

Raising Earthquake Awareness in the Eastern United States



■ *George C. Lee*

On January 17, 2001, a minor earthquake occurred in New York City. Although small, the event served as a warning that earthquakes can and do happen in the northeast. On the same date in 1995, Kobe, Japan experienced a 7.2 (JMA) magnitude event that left over 5,500 dead in a nation that expects frequent earthquakes, and had taken steps to mitigate their impact on the population. However, the Kobe event was much stronger than previously thought for that part of Japan. The year before, again on the same date, California experienced the magnitude 6.7 Northridge earthquake. Californians expect strong and frequent events of this type. Although the earthquake claimed over 50 lives, the area was relatively well prepared for this type of event, and was able to recover quickly.

In the eastern U.S., infrequent moderate earthquakes can and do occur. What would the consequences be if a magnitude 6 or greater event were to happen in the New York City area? A dramatization of such an earthquake aired on the Discovery Channel this past February. The overwhelming majority of citizens interviewed expressed surprise that a significant earthquake could occur in New York City. They were primarily unconcerned – to them, many other social and/or safety problems are more important than mitigation of earthquake risk.

MCEER's research and education programs have been concerned with both types of earthquake conditions: frequent and strong earthquakes, and infrequent, moderate earthquakes (that may have significant consequences). For example, our research on retrofitting hospitals for post-earthquake functionality is built around a two-pronged approach. In California, major health care facilities are mandated by law to be retrofitted in the next few years. Research is focused on determining the most reliable and cost-effective methods to use to retrofit these facilities. In the central and eastern U.S. (we have chosen New York City as our focal point), in addition to the engineering aspect, we also must convince hospital administrators, legislators and the public at large that the threat of a moderate earthquake and its ensuing consequences is an important issue and should be addressed. These stakeholders must first be willing to say that retrofitting/preparation for infrequent moderate earthquakes is in fact beneficial, and then allocate resources to mitigate the potential damage.

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Three MCEER Core Institutions Receive NEES Awards

Three of MCEER's core experimental facilities received substantial awards from NSF's George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES) program. The University at Buffalo received two awards totaling \$10.5 million, one to substantially upgrade its shake table research equipment, and the second to establish a large-scale laboratory experimentation equipment site. The University of Nevada, Reno will update its shake table research equipment with a \$4.4 million award, and Rensselaer Polytechnic Institute will upgrade its centrifuge research equipment with a \$2.38 million award. As of February 4, 2001, 10 institutions had received equipment awards totaling \$45 million under the NEES program.

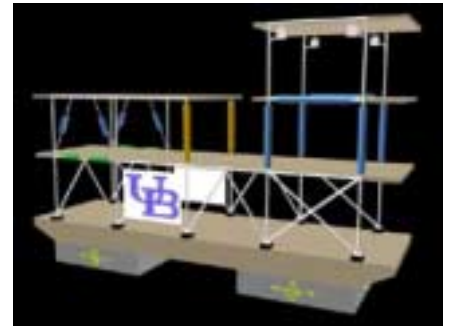
The George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) Program is a project funded under the NSF Major Research Equipment Program. The grants awarded stipulate that the equipment be operational by September 30, 2004 or earlier and that each facility be managed as a national shared-use NEES equipment site, with tele-observation and tele-operation capabilities, to provide new earthquake engineering research testing capabilities through 2014. New capabilities made possible by the equipment will be integrated into the research programs and undergraduate and graduate curriculums of the institutions, provide training opportunities for outside researchers through on site courses, host visiting scholars, and develop a web-based tele-operation simulator of the NEES equipment. More information about the NEES program is available from <http://www.eng.nsf.gov/nees>.

A summary of each of the awards follows.

University at Buffalo

The University at Buffalo's Department of Civil, Structural and Environmental Engineering has been awarded two grants: one for \$4.38 million to construct a large-scale, high-performance testing facility and one for \$6.16 million to construct a versatile, high-performance shake table and to upgrade the existing shake table. An additional \$6 million in New York state support brings the total investment to \$16.5 million. The new facility will allow for unprecedented research by incorporating the new capabilities in simulation, computing, and networking as integral parts of earthquake engineering experimental testing. This versatility is achieved through:

- A high-performance set of two shake tables that each have full six degree-of-freedom capabilities, including one that can be rapidly repositioned from immediately adjacent to the other table up to as much as 100 feet from it. Together, these tables can host specimens of up to 100 metric tons, as long as 120 feet, and subjected to fully in-phase or totally uncorrelated dynamic excitations.
- Large-scale high-performance actuators, with immediate capabilities for dynamic testing, pseudo-dynamic testing, and also, more importantly, providing the platform needed for the development of powerful new testing methodologies, such as the effective force control testing method that would make it possible to directly subject large structures to dynamic excitations without the need for shake tables.
- Substantial equipment required to operate the above two items, including high-capacity, high-performance hydraulic supply and distribution system, and miscellaneous electronic control systems.



■ *Conceptual drawing of the versatile high-performance shake table facility at UB*

This modular and highly flexible earthquake engineering experimental facility allows for multiple configurations of full-scale component tests combined simultaneously with real-time numerical simulations to investigate the seismic behavior of large structural systems in ways not possible until now.

The Principal Investigators are Michel Bruneau, Andrei Reinhorn, Michael Constantinou, Eddy Rojas and S. Thevanayagam, all of the Department of Civil, Structural and Environmental Engineering at the University at Buffalo. More details on the proposals and personnel are available at <http://civil.eng.buffalo.edu/sees/>.

University of Nevada, Reno

The University of Nevada, Reno (UNR) Civil Engineering Department was awarded \$4.4 million to upgrade the James E. Rogers and Louis Weiner Jr. Large Scale Structures Laboratory's two 14-foot square, 50-ton shake tables from uniaxial motion to biaxial motion and to purchase a third biaxial table of the same size and capacity. Additional funding from the Department of Energy (\$1 million) and the Department of Housing and Urban Development (\$1.6 million) brings the total investment to \$7 million. The new facility will be used for large-scale geotechnical and long, linear structural and lifeline earthquake engineering experi-

mentation. The following equipment is included under this award:

- One new, relocatable, 4.3 x 4.5 m, 445 kN payload, ± 1 g, ± 300 mm displacement (longitudinal and lateral) shake table.
- Upgrades to two existing, relocatable, 445 kN shake tables from uniaxial to biaxial (longitudinal and lateral) capability, to be identical to the new table.
- New hydraulic distribution lines.
- Upgraded hydraulic power supply, by adding a third pump (720 lpm).

This facility enables next generation experiments to be conducted, such as



■ *Rogers and Weiner Bridge Structures Laboratory at the University of Nevada, Reno*

studies of spatial variation in earthquake ground motion on critical extended-in-plan lifeline systems, the biaxial response of long structural systems and their components, and the behavior of very large-scale systems that are either physically too large for existing, single-table facilities, or too heavy, or both. Together the three tables can host specimens up to 1.35 MN in total weight, with the tables separated up to a maximum of 36 m centerline-to-centerline.

The Principal Investigators are Ian G. Buckle, M. Saiid Saiidi, E. Manos Maragakis, David Sanders and Ahmad Itani, all of the Civil Engineering Department, University of Nevada, Reno.

Rensselaer Polytechnic Institute

At RPI, the NEES award will be used to upgrade the existing 100 g-ton geotechnical centrifuge. The centrifuge was commissioned in 1989 and physical model simulations of soil and soil-structure systems subjected to in-flight earthquake shaking began in 1991. The research has been conducted with two existing one-dimensional in-flight shakers, which can accommodate 90 kg and 400 kg payloads, respectively. The next-generation earthquake engineering capability for the RPI centrifuge includes:

- One 2D in flight shaker (two prototype horizontal components) and associated 2D laminar box container to allow more realistic 2D modeling.
- One four degree-of-freedom robot, robot tools, and associated software, capable of performing in-flight operations such as construction and excavation, pile driving, ground remediation, cone penetration, and static and cyclic loading tests without stopping the centrifuge.
- Development of a new generation of advanced and improved sensors capable of providing a better resolution of the measured model response.
- Other equipment aimed at increasing the capability of the centrifuge to test a greater number and wider variety of earthquake engineering models.

Especially important is the future use of dense arrays of advanced sensors and of high-speed cameras to provide high resolution measured model response. In conjunction with the networked data acquisition system with remote access capability, this will allow for a quantum jump in the use of the data at RPI and throughout NEES. In addition, the equipment will allow for tele-operation/control over the Internet, which at the beginning will focus on the use of the robot by remote observers.

The upgraded centrifuge will provide capabilities to investigate three impor-



■ *RPI's 100 g ton geotechnical centrifuge*

tant problems in earthquake engineering: lateral spreading and flow failure due to soil liquefaction, soil-structure interaction and foundation response due to liquefaction and lateral spreading, and the seismic behavior of innovative slope stabilization systems.

The Principal Investigators are Ricardo Dobry, Tarek Abdoun, Mourad Zeghal and Thomas Zimmie from RPI and Ahmed Elgamal from the University of California, San Diego. More information can be found at <http://www.ce.rpi.edu/centrifuge/> and http://www.rpi.edu/web/Campus.News/mar01/mar_5/home.html#1. ♦

Raising Earthquake Awareness in the Eastern US (cont'd from p.1)

Throughout MCEER/NCEER's history, we have taken many steps to heighten awareness in the U.S. east of the Rocky Mountains to the earthquake hazard. Most notably, we participated in the effort to add seismic provisions to the New York City building code (began in 1987 and signed into law in 1995). Staff and researchers have given in-depth interviews to representatives from national and international media, including National Public Radio, the Discovery Channel in the U.S., Canada and Great Britain, especially following major earthquakes. We actively participate in committees to recommend standards and codes. We will continue these endeavors and will work with others to create earthquake resilient communities throughout the world in regions of high seismicity and where less frequent, but no less severe events can occur. ♦

—George C. Lee, Director

HSRC Meets to Review Seismic Retrofitting Manual

On February 16-17, 2001, MCEER conducted what was anticipated as the final meeting of its Highway Seismic Research Council (HSRC), the advisory group for Project 106, "Seismic Vulnerability of Existing Highway Construction," sponsored by the Federal Highway Administration (FHWA). The meeting, which was held in Las Vegas, Nevada, focused on a review of the draft *Seismic Retrofitting Manual for Highway Structures: Highway Bridges*.



■ *Certificates of appreciation were presented to the HSRC members during dinner Friday evening by George Lee and Ian Buckle. Arun Shirole is shown (left) after receiving his certificate from George Lee.*

The highway bridge retrofitting manual is the first of a two-volume set being developed by MCEER that is intended for publication by the U. S. Department of Transportation's Federal Highway Administration. The manual provides guidance on seismic vulnerability screening, prioritization, detailed evaluation, and design of retrofitting measures for highway bridges throughout the United States. The second volume contains similar seismic vulnerability analyses and retrofitting recommendations for other highway system components, including retaining structures, tunnels, slopes and embankments, culverts, and pavement. These retrofitting manuals are the culmination of a comprehensive research program

conducted under MCEER's Highway Project.

At the beginning of the meeting, MCEER Director George C. Lee welcomed the Council on behalf of MCEER, and thanked them for their commitment in guiding the research program over the past eight years. Dr. Lee also recognized the contributions of Michael Higgins as MCEER's Senior Program Officer providing project administration over the past year.

John O'Fallon, senior bridge research engineer and program manager for the FHWA project, thanked the Council on behalf of FHWA. He reminded the Council that the retrofitting manual under discussion was an important update of an earlier bridge retrofitting manual that had also been prepared by MCEER under this project and which had been published by FHWA in 1995. Publication of the new manual is expected to greatly improve the knowledge base for practitioners in bridge earthquake engineering.

Early drafts of the bridge retrofit manual had been previously sent to the Council, as well as to a select group of researchers, practicing bridge engineers, and State and Federal government engineers. The comments and concerns from these reviews were, for the most part, reflected in the version being discussed during the meeting.

Over the course of the one-and-one-half day meeting, the key elements contained in each chapter of the manual were presented by the chapter author(s) and, for most chapters, lively and useful discussions ensued. Chapter presenters included Ian G. Buckle, Maurice Power, John Mander, Geoffrey Martin, Richard Nutt and Ian Friedland.

Following the presentation and discussion sessions, the Council met in executive session to discuss the content and technical approaches contained in the manual, and to identify its perceived strengths and weaknesses. Recommendations from the Council were presented



■ *Ian Buckle (left) presented Joseph Nicoletti (right) with his certificate of appreciation during Saturday's session of the meeting.*

to the authors on Saturday, and the Council's written recommendations will be submitted to MCEER and the FHWA in the next few weeks.

One conclusion from the meeting was that the Council would like to have at least one more meeting in order to assess the final version of the bridge retrofitting manual. A determination as to whether or not the Council will meet again will be made by MCEER in conjunction with the FHWA, and is largely dependent on manual preparation timing and project funding.

The Council comprises two groups: the Coordination Group, chaired by Arun Shirole since 1995 (Joanne Nigg was the previous chair), and the Technical Group, chaired by Joseph Nicoletti since the first meeting of the Council in March of 1993. ♦

ASCE Seminar Features MCEER Investigator & Partners



MCEER investigator Michael Constantinou and several Center partners served as lecturers at *Infrastructure for Earthquakes — Seismic Retrofit of Structures*, March 19-22 in New York City. The American Society of Civil Engineers (ASCE) Metropolitan Section Infrastructure Group sponsored the program. It was held in cooperation with the ASCE student chapter and Department of Civil & Environmental Engineering at Polytechnic University.

Professor Constantinou opened the program with "An Introduction to Seismic Isolation and Seismic Energy Dissipation." He is among the world's leading authorities on the subject. A long-time

MCEER researcher, he is also professor and chair of the Department of Civil, Structural and Environmental Engineering at the University at Buffalo.

A number of members of the Center's Strategic Partnerships Network also presented papers. All are members of the Network's Specialty Interest Group on Structural Control Technologies. They include:

- Victor Zayas, Earthquake Protection Systems, Inc. (EPS), (<http://www.earthquakeprotection.com/>), "Seismic Isolation Retrofit of Bridges, Buildings and Industrial Structures."
- Roy A. Imbsen, Imbsen & Associates, Inc., (<http://www.imbsen.com/>), "Seismic Retrofit of the I-40 Bridge &

Approaches Across the Mississippi River at Memphis, Tennessee."

- Amamath Kasalanati, Dynamic Isolation Systems, Inc., (<http://www.dsi-inc.com/>), "JFK Air Rail System - Seismic Engineering Aspects."
- Emmanuel E. Velivasakis, LZA Technology, a division of Thornton-Tomasetti Group, Inc. (<http://www.thettgroup.com/index.php4>), "Seismic Upgrade of the New Terminal at the Ataturk International Airport, Istanbul, Turkey."

For more information on MCEER's Strategic Partnerships Network, contact Donald J. Goralski via email: goralski@acsu.buffalo.edu, or visit the "Partnerships" section of our web site at <http://mceer.buffalo.edu/partnerships>. ❖

EQNET Features Resources on Recent Earthquakes

In response to the recent significant earthquakes in Seattle, El Salvador, and Gujarat, India, the EQNET webmaster has compiled a list of the major informative and authoritative web links on these earthquakes. Links pertaining to the Nisqually (Seattle) earthquake of February 28, 2001 feature a wide variety of preliminary news reports and releases, as well as preliminary reconnaissance and technical reports, such as the *EERI Special Earthquake Report*, the Nisqually Earthquake Information Clearing House web site at the University of Washington, a 3D VRML (Virtual Reality Modeling Language) visualization of the Seattle earthquake by the University of Illinois, and many others from earthquake engineering centers, as well as from major news agencies in the U.S. and worldwide.

Of special interest are Seattle photographs of damaged buildings and transportation facilities in the quake's



Andrea J. Wright, The Seattle Times



AP Photo/Saurabh Das

- *These photographs are among those included in the EQNET Photo Gallery for Recent Significant Earthquakes. The photograph on the left shows the damaged Starbucks building in Seattle. The photo on the right shows residents of Bhuj, India after the January 2001 quake.*

aftermath that are contained in the *EQNET Photo Gallery for Recent Significant Earthquakes, 1999-2001*, part of the EQNET Archives. In addition to photographs for Seattle, the Gallery provides a list of resources for reconnaissance and aerial photos of significant earthquakes since 1999, including India, El Salvador, Turkey and Taiwan.

To obtain a current and authoritative overview of recent significant earthquakes, you may wish to bookmark or link to EQNET at <http://www.eqnet.org>. For comments or questions, please visit the EQNET web site, or contact Ms. Yi Chen Wang, EQNET webmaster, e-mail: ycwang@acsu.buffalo.edu. ❖

New Seminar Series at the University at Buffalo

The EERI student chapter of the University at Buffalo (UB-EERI), the MCEER Student Leadership Council, the Networking Program of MCEER, and the University at Buffalo's Department of Civil, Structural and Environmental Engineering joined forces to sponsor a new series of seminars beginning in the spring 2001 semester. The purpose of the seminars is to widen accessibility to timely, technical presentations by MCEER students, researchers, visitors and affiliates. The seminars are broadcast over the Internet in real-time, and can be viewed anytime through <http://civil.eng.buffalo.edu/webcast/>. UB's Professor Andrei Reinhorn and undergraduate student Jason Hanley, from Computer Science and Engineering, arranged the webcast.

Seismic Evaluation and Retrofit of Water Supply Lifelines

Thomas D. O'Rourke, Thomas R. Briggs Professor of Engineering, School of Civil and Environmental Engineering, Cornell University

Prominent MCEER researcher Professor Thomas O'Rourke gave a seminar entitled *Seismic Evaluation and Retrofit of Water Supply Lifelines*, at the University at Buffalo on January 26, 2001.

After an introduction by Dr. Michel Bruneau of MCEER and UB, Professor O'Rourke presented the salient features of the MCEER research program focused on the seismic evaluation and retrofit of the water supply lifelines. The presentation started with implications of the performance of Los Angeles Department Water and Power (LADWP) and Metropolitan Water District (MWD) water supply systems during the Northridge earthquake of January 17, 1994.

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■ Professor Thomas D. O'Rourke's seminar addressed the seismic evaluation and retrofit of water supply lifelines. Shown from left are Michael Gaus, Thomas D. O'Rourke, Michel Bruneau and Michael Constantinou.

Mitigation: A Framework for Analysis

William J. Petak, Professor, School of Policy Planning and Development, University of Southern California

Dr. William J. Petak, Professor at the School of Policy Planning and Development, University of Southern California and prominent MCEER researcher, gave a seminar entitled *Mitigation: A Framework for Analysis*, at the University at Buffalo on February 13, 2001.

Dr. Michel Bruneau of MCEER and UB introduced Professor Petak, who began the presentation with three fundamental questions:

- Are risks from the earthquake hazard public problems or private problems?



■ Professor William Petak presented a framework for understanding the complex process behind hazard mitigation policy and decision-making.

(Continued on page 9)

A Simple Method for the Design of Optimal Damper Configurations in MDOF Structures

Diego Lopez Garcia, Ph.D. candidate, Department of Civil, Structural and Environmental Engineering, University at Buffalo

The winner of EERI's 2001 annual student paper competition, Mr. Diego Lopez Garcia, Ph.D. candidate, Department of Civil, Structural and Environmental Engineering, University at Buffalo, gave a seminar entitled *A Simple Method for the Design of Optimal Damper Configurations in MDOF Structures*, at the University at Buffalo on February 23, 2001.

Mr. Lopez Garcia presented his award-winning research work following an introduction by Benedikt Halldorsson, UB-EERI student chapter president. The presentation started with a brief introduction to various damper systems, followed by an explanation of the factors that make a design method of optimal damper configuration simple, practical, and efficient. The proposed "Simplified Sequential Search Algorithm" was presented, which was designed to meet requirements for a design method that was simple, practical, efficient and easily integrated into conventional design procedures used by

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O'Rourke Seminar

(Continued from page 8)

His presentation featured advanced uses of GIS, and explained how the distribution pipeline network could be a regional sensing system to evaluate seismic hazards. The presentation also addressed a new application of fiber-reinforced composites to strengthen the welded slip joints of critical water trunk lines. This strengthening method was developed because many compressive failures of the welded slip joints had been found during the Northridge earthquake.

After the presentation, UB-EERI student chapter President Benedikt Halldorsson led the discussion session. Questions were asked from the audience, all related to the strengthening method for water trunk lines.

In addition, the seminar was webcasted through the Internet, enabling viewers from around the world to watch the presentation. ❖

—Submitted by Yasuo Kitane

Petak Seminar (Continued from page 8)

- When does a problem change from a private problem to a public problem?
- What are public sector and private sector responsibilities for reducing risk of loss?

Over the course of addressing these issues, the presentation showed the importance of involvement by the various stakeholders in shaping effective earthquake hazard mitigation policy from the formulation stage through implementation. A brief discus-

Lopez Garcia Seminar (Continued from page 8)

practicing engineers. Through a comparison study, it was shown that the efficiency of damper configurations given by the proposed algorithm is comparable to the efficiency of damper configurations given by more sophisticated procedures in the case of linear viscous dampers. A brief discussion session followed, initiated by questions

from various faculty and students in attendance, many from the departments of Civil, Structural, and Environmental Engineering, Planning and Geography at UB.

In addition, the seminar was broadcast successfully over the Internet, as was the previous seminar. The presentation by Dr. Petak was recorded and has been made accessible through <http://civil.eng.buffalo.edu/webcast/>. ❖

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—Submitted by Yasuo Kitane

MCEER Offers Short Course for Teachers at Expanded Annual Teacher Seminar

Professional development opportunities help precollege teachers to improve teaching approaches and make them aware of new materials and technologies which can be used in the classroom. Experiences in research environments are especially useful. However, statistics indicate that these opportunities may be limited, costly or ill-timed. MCEER has expanded its *Annual Teacher Seminar* to offer a four-day short course for middle and high school level teachers, focusing on earthquake studies and how they can be translated into meaningful classroom activities as part of stan-

dard curricula in the sciences, mathematics and technology.

MCEER researchers, students and staff will join together to provide tutorials on earthquakes, earthquake engineering, and socio-economic impacts, followed by in-depth exposure to ongoing MCEER research projects. Teachers will then work with researchers, staff and students to research, develop and test materials and methods which can be used to integrate earthquake research lessons into the classroom.

Social events throughout the week will allow teachers to network with

each other and with MCEER mentors, and to enjoy pleasant western New York summer activities.

The inquiry-based program will be held at the University at Buffalo campus August 1 – 5, 2001. Participants from across the U.S. and Canada are encouraged to participate. A limited number of travel stipends of \$1,000 will be available to those traveling more than 500 miles. For additional information, contact Andrea Dargush at MCEER, dargush@acsu.buffalo.edu. Complete program information will be made available on the MCEER website. ❖

MCEER Holds Second Workshop on Mitigating Earthquake Disasters Through Advanced Technologies

The second in a new series of MCEER/NSF sponsored workshops involving advanced technologies was held November 30-December 1, 2000 in Las Vegas, Nevada. The *Mitigation of Earthquake Disaster by Advanced Technologies (MEDAT-2)* workshop focused on the application of advanced technologies (nondestructive inspection, health monitoring advanced materials, innovative devices, etc.) for the seismic evaluation and retrofit of health care facilities.

Co-chairs Michel Bruneau of MCEER and Daniel Inman of Virginia Polytechnic Institute and State University welcomed about 35 engineers, architects, and researchers from various fields of advanced technology. Discussion sessions centered on mitigation techniques for soil liquefaction, structural damage and nonstructural damage that could be used for the seismic retrofit of hospitals.

The first session was on soil liquefaction. Ricardo Dobry, RPI and Juan Baez, Hayward Baker, Inc. provided a general overview of the earthquake engineering issues, followed by seven presentations by both MCEER researchers and other practitioners on the use of advanced technologies. James Mitchell, VPI, summarized the state-of-the-art in various advanced technologies that could be applied to earthquake engineering problems.

Michel Bruneau, MCEER and the University at Buffalo (UB), provided an overview of earthquake engineering issues for the MCEER hospital project in the second session. The session followed the same format as the first, and nine presentations were given on materials and damage monitoring. Another nine presentations focused on damping and semi-active systems. Larry Soong, UB, gave a state-of-the-art report on these systems, and Andrew Whittaker, UB,

addressed the state-of-the-practice on passive seismic control of building structures. Jayanth Kudva, Northrop Grumman, Corp., gave a general overview of advanced technology issues.

Mircea Grigoriu, Cornell University, introduced the third session, which focused on advanced technologies for nonstructural retrofit. Eight example presentations were given, and Daniel Inman, VPI, provided an overview of the advanced technology issues.

Presentations made at the workshop are available on our web site at http://mceer.buffalo.edu/publications/sp_pubsl/medat2/default.asp. Proceedings are currently being compiled, and will be available this summer. Extensive materials from the first MEDAT workshop are also on our web site at http://mceer.buffalo.edu/publications/sp_pubsl/medat1/default.asp. ❖

Recent Events...

November 1, 2000 – April 30, 2001

November 2-4, 2000

Annual Investigators/Student Leadership Council Meetings
Buffalo, New York

November 5-6, 2000

NSF Engineering Research Centers (ERC) Annual Meeting
Washington, D.C.

November 6-12, 2000

China-US Millennium Symposium on Earthquake Engineering
Beijing, China

November 8, 2000

NYCEM Meeting
New York, New York

November 11-14, 2000

Project Impact Summit
Washington, D.C.

November 29 - December 1, 2000

Mitigation of Earthquake Disaster by Advanced Technologies: MEDAT-2 Workshop
Las Vegas, Nevada

January 26-27, 2001

Executive Committee Meeting
Buffalo, New York

January 26, 2001

Seminar by Thomas D. O'Rourke
Seismic Evaluation and Retrofit of Water Supply Lifelines
Buffalo, New York

February 12, 2001

Research Committee Meeting
Buffalo, New York

February 13, 2001

Seminar by Dr. William Petak
Mitigation: A Framework for Analysis
Buffalo, New York

February 15-17, 2001

MCEER Highway Seismic Research Council Meeting
Las Vegas, Nevada

February 23, 2001

Seminar by Diego Lopez Garcia
A Simple Method for the Design of Optimal Damper Configurations in MDOF Structures
Buffalo, New York

March 12, 2001

Workshop on Barriers to Implementation of Earthquake Hazard Mitigation Policies
San Francisco, California

April 6, 2001

Seminar by Dominic Kelly
Design Philosophy in Regions of Low-to-Moderate Seismicity
Buffalo, New York

April 18, 2001

Joint Meeting of Scientific and Implementation Advisory Committees
Chicago, Illinois

Student Spotlight

Diego Lopez Garcia is a Ph.D. student and graduate research assistant in the Department of Civil, Structural and Environmental Engineering at the University at Buffalo. His research activities include earthquake-induced pounding in buildings and bridges (Ph.D. dissertation, in progress), optimal location of passive energy dissipation devices, and seismic fragility of nonstructural components. His advisor is MCEER researcher Dr. T.T. Soong, Samuel P. Capen Professor of Engineering Science. The YPF Foundation (Buenos Aires, Argentina) sponsors Diego's graduate studies through a "Jose A. Estensoro" fellowship.

Diego became interested in earthquake engineering because he grew up in a seismically active place, and was introduced to the subject in his undergraduate studies. According to Diego, he "grew up in San Juan, Argentina, a city that was completely destroyed by a 7.40 magnitude earthquake in 1944. Another 7.40 magnitude earthquake occurred in 1977, but by this time, most of the city was already rebuilt according to earthquake-resistant codes, hence damage and casualties were not significant. Nevertheless, I was 10 years old and I still have a strong memory of that earthquake."

When asked about his undergraduate studies, Diego said, "I did my undergraduate program at the Universidad Nacional de San Juan (San Juan, Argentina) and the Civil Engineering program included a couple of courses about earthquake engineering. I performed as a teaching assistant in one of these courses and I also participated as a research assistant in a project related to earthquake engineering." The Buenos Aires Stock Exchange Foundation financially supported Diego's undergraduate studies.

When not involved in his research work, Diego enjoys spending time with his wife and young son. He was once a formal member of the San Juan Symphony Orchestra, where he played clarinet. He received a fellowship from the Antorchas Foundation in Buenos Aires to study clarinet at the Orchestra Academy of the Berlin Philharmonic in Germany in 1987-88. Although he does not play professionally anymore, he says "classical music is still my main non-academic, non-professional interest."

Diego expects to graduate between December 2002 and May 2003. He hopes to get a faculty position at a major research university in the U.S. and devote himself to teaching and doing research. He received the 2001 EERI Graduate Student Paper Award (see page 11) and presented a well-attended seminar on the topic as part of a new series at the University at Buffalo (see page 6).❖



■ *Diego Lopez Garcia (left) is shown with fellow students Ali Rejaie, USC, and Selahattin Ersoy, New Jersey Institute of Technology.*

NYCEM/MCEER Help Discovery Channel Examine Earthquakes in New York City

On Monday, February 19, the Discovery Channel aired an episode of Sci-Trek titled, "An Earthquake in New York City?" The program examined the possibility of an earthquake in the Big Apple, and the vulnerabilities that exist there. A number of MCEER affiliates appeared in the broadcast, including Deputy Director Michel Bruneau and Assistant Director Andrea Dargush. Dr. Bruneau discussed the importance of preparedness of hospitals and other critical facilities following earthquakes and Ms. Dargush spoke about the broad inventory of structural types in the city, such as those examined by the FEMA-sponsored New York City area Consortium for Earthquake-loss Mitigation (NYCEM). Klaus Jacob, former NCEER executive committee member and senior research scientist at Lamont Doherty Earth Observatory, was featured throughout the broadcast. Guy Nordenson, Princeton University, discussed the evolution of the existing New York City seismic code, an effort with which MCEER (then NCEER) was extensively involved.❖

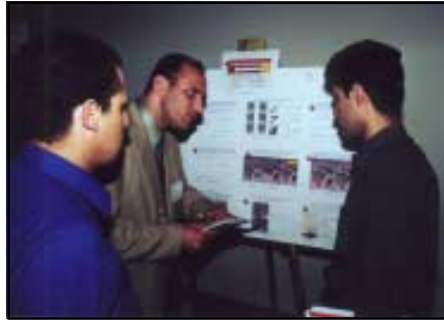


■ *Representatives from the Discovery Channel visited the Seismic Lab at UB during filming of "An Earthquake in New York City?"*

Student Leadership Council Activities

The MCEER Student Leadership Council (SLC) has been quite busy over the past several months on a number of fronts. First, we have been working hard to prepare for an SLC retreat. The concept of an annual retreat was conceived during the SLC sessions at the 2000 Principal Investigator's Meeting in November. The idea behind the retreat is to give SLC members an opportunity to gather together and present research to their peers in a low stress environment. The retreat would also provide an opportunity to further the professional development of its student members by bringing in a speaker to address an area that the membership of the SLC views as being particularly important. We currently have about fifteen members who have committed to attending the retreat, which has been scheduled for mid-August at The Pennsylvania State University.

Also this past November, three members of the SLC participated in NSF's Annual Meeting of Engineering Research Centers in Washington, D.C. Michael Kiley-Zufelt,



■ The EERI meeting provided students with the opportunity to meet leading professionals in earthquake hazard mitigation. Shown above is Ali Rejaie (center) of the University of California.

Ali Rejaie and Gauri Guha made poster presentations and participated in the ERC retreat.


During early February, several members of the SLC attended the EERI Annual Meeting in Monterey, California. The meeting provided an excellent chance for SLC members to attend sessions that featured some of the leading scholars and practitioners in the area of seismic miti-

gation and to hear from emergency managers and other front line personnel in the battle to establish disaster resilient communities. The meeting was a whirlwind of activity with meetings taking place in hallways and in conversation pits between scheduled sessions, after the official close of the day's work, and at some inhumanly early morning hours. And, students being students, your colleagues found time to slip out and enjoy a cloudy but beautiful hour watching the waves crash on the amazingly pristine rocky coast of the Monterey Bay.

During one of those early morning gatherings at the EERI Annual Meeting, the groundwork was laid for the upcoming NSF site visit to MCEER, which takes place June 6-8. The SLC will be putting together its own research accomplishments volume to present at the site visit. The volume will contain abstracts and summaries of the research done by SLC members during the past year. It will be available through MCEER's web site this summer. ❖

—Submitted by Michael Kiley-Zufelt

NSF/MCEER Offers Year 2001 Research Experiences for Undergraduates



Undergraduate students are invited to explore new directions in earthquake studies this summer through the NSF sponsored Research Experiences for Undergraduates (REU) Program. The program offers opportunities for undergraduate students to conduct individual research that contributes to ongoing programs at the three NSF-funded earthquake engineering research centers.

MCEER's REU Program enables undergraduate students to participate in Center research activities through

summer internships with MCEER researchers. All projects involve state-of-the-art studies to improve the disaster resiliency of communities, through application of advanced technological tools. REU opportunities are available in the following fields of study:

- Seismology
- Geotechnical Engineering
- Structural Engineering
- Risk Engineering
- Architecture & Urban Planning
- Structural Control
- Materials Science
- Sociology

- Economics
- Public Policy

MCEER-supported students will participate in a faculty-advised, graduate-student mentored research project. The activity will require participation in a team-based research effort, including a literature search, thesis development and results presentation.

For more information, contact Andrea Dargush, MCEER, e-mail: dargush@acsu.buffalo.edu, or check the web site at <http://mceer.buffalo.edu/education/reul/default.asp>. ❖

MCEER Welcomes New Committee Members



Three new members have been appointed to MCEER's Scientific Advisory Committee. They are Professor Ian G. Buckle, University of Nevada, Reno, Professor Andre Filiatrault, University of California, San Diego and Professor Dennis Mileti, Director, Natural Hazards Center, University of Colorado. The Scientific Advisory Committee provides input into the technical merits of MCEER's research program and its strategic plan. It is chaired by Professor Surendra P. Shah, Northwestern University.

The Implementation Advisory Committee (IAC), chaired by Dr. Jeremy Isenburg, Weidlinger Associates, welcomes Paul Armstrong, International Conference of Building Officials, and Maria Vorel, National Director, Project Impact, FEMA. The IAC assists MCEER in focusing its research to ensure that it meets the needs of potential end users.

A joint meeting of the Scientific and Implementation Advisory Committees is scheduled for April 18, 2001. ♦

The MCEER Bulletin address list experienced some serious problems that may have affected the mailing of the Fall 2000 issue. These problems have been resolved, but it is possible that recent requests to be added, removed or to update mailing list information may have been lost (i.e., those made between September and December 2000). If you did not receive the Fall 2000 issue, notice that your address is incorrect, or wish to be removed from the list, please send an email to Jane Stoye at jestoye@acsu.buffalo.edu. ♦

☆ **Diego Lopez Garcia**, a Ph.D. candidate in the Department of Civil, Structural and Environmental Engineering at the University at Buffalo under Professor T.T. Soong, was awarded the 2001 Earthquake Engineering Research Institute (EERI) Graduate Student Paper Award for his paper entitled, "A Simple Method for the Design of Optimal Damper Configurations in MDOF Structures." He received a travel award to present his paper at the *EERI Annual Meeting* in Monterey, California, February 7-10, 2001.

☆ **Patricia Grossi**, a recent Ph.D. graduate in Systems Engineering at the Wharton School, University of Pennsylvania, previously received the NEHRP Graduate Fellow in Earthquake Hazard Reduction, awarded by EERI under a cooperative program funded by FEMA. Howard Kunreuther and Paul Kleindorfer were her co-advisors, and her research focuses on the impact of uncertainty in risk assessments on policy.

☆ Two members of MCEER's Highway Seismic Research Council (HSRC) received prestigious awards from ASCE. **Joseph Penzien**, Senior Principal and Chairman of the Board of Directors of International Civil Engineers Construction, Inc., was awarded the Ernest E. Howard Award for his contributions to earthquake engineering and his public service in advancing seismic safety. **James E. Roberts**, Chief Deputy Director of the California Department of Transportation (Caltrans) has received the ASCE Charles Martin Duke Lifeline Earthquake Engineering Award. He was recognized for his technical prowess and public policy leadership in the seismic strengthening of bridges and his pioneering efforts in the earthquake-resistant design and retrofitting of highway transportation systems.



■ Former student Patricia Grossi and current doctoral candidate Diego Lopez Garcia received awards at EERI's annual meeting. From left are Chris Poland, Diego Lopez Garcia, Patricia Grossi and Michel Bruneau.

☆ **Sarah Billington**, Assistant Professor in the School of Civil and Environmental Engineering at Cornell University, has won the National Science Foundation's ARC Career Award. She was recognized for research investigating the ability of innovative materials based on polymeric fiber cement to make structures more resistant to seismic events. The award is administered by the Civil Engineering Research Foundation (CERF), and will be used, along with matching NSF funds, to further the research. Graduate and undergraduate students will be involved in future projects.

☆ Highway Project researcher Professor **M. Saïid Saïidi** was recently selected as the 2000 Outstanding Re-



searcher of the Year at the University of Nevada, Reno, from among 800 faculty members. He was recognized for his research on earthquake engineering of bridges. Dr. Saïidi has been directing a large number of research projects with funding from MCEER (through the FHWA-funded Highway Project and US-PRC Researcher Exchange Program), NSF, the California and Nevada departments of transportation, and private industry. He is an ACI fellow, EERI member (since 1981) and holds a professorship awarded by the UNR Foundation.

MCEER Seeks Senior Program Officer

MCEER is seeking a Senior Program Officer to provide day-to-day administrative and technical management of the Highway Project. Minimum qualifications required for the position include the following:

- Research program/project management experience, with an emphasis on bridge engineering;
- Excellent demonstrated verbal and written communication capabilities;
- BS in Civil Engineering or Structural Engineering;
- Knowledge of the operations of AASHTO and its committees, State Departments of Transportation and the Federal Highway Administration.

Additional qualifications strongly preferred include the following:

- Experience in or knowledge of earthquake engineering;
- MS or ME degree in Structural Engineering;
- Professional Engineering registration.

Candidates should submit a letter of interest and resume or curriculum vitae to: Ms. Connie Beroza, MCEER, University at Buffalo, 109 Red Jacket Quadrangle, Buffalo, NY 14261-0025; e-mail: apply@mceermail.buffalo.edu.

Suitable candidates will be invited to interview for the position beginning in early May 2001. ❖

Thanks for Your Interest in Our Web Site!



- Visit us online at <http://mceer.buffalo.edu>

During the past year, over 100,000 people have visited the MCEER web site, according to the counter on our home page. The counter provides the number of distinct visitors to the site, omitting visits from MCEER's own domain and reloads within the same browser session. Including these parameters, the site has over 1,000,000 hits per year. ❖

MCEER Staff News

MCEER welcomes Mr. **Gerald Meyers** as Business and Contracts Manager. Mr. Meyers will assume responsibility for coordinating the Center's business operations, including contracts, personnel, purchasing and other related business activities.

Mr. Meyers joins MCEER from the Mid Erie Health Services Corporation, a non-profit corporation where he was accounting/business manager for 19 years. He was responsible for all business functions, including accounting, budgeting, cost analysis, purchasing, financial reporting and human resources. He has also held positions as a Senior Cost Analyst, Corporate Risk Insurance Manager and Financial Consultant in various private sector environments. He is a member of the American Man-

agement Association and past member of the National Association of Insurance and Financial Advisors. Mr. Meyers holds a B.S. in Business Management/Accounting from the University at Buffalo.

Michelle Zuppa has joined MCEER publications as desktop publisher. Michelle brings strong skills in design of both print and web publications. She will be responsible for the layout of the *MCEER Bulletin*, *Research Progress & Accomplishments*, as well as many other projects. Prior to joining MCEER, she operated her own freelance graphic design and writing business, and served as communications coordinator for NOCO Express. She has a B.A. in English literature from Cornell University.

Michael Higgins, Senior Project Officer for Transportation Research, has left

MCEER to pursue other interests in the Washington, D.C. area. Ian M. Friedland, Associate Director for Development, Applied Technology Council, will oversee the MCEER Highway Project until a successor for Mr. Higgins is named. Mr. Friedland is former Assistant Director for Transportation Research at MCEER.

Dorothy Tao has stepped down as manager of the Information Service and has reduced her hours to three days a week. Andrea Dargush, MCEER Assistant Director for Education and Research Administration, will oversee Information Service activities.

Marsha Flett, Quakeline database coordinator, has left MCEER's Information Service to pursue other endeavors. ❖

The 921 Chi-Chi, Taiwan Earthquake of 1999 Collection on CD-ROM

The 921 Chi-Chi Taiwan Earthquake of 1999 Collection on CD-ROM contains an extensive photograph collection from the 921 Chi-Chi, Taiwan earthquake and the full-color, complete text of the reconnaissance report (technical report MCEER-00-0003). The reconnaissance effort took place October 3-5, 1999, about two weeks after the September 21, 1999 event. Over 450 high resolution images (300 dpi print-quality jpeg files) are included in an html file for viewing in any web browser. The images can be used in printed publications and presentations as long as the photographer and MCEER are credited.



■ The 921 Chi-Chi Taiwan Earthquake of 1999 Collection on CD-Rom features over 450 high resolution images and a full-color version of MCEER's reconnaissance report.

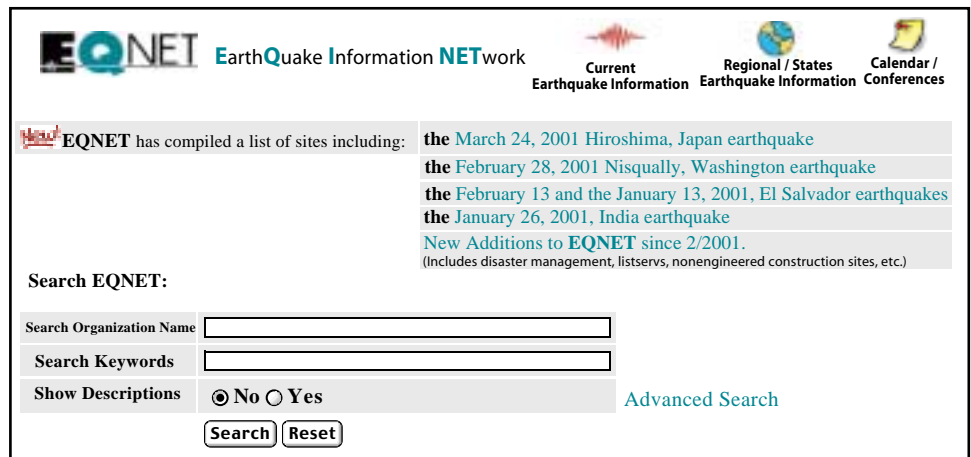
The reconnaissance report is in PDF format, and requires Adobe® Acrobat®™ Reader 4.05 to view. The "ReadMe" file contains detailed information on how to use the CD-ROM. The CD-ROM, publication number MCEER-00-SP03, is

available from MCEER Publications for \$50.00. To order, call (716) 645-3391, ext. 105, or check the publications section of our web site at <http://mceer.buffalo.edu/outreach/pr/taiwanCD.asp>. ❖

EQNET — Portal to Earthquake Information

Do you need quick access to earthquake images for a report due tomorrow? A quick database search for an important client proposal? All the latest news and images on the Seattle earthquake, or recent events in India, El Salvador, and Turkey? Visit the earthquake information portal, EQNET, at: <http://www.eqnet.org> for quick, efficient access to all of these resources.

In collaboration with the Earthquake Information Provider's Group (EqIP), the MCEER Information Service staff maintains and develops EQNET with the assistance of EQNET webmaster, Ms. Yi-Chen Wang, graduate student, Department of Geography, University at Buffalo. In 1995, at the suggestion of NSF, EqIP's members (MCEER, NISEE, NHRAIC, EERI, ATC, and others) recognized the need to integrate and select the most useful resources from the many and often confusing earthquake/disaster information sources on the Internet. Funded originally by NSF, and currently by FEMA, EQNET provides extensive categorized listings of the most useful web sources in Information Services, Databases, Seismic Maps and Codes, Disaster Management, Education, Earthquake Engineering, and Seismology. EQNET



■ The EQNET welcome screen features links to information on recent earthquakes.

also features quick links to current seismic events (with extended links for significant earthquakes), state and regional information, and an extensive calendar of conferences and continuing education opportunities. EQNET currently logs over 4,000 visits per month, and the number is growing.

A popular feature of EQNET is the **Archives** section, which stores web reconnaissance reports and images from recent significant earthquakes such as Turkey and Taiwan in one place. The **Archives** are updated continually with the latest web path information. This means that if you want to obtain a copy of a re-

port that is no longer at its original location, you may be able to retrieve it from the **Archives** at its new address.

Finally, we are pleased to announce that EQNET was selected as the site of the week by the Radio-Television News Director's Association and Foundation (RTNDA) for the week of March 5-12, 2001 (see <http://www.rtna.org>). Congratulations to Yi-Chen Wang for her outstanding effort and initiative. Please visit <http://www.eqnet.org> to view EQNET or to submit a site for inclusion. Comments are welcome and may be sent to Yi-Chen Wang, email: ycwang@acsu.buffalo.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 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.asp>.

A Risk-Based Methodology for Assessing the Seismic Performance of Highway Systems by S.D. Werner, C.E. Taylor, J.E. Moore, II, J.S. Walton and S. Cho, 12/31/00, MCEER-00-0014, 286 pages, \$35.00

Post-earthquake functionality strongly depends on the characteristics of the highway system in question, such as its configuration, the locations of the individual components within the overall system and within specific links and subsystems, and the locations, redundancy, and traffic capacities and volumes of the links between key origins and destinations within the system. Consideration of the importance of each component to the overall system performance can provide a much more rational basis for establishing seismic strengthening priorities, defining seismic design and strengthening criteria, effecting emergency lifeline route planning, estimating economic impacts due to component or system-wide damage, and can also provide real-time information on how to get emergency response resources to a given location following a damaging

event. The procedures contained in this report provide a basis for addressing the highway system seismic performance issues, and incorporate data and methodologies pertaining to engineering issues (structural, geotechnical, and traffic capacity), repair and reconstruction, system network and risk analysis, and socioeconomic considerations for impacts resulting from system damage. They also provide a mechanism to estimate system-wide direct losses and indirect losses due to reduced traffic flows and/or increased travel times.

Effect of Spatial Variation of Ground Motion on Highway Structures

by M. Shinozuka, V. Saxena and G. Deodatis, 12/31/00, MCEER-00-0013, 264 pages, \$35.00

In this report, a methodology was developed to generate spatially varying ground motion time histories along the length of a long, multi-span bridge at its supports. Spatial variability of seismic ground motion can be mainly attributed to the following three mechanisms: difference in arrival times of seismic waves at different locations, which is commonly known as the wave passage effect; loss of coherence of seismic waves due to multiple reflections and refractions as they propagate through the highly inhomogeneous soil medium, referred to as the incoherence effect; and change in the amplitude and frequency content of seismic ground motion due to different local soil conditions, known as the local soil effect. The methodology developed in this study to generate spatially varying seismic ground motion time histories at different locations reflects all three of these effects.

Representative highway bridges were analyzed using two cases of input ground motions at the bridge supports. In the first case, the input motions were identical at all supports; in the second case, different input motions were applied at each pier along the length of the bridge reflecting the wave passage effect, the incoherence effect,

and the local soils effect. This was done to assess the effect of spatial variability of ground motion when compared to the standard assumption currently used in practice of identical support ground motion. An extensive sensitivity analysis was carried out as a function of various parameters controlling the spatial variability of ground motions. Based on the results from these studies, two guidelines were proposed: one for the analysis and design of highway bridges that are less than approximately 1,000-to-1,500 feet long and have all supports on the same local soil conditions, and the second for bridges that are more than approximately 1,500 feet long or bridges of any length that have supports on different local soil conditions.

Experimental Evaluation of Seismic Performance of Bridge Restrainers

by A.G. Vlassis, E.M. Maragakis and M. Said Saiidi, 12/30/00, MCEER-00-0012, 160 pages, \$30.00

The experimental study described in this report investigates the impact between adjacent bridge spans at in-span hinges, evaluates the efficacy of restrainers in reducing relative displacement across the hinges and examines the effects of restrainer stiffness and gap on the response of the hinge-restrainer system. Experimental results indicated that impacts between the adjacent frames produce acceleration levels significantly higher than what is typically assumed in design. Restrainers were capable of reducing hinge relative displacements and preventing span unseating. However, restrainer yielding occurred under strong input motions, especially when the restrainer gap was set to zero. Only pounding at the hinge location was included in this study, while pounding elsewhere in the superstructure as well as the detailed response behavior of substructure elements were neglected.

Dynamic Soil-Foundation-Structure Interaction Analyses of Large Caissons

by C-Y. Chang, C-M. Mok, Z-L. Wang, R. Settigast, F. Waggoner, M.A. Ketchum, H.M. Gonnermann and C-C. Chin, 12/30/00, MCEER-00-0011, 108 pages, \$25.00

Large cellular reinforced concrete caissons exist as foundations of major long-span bridges across waterways in many parts of the country. The purpose of this study was to qualitatively assess the effects of various factors affecting the caisson response. Several equivalent linear and nonlinear analyses were performed for a typical caisson, idealized from the large caisson at Pier W3 of the west spans of the San Francisco-Oakland Bay Bridge. The results indicate that the effects of the superstructure on the response of the caisson were insignificant. The lateral earth pressure, base bearing pressure, and soil stresses computed by the equivalent linear analysis indicate the possibility of soil-foundation separation (gapping and uplift). The results of nonlinear analyses indicate that motions and stresses developed in the caisson are sensitive to the soil-caisson and rock-caisson interface properties.

Development and Evaluation of Simplified Procedures for Analysis and Design of Buildings with Passive Energy Dissipation Systems

by O.M. Ramirez, M.C. Constantinou, C.A. Kircher, A.S. Whittaker, M.W. Johnson, and J.D. Gomez, 12/8/00, MCEER-00-0010, 510 pages, \$40.00

This report presents the development and evaluation of simplified methods of analysis and design for buildings with passive energy dissipation systems. The work was conducted under the auspices of the Building Seismic Safety Council, Technical Subcommittee 12, Base Isolation and Energy Dissipation, for the year 2000 update of the *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*. Topics presented in the report include development of extended damping coefficients for modification of response spectra for damping in excess of 5% of critical; development of relationships between elastic and inelastic displacement of yielding systems with energy dissipating devices; a study of displacement ductility demand in yielding structures with viscous damping systems; development of equivalent lateral force and modal analysis procedures for buildings with damping systems; and validation studies of the developed analysis

procedures using 3- and 6-story structures with linear viscous, nonlinear viscous, solid viscoelastic and yielding damping systems.

Proceedings of the First MCEER Workshop on Mitigation of Earthquake Disaster by Advanced Technologies (MEDAT-1)

Edited by M. Shinozuka, D.J. Inman and T.D. O'Rourke, 11/10/00, MCEER-00-0009, 270 pages, \$35.00

Over 55 researchers from the U.S. and Japan participated in the first *Mitigation of Earthquake Disaster by Advanced Technologies (MEDAT-1)* workshop, held in Los Angeles on March 2-3, 2000. Participants explored the state-of-the-art field applications of non-destructive inspection and health monitoring technology including remote sensing techniques for the purpose of mitigating urban earthquake disasters. Innovative applications of technology either actually implemented or with a high potential for implementation in civil infrastructure systems were emphasized. The proceedings contain 15 papers and minutes from two discussion sessions. Summary information about this workshop is available from the publications section of MCEER's web site at http://mceer.buffalo.edu/publications/sp_pubs/medat1/default.asp.

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Upcoming Events

April 28 – May 1, 2002

Third National Seismic Conference and Workshop on Bridges and Highways: *Advances in Engineering Technology for the Seismic Safety of Bridges in the New Millennium* ■ Portland, Oregon

Sponsored by:

Federal Highway Administration ■ Oregon Department of Transportation
■ Washington State Department of Transportation

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■ Fax: (410) 309-7051 ■ E-mail: mike.higgins@soundprint.com

July 21 – 25, 2002

7th U.S. National Conference on Earthquake Engineering: *Urban Earthquake Hazard* ■ Park Plaza Hotel ■ Boston, Massachusetts

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Organizing Committee:

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Contact:

Andrea Dargush, MCEER ■ Phone: (716) 645-3391 ext. 106 ■ Fax: (716) 645-3399
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