construction across the Mississippi River in Cape Girardeau, Missouri. The Bill E. Emerson Memorial Bridge will be comprised of a main cable-stay span crossing the Mississippi River shipping channel that is 1,120 feet long; it also includes 11 approach spans of conventional bridge construction on the Illinois side of the river. Total bridge length is 3,956 feet. The Missouri side of the bridge will have abutment and tower foundations anchored in bedrock, while on the Illinois side, the foundations will be constructed in relatively deep soft soils.

The bridge is in the New Madrid Seismic Zone, and will be subject to regular strong ground motion events. As a result, a high level of seismic design has been included for the structure. It is for this reason that the Missouri Department of Transportation and the Federal Highway Administration highly support this project which is expected to provide a significant amount of bridge structural response data. It is currently believed that this may be the only cable-stayed bridge instrumentation project in the U.S.

The instrumentation scheme will include (a) free-field equipment in the vicinity of the bridge, which will allow the assessment of spatial variation of input ground motions at the piers of this long structure; (b) accelerometers and displacement transducers in the foundations of the main towers and cable-stayed abutment; and (c) accelerometers and displacement transducers on the main towers and along the deck for both the cable-stayed and approach spans. Additional hardware will be included to measure wind-induced structural response data.

MCEER has subcontracted with the US Geological Survey to design the instrumentation plan and, upon approval, acquire the hardware for the system. Dr. Nicholas Jones of Johns Hopkins University will assist in reviewing and approving the instrumentation plan. Project stakeholders include the States of Missouri and Illinois, the FHWA, MCEER, USGS, and the bridge designer, HNTB Corporation.

Two project meetings have been held to date, the most recent of which was on August 4, 1999, in Cape Girardeau, Missouri. It is anticipated that the system design will be complete by the end of November, and the bridge will be completed and open to traffic in early 2003.
Research Progress and Accomplishments: 1997-1999

Research Progress and Accomplishments highlights selected MCEER research efforts and provides those in the earthquake engineering community with a glimpse of the foci and direction of MCEER’s programs. This work presents twelve different research projects. Some describe efforts that have been completed and are now represented in codes, standards and regional or national guidelines, while others describe work in progress.

Each paper, whether it be on developing loss estimation techniques, construction of a benchmark model for repetitive testing, or the vulnerability analysis of the Los Angeles Department of Water and Power’s vast network, provides a snapshot of how MCEER accomplishes its multidisciplinary and team-oriented research. The authors identify the sponsors of the research, collaborative partners, related research tasks within MCEER’s various programs, and links to research and implementation efforts outside MCEER’s program.

Papers are:

- A New Application for Remotely Sensed Data: Construction of Building Inventories Using Synthetic Aperture Radar Technology by R. Eguchi, B. Houshmand, C. Huyck, M. Shinozuka and D. Tralli
- Improving Earthquake Loss Estimation: Review, Assessment and Extension of Loss Estimation Methodologies by K. Tierney, S. Chang, R. Eguchi, A. Rose and M. Shinozuka
- Benchmark Models for Experimental Calibration of Seismic Fragility of Buildings by A. Reinhorn, M. Constantinou and D. Kusumastuti
- Development of a Semi-Active Structural Control System by G. Lee, Z. Liang and M. Tong
- GIS Characterization of the Los Angeles Water Supply, Earthquake Effects and Pipeline Damage by T. O’Rourke, S. Toprak and S-S. Jeon
- Axial Behavior Characteristics of Pipe Joints Under Static Loading by E. Maragakis, R. Siddharthan and R. Meis
- Seismic Performance Analysis of Electric Power Systems by M. Shinozuka and S-T. Mau
- National Representation of Seismic Hazard and Ground Motion for Highway Facilities by M. Power, S-J. Chiou and R. Mayes
- Updating Assessment Procedures and Developing a Screening Guide for liquefaction by T. Youd
- Fragility Curve Development for Assessing the Seismic Vulnerability of Highway Bridges by J. Mander
- Changes in the New AASHTO Guide Specifications for Seismic Isolation Design by M. Constantinou
- Seismic Retrofitting Manuals for Highway Systems by I. Friedland and I. Buckle

The full-color report is available on our website in PDF format at http://mceer.buffalo.edu. A limited number of black and white copies are available by contacting MCEER publications.

Mitigation of Seismic Effects on Transportation Structures Workshop Review

The MCEER Highway Project co-sponsored the International Workshop on Mitigation of Seismic Effects on Transportation Structures, which was held in Taipei, Taiwan, on July 12 – 14, 1999. The workshop, which was attended by practicing transportation engineers and bridge and earthquake engineering researchers from Taiwan, the U.S., and Japan, provided a forum for identifying and comparing problems, exchanging ideas on recent and future developments, promoting international cooperative research, and formulating action plans associated with the mitigation of seismic effects on transportation structures. The technical program covered a broad range of topics regarding the seismic performance criteria, design, evaluation, and retrofitting of highway and railway foundations, structures, and systems.

The workshop was hosted by the National Center for Research on Earthquake Engineering (NCREE), under the lead of Dr. Chin-Hsiung Loh. Organizers for the U.S. and Japanese delegations were Dr. Joseph Penzien and Dr. Kazuhiko Kawashima, respectively. U.S. participants included MCEER affiliates Norman Abrahamson, Ian Friedland, I. M. Idriss, Roy Imbsen, George Lee, Stephen Mahin, James Roberts, Frieder Seible, and Wen Tseng. Proceedings of the workshop are available from NCREE by contacting Dr. J-F Chai at chai@email.ncree.gov.tw or via fax at 886-2-2732-2223.

Any comments or suggestions concerning the Bulletin are welcome! To do so, write the Editor at jestoyle@acsu.buffalo.edu.
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

Seismic Hazard, Exposure, Bridge Performance, and Structural Importance


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


Structural Analysis, Design and Response


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


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

Any comments or suggestions concerning the Bulletin are welcome! To do so, write the Editor at jestoyle@acsu.buffalo.edu.
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.

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

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


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


Foundations and Soil–Structure Interaction

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


Liquefaction and Soil Behavior


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

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

* Indicates unpublished reports.

Kudos (cont)

Maria Feng, MCEER investigator and an associate professor in the department of civil and environmental engineering at the University of California, Irvine, has won the prestigious 1999 Walter L. Huber Civil Engineering Research prize from ASCE. The award is for “innovative, interdisciplinary and practical research on sensing, monitoring and controlling dynamic response of civil engineering systems subjected to earthquake and wind loads.”

Jane Stoyle, MCEER Publications Manager, and William Johnson, MCEER Business Manager, were recently recognized by University Services, University at Buffalo, for their efforts to produce MCEER technical reports using digital technology through Print and Mail Services. University Services recognizes employees who have completed projects that have improved the quality of service by increasing “efficiency or productivity; saving the university time or money; reducing bureaucracy; meeting a specific customer need; and/or improving staff morale, cooperation, and understanding.”

NOTICE

Due to space limitations, the MCEER Bulletin cannot include requests to publish announcements from other organizations. Announcements can be included on our web site and/or in the MCEER Information Service News.
Response of Buried Pipelines Subject to Earthquake Effects

by M.J. O’Rourke and X. Liu

The earthquake safety of buried pipelines has attracted a great deal of attention in recent years. These pipeline systems are commonly used to transport water, sewage, oil, natural gas and other materials. They are often referred to as “lifelines” since they carry materials essential to the support of life and maintenance of property.

Important characteristics of buried pipelines are that they generally cover large areas and are subject to a variety of geotectonic hazards. They can be damaged either by permanent movements of ground (i.e., PGD) or by transient seismic wave propagation. Permanent ground movements include surface faulting, lateral spreading due to liquefaction, and landsliding. Although PGD hazards are usually limited to small regions within the pipeline network, their potential for damage is very high. On the other hand, wave propagation hazards typically affect the whole pipeline network, but the rate of damage is lower (i.e., lower pipe breaks and leaks per unit length of pipe).

This monograph reviews the behavior of buried pipeline components subject to permanent ground deformation and wave propagation hazards, as well as existing methods to quantify the response. The review focuses on simplified procedures which can be directly used in the seismic analysis and design of buried pipeline components. Where alternate approaches for analysis or design are available, results from the different procedures are compared. Finally, the authors attempt to benchmark the usefulness and relative accuracy of various approaches through comparison with available case histories. Chapters include:

- Review of seismic hazards and the performance of buried pipelines in past earthquakes
- Description of the various forms of permanent ground deformation (PGD) and procedures to quantify and model the amount and spatial extent of PGD
- Review of seismic wave propagation and procedures for estimating ground strain and curvature due to travelling wave effects
- Failure modes and criteria for buried pipelines
- Commonly used techniques to model soil-pipe interaction
- Response of continuous pipelines subject to longitudinal and transverse PGD

Order Information

The monograph is $25. To order, contact MCEER Publications at (716) 645-3391 ext. 4 or visit the web site at http://mceer.buffalo.edu. ✦

Partnership Creates HAZUS Listserve Discussion List

MCEER, in partnership with the Northwest States Emergency Consortium (NESEC) and the Federal Emergency Management Agency (FEMA), established a listserve to offer a forum for discussion of issues related to the use and application of the NIBS/FEMA loss estimation software, HAZUS. To join the list, send the following command to listserv@listserv.buffalo.edu via email as the first line in the body of the mail message: sub HAZUSNET-USA-LIST [your name]. Be sure to leave the subject line blank. The listserve discussion will be regularly archived and periodically moderated for content. ✦
Center (DRC), USGS, NOAA, IBHS, and many more. EQNET currently includes over 200 links to EqIP member sites, plus many additional links.

EQNET is continually developing. New features of the site include a comprehensive calendar of national and international earthquake-related meetings, conferences, and short courses. By using the online form provided, members of the earthquake community can easily submit new meetings and courses to the calendar. In addition, links to current sources of information about the catastrophic earthquakes in Izmit (Kocaeli), Turkey on August 17, 1999 and in Taiwan on September 20, 1999 were added to EQNET within days of these events.

The webmaster for EQNET for the 1999-2000 year is Ms. Yi Chen Wang, a graduate assistant in the National Center for Geographic Information and Analysis (NCGIA) at the University at Buffalo. Ms. Chen has been hard at work assigning descriptors that will permit more efficient searching of EQNET. She has also submitted EQNET information to numerous large search engines to enhance EQNET retrieval.

For additional information about EQNET, contact Dorothy Tao at the MCEER Information Service (email: singtao@acsu.buffalo.edu). Comments, submissions, and suggestions are welcome. For additional information about EqIP, contact Jill Andrews of SCEC, Chair, EqIP Steering Committee, via e-mail: jandrews@terra.usc.edu.

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, author and keywords, and to place orders for these reports. Visit the site at http://mceer.buffalo.edu/publications/default.html.

Proceedings of the U.S.-Italy Workshop on Seismic Protective Systems for Bridges
Edited by I.M. Friedland and M.C. Constantinou, 11/3/98, MCEER-98-0015, 474 pages, $35.00

Over forty participants attended the two day U.S.-Italy Workshop on Seismic Protective Systems for Bridges at Columbia University, New York City, New York. This workshop, held on April 27-28, 1998, was organized by MCEER and sponsored by the MCEER Highway Project, through the U.S. Federal Highway Administration, and the National Group for Defense Against Earthquakes, of the Italian National Research Council. The proceedings consist of 25 papers and focus on research and application of seismic protective systems for bridges, and the practice of bridge seismic isolation and energy dissipation within both the U.S. and Italy. The following themes are addressed:

- active control systems applications
- use of other advanced technologies for improving seismic performance of bridges
- development of bridge fragility curves applicable to performance of bridges with protective systems
- comparison of design philosophies and practices in both the U.S. and Italy
- discussion of standards currently in use by the U.S. and Italy.

Modeling of Pile Footings and Drilled Shafts for Seismic Design
I. Po Lam, M. Kapuskar and D. Chaudhuri, 12/21/98, MCEER-98-0018, 156 pages, $30.00

This report reviews, assesses and provides recommendations concerning design guidelines for pile footings and drilled shafts. For both types of foundations, a two-step process was developed and various parameters that affect predicted foundation response are identified. The implications of the foundation modeling process in estimating structural response are described. The research examined the applicability of conventional p-y formulations in modeling soil-pile behavior, and assessed modifications to account for cyclic loading conditions, pile group effects, and soil-pile interaction behavior in liquefied soil. For both types of foundations, the report attempts to integrate the structural and geotechnical engineering points of view.
Seismic Evaluation of a Masonry Infilled Reinforced Concrete Frame by Pseudodynamic Testing
S.G. Buonopane and R.N. White, 2/16/99, MCEER-99-0001, 160 pages, $30.00
This report presents the results from a seismic evaluation of masonry infilled frames performed by pseudodynamic testing. The test specimen was a two-story, two-bay half-scale model, which was subjected to four pseudodynamic tests of increasing magnitude. The experimental program provided detailed data on the behavior of frames and infills under realistic seismic loading conditions. The data can be used to calibrate and verify advanced finite element methods and to improve simple analytical models for evaluation and design.

Response History Analysis of Structures with Seismic Isolation and Energy Dissipation Systems: Verification Examples for Program SAP2000
J. Scheller and M.C. Constantinou, 2/22/99, MCEER-99-0002, 128 pages, $25.00
SAP2000 is the latest version in the popular SAP series of commercial structural analysis programs. It was released in 1997 and can be used for the dynamic analysis of structures with seismic isolation and energy dissipation systems. In this report, five examples are used to verify the results obtained by SAP2000. Three of the examples involved seismically isolated structures: an 8-story building isolated with bearings, a liquid storage tank isolated with a friction pendulum isolation system, and a 7-story building model isolated with a friction pendulum system. Results from the 3D-BASIS analysis program and experimental testing were compared to the SAP2000 analysis, and produced excellent agreement. The other two examples involved structures with energy dissipation devices: a 3-story building model with linear and nonlinear viscous fluid dampers, and a model with a toggle brace-damper energy dissipation system. Results from the ANSYS analysis program and experimental testing were compared to the SAP2000 analysis, where most results were in good agreement. However, SAP2000 under-predicted the displacement response of the structure tested with nonlinear viscous dampers.

The input files for the programs used, the history of the seismic excitation and the experimental results are located in the Publications section of MCEER’s web site at http://mceer.buffalo.edu/publications/default.htm

Experimental Study of Bridge Elastomeric and Other Isolation and Energy Dissipation Systems with Emphasis on Uplift Prevention and High Velocity Near-Source Seismic Excitation
A. Kasalanati and M.C. Constantinou, 2/26/99, MCEER-99-0004, 238 pages, $35.00
This report provides an assessment of the benefits offered by damping systems in near-source earthquakes and of the accuracy of currently available tools for analytical prediction of their seismic response. A two-span continuous deck bridge configuration was used in the test program. First, an isolator testing machine was designed and constructed that was capable of testing small bearings under controlled conditions. Next, three vastly different bearings (flat sliding, friction pendulum and elastomeric) were tested prestressed in the testing machine. Test results provided strong evidence for the capability of prestressing to prevent uplift or tension in isolation bearings. Finally, an experimental study of bridge elastomeric isolation systems with emphasis on near-source high velocity seismic excitation was performed. The addition of the damping devices caused a substantial reduction in displacement, provided relief to the vulnerable pier, caused a reduction in the total shear force transmitted to the bridge substructure, and provided for redistribution of the reduced inertia forces from the vulnerable pier to the presumed strong abutments.

The experimental results for the prestressed isolators, non-isolated configurations, and bridge model isolated with low damping elastomeric bearings, high damping elastomeric bearings, low damping elastomeric bearings with linear viscous dampers, and low damping elastomeric bearings combined with nonlinear viscous dampers are provided in the publications section of MCEER’s web site at http://mceer.buffalo.edu/publications/default.html

Any comments or suggestions concerning the Bulletin are welcome! To do so, write the Editor at jestoyle@acsu.buffalo.edu.
Truss Modeling of Reinforced Concrete Shear-Flexure Behavior

This report describes the development of a comprehensive theory for analyzing the inelastic shear force versus shear deformation behavior of columns. To achieve this, two concrete shear truss mechanisms (constant angle truss and variable angle truss) are investigated and as a result, new truss models based on numerical integration schemes are suggested and analyzed. These models will enable structural engineers to quantitatively as well as qualitatively understand the flow of forces at any instance of column deformation. They are suitable for hand (design office) analysis. However, more sophisticated truss models can easily be incorporated with comprehensive computational modeling-based techniques (such as DRAIN-2DX).

Experimental Investigation and Computational Modeling of Seismic Response of a 1:4 Scale Model Steel Structure with a Load Balancing Supplemental Damping System
G. Pekcan, J.B. Mander and S.S. Chen, 4/2/99, MCEER-99-0006, 216 pages, $35.00

This report describes the development of a novel idea for placement of damping systems in structures to reduce their vibrations and eliminate damage even in the case of high velocity pulses expected near a fault. The work presents a detailed study of the new concept supported by rigorous nonlinear analytical modeling and simulations and moreover, supported by a consistent experimental study of scaled models tested on the shaking table. The study discusses the advantages of the proposed system and the remaining challenges to be resolved in the future, thus providing a base for further expansion of knowledge. The solution suggested in this study helps to advance the engineering knowledge of innovative structural applications.

Impact Assessment of Selected MCEER Highway Project Research on the Seismic Design of Highway Structures

This report presents an independent assessment of the results obtained from each of the studies conducted under the four-year MCEER research project on the “Seismic Vulnerability of New Highway Construction” (Project 112). It also provides an assessment of the potential impact of these results on future seismic design specifications for highway structures. This effort was conducted over an 18-month period as the final task of the project (see related article on page 7). The Applied Technology Council reviewed 32 MCEER final research and technical reports to develop recommendations regarding future bridge seismic design guidelines. The results of the research impact assessment and specification recommendations are documented in this report. A previously published report (NCEER-97-0002) reviewed and assessed current domestic and foreign seismic design criteria for new highway construction.