Remote Sensing Institute Receives NOAA CSC Award to Develop Community Resilience Index

MCEER’s Remote Sensing Institute (RSI) has received a $270,000 award from the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center (CSC) to develop and implement an integrated Community Resilience Index (CRI) for communities in the U.S. portion of the Gulf of Mexico. Professor Christian Renuschler, from the Department of Geography at the University at Buffalo, is the Principal Investigator and led the proposal effort on behalf of MCEER and the RSI.

The study, to be conducted over the next two years, includes the development of approaches that quantify the resilience of physical, economic, socio-cultural, and ecological capital in a community. The goal is to develop:

- A conceptual framework for measuring, assessing and monitoring the CRI
- A quantifiable CRI toolkit that integrates quantitative and qualitative methods using spatial and non-spatial data to identify scientifically defensible indicators for community resilience
- An implementation plan that enables local and regional stakeholders to continuously monitor and enhance their resilience against episodic and slow-onset coastal hazards

A pilot study for two coastal communities in New Orleans, LA, and Galveston, TX, will be carried out to develop and test the CRI. The CRI will be designed so that every community along the Gulf of Mexico coastline will be able to assess and enhance their resilience against multiple coastal hazards.

For example, the maps show coastal communities and ecosystems...
Leading Experts Present Emerging Developments in Multi-Hazard Engineering at AEI-MCEER Symposium

Over 115 structural engineers, architects, faculty researchers, and students convened in New York City for the Symposium on Emerging Developments in Multi-Hazard Engineering, held September 18, 2007 at the McGraw-Hill Auditorium. The event was jointly organized by the Architectural Engineering Institute (AEI) of ASCE and MCEER. It also received generous sponsorship from the Steel Institute of New York.

The symposium was co-chaired by Mohammed Ettouney, Weidlinger Associates, Inc. and Past President of AEI, and Michel Bruneau, MCEER, University at Buffalo. It featured 13 presentations by nationally-recognized researchers and practitioners that highlighted recent advances in the emerging field of multi-hazard engineering. These included perspectives and solutions for protecting infrastructure from specific hazards, as well as the potential to adapt existing design measures for multi-hazard protection of the built environment. Other topics included:

- Lessons from 9/11 and Hurricane Katrina
- Analyzing Infrastructure Vulnerabilities to Multiple Hazards
- Risk Assessment of Infrastructure in a Multi-Hazard Environment
- Critical Issues in Achieving a Resilient Transportation Infrastructure
- Application of Multi-Hazard Theory to Bridge Design, Analysis, and Monitoring

One of the most important outcomes of the symposium was the clarification of what is meant by multi-hazard engineering. Most of the speakers provided insight into their own understanding, pointing to aspects that uniquely define this emerging field. The consensus was that the field is about simultaneously addressing all hazards as a problem of optimization under constraints, rather than studying infrastructure systems under several hazards acting simultaneously or addressing individual hazards sequentially.

The range of hazards considered includes natural hazards (e.g. earthquakes, floods, and windstorms), accidental hazards, and malevolent action. Concurrent hazard events and interdependent hazard events such as fire following an earthquake, flood following a hurricane, or tsunami following an earthquake are addressed as special cases of importance.

The motivation for such an approach is the need for a rational basis for decision-making which will make it possible to identify which risks should be mitigated first; select the best mitigation options; and define priorities in a context of limited resources.

The symposium opened with a presentation by G. Edward Gibson, Jr., 2007 AEI President, who championed AEI’s mission, which promotes a multidisciplinary approach and excellence in practice, education, research of architectural engineering.

Co-organizers Amar Chaker, AEI Director, and Michel Bruneau, MCEER Director, followed with presentations that emphasized the strong interests that their organizations have in multi-hazard engineering. Both outlined their strategies in this growing area, and gave an overview of the topics to be covered, as well as the challenges to be addressed in presentations to follow.

Other presenters were: Sreenivas Alampalli, New York State Department of Transportation; Bruce Ellingwood, Georgia Institute of Technology; Mircea Grigoriu, Cornell University; Anne Kiremedjian, Stanford University and Chair of ASCE’s Council on Disaster Risk Management; Paul Malikar, U.S. Army Research and Development Center; Vilas Mujumdar, National Science Foundation; Rae Zimmerman, New York University; Milagros Kar, U.S. Army Research and Development Center; Michel Bruneau, MCEER, University at Buffalo.

A lively panel discussion between three of the speakers (Ellingwood, Englot and Mujumdar) and the attendees concluded the event and provided the elements of a roadmap to tap the potential of multi-hazard engineering.

For more information, visit http://mceer.buffalo.edu/meetings/aei/default.asp.
UB President John B. Simpson welcomed the audience to the NCS Dedication.

On October 12, 2007, the University at Buffalo unveiled the Nonstructural Components Simulator (UB-NCS), a two-level platform for real-time experimental performance evaluation of nonstructural components and equipment.

The Dedication was the culmination of several years of research carried out by MCEER investigators at UB. Led by Andre Filiatrault, Gilberto Mosqueda and Andrei Reinhorn, the MCEER team developed testing protocols for the equipment, and designed the hospital room used for the Dedication’s demonstration tests. The testing protocol was described in detail at the morning’s Symposium on Seismic Regulations and Challenges for Protecting Building Equipment, Components & Operations (see review on page 4) by Rodrigo Retamales, Ph.D. candidate in the Department of Civil, Structural and Environmental Engineering (CSEE) at UB.

The UB-NCS enables engineers to examine the effects of earthquakes on architectural systems, building equipment and contents. It is the latest addition to the UB-NEES facility, located in UB’s CSEE Structural Engineering and Earthquake Simulation Laboratory (SEESL). The equipment acquisition was funded through the Network for Earthquake Engineering Simulation (NEES) program of the National Science Foundation with additional support for development from MCEER.

At the Dedication ceremony, introductory remarks were made by UB president John B. Simpson, and CSEE chair A. Scott Weber. They were followed by Andre Filiatrault, SEESL Director, who dedicated the NCS in memory of earthquake victims around the world. MCEER investigator and CSEE faculty member Gilberto Mosqueda next provided an overview of the NCS and an explanation of the two demonstration tests to be conducted during the Dedication.

The tests were conducted to determine the effects of two earthquake intensities on a full-scale composite hospital room containing various types of medical equipment. Nonstructural content typically found in an emergency room and other rooms in a hospital, such as steel stud partition walls, a suspended ceiling system, a sprinkler system with horizontal and vertical piping spanning between two stories, copper medical gas lines, a 180-lb. “patient” (actually a crash test dummy), four wall-mounted patient monitors and a surgical lamp were installed prior to the test.

The first demonstration subjected the mock hospital room to 100% of the force of a design earthquake, with peak drifts of .87%, and peak accelerations of .77g. Real-time video from several cameras positioned within the mock hospital room and above its ceiling, gave the more than 100 attendees and 200 remote web-cast observers a glimpse of the behavior of equipment and contents throughout the shaking.

After a brief examination of damage, the room was shaken for a second time—to an intensity corresponding to 150% of the design earthquake, or a maximum considered earthquake (MCE).

Two monitors fell during the first test—breaking off at their swivel mounts, while the mounts remained attached to the walls. Damage was
Symposium Aims to Educate Industry on Code Changes for Nonstructural Components

Nearly 100 participants from 18 states, Canada and Mexico, gathered at the University at Buffalo (UB) on October 12, 2007 for a Symposium on Seismic Regulations and Challenges for Protecting Building Equipment, Components & Operations. These included building equipment and isolation/restraint manufacturers, engineers, healthcare facilities managers, faculty researchers, students, and other related practitioners.

The symposium opened with a discussion of recent changes to building codes and regulations, which now require certified seismic installation of equipment and contents. Two speakers, Robert Bachman, a consulting structural engineer and immediate past chair, ASCE 7 Seismic Task Committee (2002 and 2005 cycles), and Christos Tokas, of the State of California Office of Statewide Health Planning and Development (OSHPD), opened with presentations on changes brought about by the 2003 and 2006 International Building Code (IBC) and California’s SB 1953 legislation for hospitals, as well as the January 2008 adoption of the 2006 IBC in California. These included descriptions of current code requirements and test protocols for nonstructural components, and requirements in California’s Hospital Seismic Retrofit Program, which is designed to ensure continuing operation of acute care facilities following an earthquake.

Session two involved presentations from a group of practitioners, and focused on implementation issues that they currently face, as well as how they are attempting to meet challenges posed by changing codes. Jim Carlson of the Omaha Public Power District and member of MCEER’s ASHRAE consortium explained how development of comprehensive codes, flexible implementation of code application by building officials (with enhanced training), proper installation by contractors, and qualification of equipment by manufacturers have been used by the nuclear industry and can be used by other industries to reduce earthquake risk. Jay Lewis of Terra Firm Earthquake Preparedness provided a business perspective, explaining the economic advantages of performance-based design to building owners, because loss of function is more costly than designing buildings that will function after earthquakes.

Scott Campbell of Kinetics Noise Control gave an overview of the harmonization of design parameters between structural and nonstructural components, emphasizing that limited nonstructural damage may produce loss of use of critical or expensive equipment. He was followed by Paul Hough of Armstrong World Industries who described the development of a protocol for testing and qualifying ceiling systems—which include light fixtures, sprinklers and other nonstructural components.

Seismic qualification and testing of equipment was the subject of the final session. Steve Eder of Facility Risk Consultants discussed seismic qualification of equipment by analysis methods, and explained an alternative, using earthquake experience data, as the Seismic Qualification Utility Group, or “SQUG” has developed for the past 20 years. Andre Filiatrault, UB, explained the testing equipment and protocols available to carry out qualification and seismic fragility testing of nonstructural components. Rodrigo Retamales, Ph.D. candidate from UB, described a novel testing protocol for experimental seismic qualification and fragility assessment of nonstructural components and systems using the nonstructural components simulator at UB.

The event was jointly sponsored by MCEER, the Department of Civil, Structural and Environmental Engineering, the Structural Engineering and Earthquake Simulation Laboratory, and the George E. Brown, Jr. Network for Earthquake Engineering Simulation. For more information, visit http://mceer.buffalo.edu/Nonstructural_Components/default.asp.

The Symposium was held in conjunction with the opening and dedication of a new nonstructural components simulator (see review on page 3).
Team Investigates Highway Damage following the Pisco, Peru Earthquake

On August 15, 2007, a $M_w$ 8.0 earthquake occurred off the coast of Peru. According to the USGS, the earthquake killed over 500 people and injured more than 1,000, destroying more than 35,500 buildings and damaging 4,200 more. Widespread communications and power outages occurred. The Pan-American Highway and other transportation routes suffered heavy damage due to landslides and faulting that resulted from liquefaction of sandy and silty soils near the Pacific Ocean.

On September 21-28, 2007, MCEER’s Jerome O’Connor, Senior Program Officer for Transportation Research, and ASCE field investigation team members Lucero Mesa, South Carolina Dept. of Transportation, and Monique Nykamp, Shannon & Wilson, Inc., visited the area to conduct a post-earthquake investigation of damage to the highway system. Upon arrival, the team was briefed on road damage by Professor Julio Kuroiwa, Professor Emeritus at Peru’s National University of Engineering and Scientific Advisor to Peru’s Civil Defense. Prof. Kuroiwa also shared much information on disaster reduction that appears in a comprehensive book that he has prepared for the United Nations. They then spent several days documenting damage that occurred to bridges, as well as embankments, pavements, culverts and retaining walls.

The post-earthquake investigation was conducted under MCEER’s Highway Project, which is funded by the Federal Highway Administration.

A reconnaissance report will be available from MCEER in the coming months. For more information, visit http://mceer.buffalo.edu/research/reconnaissance/peru8-15-07/default.asp.

Remote Sensing Institute

Continued from p.1

along the Gulf of Mexico in three parishes of southwestern Louisiana. During Hurricane Rita, the coastal wetland ecosystem in Vermilion and Cameron Parishes had an impact on the surge height caused by the hurricane, which in turn protected some of the infrastructure, industries, and residential areas further inland in Calcasieu Parish. The proposed CRI would help consider this type of interaction, as well as other landscape characteristics such as geomorphologic, ecological, physical, and socio-economic features that may influence the resilience of a coastal community.

Other members of this interdisciplinary project team include Michel Bruneau, MCEER, University at Buffalo, Ronald Eguchi and Beverley Adams, ImageCat, Inc., Stephanie Chang, University of British Columbia, John Pine, Louisiana State University’s Hurricane Center, and Scott Miles, Western Washington University.

George C. Lee Honored by White House

On November 16, 2007, George C. Lee was among 11 people to receive the 2006 Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring from President George W. Bush in a ceremony at the White House.

The annual award, administered by the National Science Foundation, recognizes commitment to mentoring students and improving the participation of minorities, women and disabled students in science, mathematics and engineering. The award includes a $10,000 grant for continued mentoring work and a Presidential certificate.

George is internationally recognized for his scholarship and leadership in multidisciplinary earthquake engineering, and is a leader in providing and sustaining educational opportunities in engineering. For nearly 40 years his mentoring efforts have led to thousands of underrepresented high school students in the greater Buffalo area being exposed to engineering and science.

George was the principal founding member of BEAM, Buffalo Area Engineering Awareness for Minorities, an organization whose membership draws on Omega Psi Phi, a black professional men’s national fraternity, and the Buffalo City Schools in addition to the University at Buffalo population. He has designed, developed and obtained funding for a wide variety of highly effective mentoring programs, including research internships for students in grades 5-12 and their teachers; community programs; and leadership training programs.

At MCEER, Dr. Lee has worked to increase underrepresented group participation both among the Center’s researchers and in its executive committee. As a researcher and UB faculty member, he also has advised numerous students from underrepresented groups.

Prior to serving in his current roles as MCEER Special Tasks Director, Samuel P. Capen Professor of Engineering, and Senior University Advisor for Technology, George was MCEER Director (1992-2002), Chair, Department of Civil Engineering (1974-1977), and Dean, School of Engineering and Applied Sciences (1977-1995), Associate Director, Calspan-UB Research Center (1984-1989) and Acting Director, National Center for Earthquake Engineering Research (1989-1991). More information is available at http://mceer.buffalo.edu/outreach/people/Lee.asp.

NCS Dedication Review

Continued from p.3

also observed to the gypsum walls, several ceiling tiles, and to the surgical lamp, which crashed to the floor. While water and gas piping remained intact, gas piping within the walls was permanently bent into an “S” shape. During the larger MCE motion, more damage was seen, and the “patient” was thrown off the gurney and almost out of the room.

In addition to Filiatrault, Mosqueda, Reinhorn and Retamales, the research team included SEESL lab staff Mark Pitman and Scot Weinreber. Ruben Boroschek, Director of the World Health Organization (WHO) Collaborating Center for Disaster Mitigation in Health Facilities at the University of Chile, also contributed to the research effort. A formal cooperative agreement between MCEER and the WHO Collaborating Center helped in the acquisition of the hospital equipment used in the demonstration tests, and will further promote the exchange of experimental test results between researchers in the U.S. and Latin America, with a focus on the seismic safety of medical equipment.

Both tests along with an archived webcast of the Symposium can be viewed at http://mceer.buffalo.edu/Nonstructural_Components/default.asp. For more information, contact Andre Filiatrault, SEESL director, at af36@buffalo.edu or Donald J. Goralski, MCEER, at goralski@buffalo.

Future tests are planned under a newly awarded NEESR project that will examine earthquake effects on ceiling-piping-partition systems (see page 7).
Investigators Develop New Design Methodology for Steel Truss Bridge Towers

MCEER investigators have developed a systematic design/retrofit procedure for steel truss bridges that allows controlled rocking and uplift at the base of bridge piers to protect the bridge tower from damage due to earthquakes. The procedure uses a capacity-based approach, and was validated by a series of shake table tests carried out at the University at Buffalo (UB).

The technique, which allows the bridge tower to rock in a controlled manner, has been implemented in some instances in the past, such as for the seismic retrofit of the north approach spans of the Lion’s Gate Bridge in Vancouver, British Columbia. However, to date, no systematic design procedure based on reliable test data has been available to engineers.

During the test program, a 20 ft. truss tower was subjected to ground motions simulating the 1994 Northridge, California earthquake. Testing was conducted both with and without passive energy dissipation devices, inserted at the pier base to control the dynamic rocking behavior. Tests were conducted with hysteretic dampers as well as with viscous dampers provided by Taylor Devices, Inc., a member of MCEER’s Strategic Partnerships Network. Results showed that satisfactory designs can be achieved both with and without the dampers, but the use of energy dissipation was effective in limiting the amplitude of uplift (reducing it by half in some of the examples tested) and in limiting the velocity of the impacting pier leg during the rocking motion.

The research was funded by the Federal Highway Administration as part of MCEER’s highway project and was carried out by Michel Bruneau, UB Professor of Civil, Structural and Environmental Engineering and MCEER Director, and Michael Pollino, a recent Ph.D. graduate of the UB Department of Civil, Structural and Environmental Engineering, currently employed at the Boston office of Simpson Gumpertz and Heger.

Video of the test is available at: http://mceer.buffalo.edu/publications/bulletin/07/21-03/07Truss.asp. A technical report is in preparation and will be available in early 2008.
Dispatching and Routing of Emergency Vehicles in Disaster Mitigation Using Data Fusion

The use of data fusion in disaster mitigation was the topic of a multi-year multidisciplinary project carried out through the Center for Multisource Information Fusion at UB and sponsored by the U.S. Air Force Office of Scientific Research. A simulation engine was created to answer this basic question through the development and testing of various levels and types of data fusion techniques. The project was conducted by a large team of scientists led by Dr. Peter Scott of the Department of Computer Science and Engineering.

A key part of this project was research on investigating the problem of optimizing the available resources to minimize the response time for a casualty pickup or a delivery and to maximize the life expectancy of casualties. This part of the effort was led by Dr. Rajan Batta and conducted by a team consisting of two former doctoral students, Arun Jotshi and Qiang Gong. Results are summarized in their doctoral dissertations and in four research articles:


The steps involved in this part of the research effort are described below.

Information about different entities—casualties, roads, emergency vehicles (EVs), clusters (casualties located in the same geographic area), hospitals—is assumed to flow from multiple sources. Data fusion was used to develop appropriate estimates, which formed the basis of an efficient dispatching and routing methodology. A Best Exit-Entry approach was used for efficient shortest path calculations, and travel delays due to congestion and road damage were incorporated. Three different dispatch decisions were modeled—dispatch to a casualty (in absence of clusters), dispatch to a cluster (and subsequently to one of its cells), and dispatch to a hospital.

Experimentation on parameter settings was illustrated with a case study of a post-earthquake disaster relief scenario in Northridge, California. Seven sets of parameters were investigated to illustrate the developed methodologies. Changing the parameters had a direct effect on the corresponding dispatching decisions. The results demonstrate that even though the average distance to a casualty pick up location and a cluster is comparable across the three scenarios, the average response time to a casualty is almost double the average response time to a cluster.

Sensors report information on casualties and the status of roads. These consist of satellites, sensor systems embedded in the infrastructure (e.g., sur-
Congestion.

Civic Engagement and Public Policy

Casualty-

Artistic Expression and Performing Arts

\[\text{developed in this research.}\]

\[\text{tion software that was deve}\]

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\[\text{The figure summarizes the}\]

\[\text{ing and routing strategy.}\]

\[\text{need for an efficient dispatch}\]

\[\text{gency Vehicle (EV); hence, the}\]

\[\text{wait for service by an Emer}\]

\[\text{is very high. A queue is thus}\]

\[\text{the discovery rate of casualties}\]

\[\text{In the case of a major disaster,}\]

\[\text{Information on each disaster-}\]

\[\text{generated patient is composed of his/her location and injury class. For such purposes, four casualty classes are defined: Type 1 (mildly injured); type 2 (moderately injured); type 3 (severely injured); and type 4 (mortally injured). The casualties are distributed randomly across the affected area.}\]

\[\text{Information on each link (road segment) constitutes the level of damage and congestion on the link during a particular interval of time. Each level associated with a link is assigned a probability that measures the likelihood that the information is accurate.}\]

\[\text{In the case of a major disaster, the discovery rate of casualties is very high. A queue is thus created in which the casualties wait for service by an Emergency Vehicle (EV); hence, the need for an efficient dispatching and routing strategy.}\]

\[\text{The figure summarizes the interactions between the different components of the simulation software that was developed in this research.}\]

\[\text{--Submitted by Rajan Batta, University at Buffalo}\]

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**The UB 2020 Initiative**

UB 2020 is the University at Buffalo’s campus-wide plan to achieve academic excellence by forging a coherent university-wide vision. Started in 2004, the plan is the most ambitious transformation at UB since the campus joined the SUNY system in 1962. Among the many results will be a university that is bigger in size, sharper in both focus and physical appearance, and stronger academically. The main focus is on:

- **Achieving Growth**: Implement plans to grow by as much as 40% by the year 2020 in an effort to become one of the top research universities in the country.

- **Excelling in Academics**: Concentrate in the areas of greatest academic strengths, realign resources, make strategic investments, develop partnerships, increase synergies across the campuses, and recruit top faculty.

- **Building UB**: The Comprehensive Physical Plan: Develop a physical presence that supports a model twenty-first century university—an open place of learning and a generator of new ideas that sets a standard of academic excellence and serves a diverse population in today’s knowledge-based society.

- **Transforming Operations**: Realign operational services, such as human resources, information technology, and sponsored programs, for efficient service and process delivery.

A cornerstone of the UB 2020 vision is the identification and development of strategic strengths. These strategic strengths will be used to focus academic planning, organize and empower faculty, better use and identification of needed infrastructure, and enable more strategic planning to achieve its vision. Eight strategic strengths, based on existing academic excellence, have been identified:

- Artistic Expression and Performing Arts
- Civic Engagement and Public Policy
- Cultures and Texts
- Extreme Events: Mitigation and Response
- Health & Wellness Across the Lifespan
- Information and Computing Technology
- Integrated Nanostructured Systems
- Molecular Recognition in Biological Systems and Bioinformatics

MCEER is coordinating the UB 2020 Strategic Strength on Extreme Events, as its research and outreach expertise are uniquely qualified to lead this effort. More information is available on the MCEER website at [http://mceer.buffalo.edu/ub2020/default.asp](http://mceer.buffalo.edu/ub2020/default.asp).
Fifth International Workshop on Remote Sensing Held at The George Washington University

2008 marked the fifth anniversary of the *International Workshop Series on the Application of Remote Sensing for Disaster Response*. This year’s event was hosted by Ray Williamson, Research Professor of Space Policy and International Affairs at the Elliot School of International Affairs, George Washington University (GWU), and Ron Eguchi, President and CEO at ImageCat, Inc. MCEER and its Remote Sensing Institute has been a primary sponsor for each of the workshops, which have been hosted by international institutions including Chiba University in Japan, and Cambridge University in England.

To celebrate the coming of age for the workshop series, and recognize the increasingly widespread implementation of remote sensing applications during recent disasters such as Hurricane Katrina, the 2007 event included a one-day international Symposium on Remote Sensing Applications for Natural Hazards. A keynote by Gene Whitney from the President’s Office of Science and Technology Policy, together with application-oriented presentations including a review of the International Charter, Space and Natural Disasters by Barbara Ryan from USGS, drew policy makers and practitioners from the Washington, D.C. area. The symposium concluded with a user-led discussion of future research, development, and application needs.

The symposium was complemented by a two-day technical workshop, attended by forty of the world’s leading researchers in remote sensing and GIS for disasters. Following words of welcome from the workshop’s founding father, Masanobu Shinozuka, Distinguished Professor and Chair of Civil and Environmental Engineering at the University of California at Irvine (UCI), the first day focused on optical and radar-based techniques for assessing urban damage caused by hazards ranging from earthquakes and hurricanes to floods.

Addressing one of the resolutions ratified at the 2006 workshop in Cambridge, England, Ellen Rathje, Associate Professor at the University of Texas at Austin and Dr. Beverley Adams from ImageCat’s European office, presented an evaluation of earthquake damage scales used in remote sensing studies. During the second day, attendees enjoyed diverse presentations on response and recovery, advanced technology-based tools, and techniques for modeling urban disasters that included a new application assessing impacts from near-earth objects.

The workshop and symposium were sponsored by the MCEER Remote Sensing Institute, Space Policy Institute at GWU, EERI, UCI, Imaging Notes and ImageCat, Inc. The 6th International Workshop will take place in September 2008, and will be hosted by Professor Paolo Gamba from the University of Pavia, Italy. To view the presentations, visit [http://www.gwu.edu/~spi/](http://www.gwu.edu/~spi/).

-Submitted by Beverley Adams, ImageCat Inc.
Minnesota Bridge Collapse Highlights Research Needs

Following the collapse of the I-35W Bridge in Minneapolis, Minnesota, MCEER’s Senior Program Officer for Transportation Research, Jerry O’Connor, shared his knowledge on bridge safety with a variety of local and national members of the media. The collapse of the 8-lane steel arch bridge, which occurred August 1, 2007, brought attention to a potentially growing problem facing our nation’s bridge network – that is, the effects of aging and repair/maintenance over the lifespan of a bridge.

Drawing on his bridge inspection experience, O’Connor shared information on bridge safety in general, explaining the most common causes of bridge failure. These include scour, steel fatigue, and overload. He explained that often a bridge’s condition can be weakened by corrosion of its structural members and connections, so it is no longer able to carry its design load. He also discussed the use of sufficiency rating by DOTs to identify and prioritize bridge repairs, rehabilitations and replacements (see related article on International Bridge Study, this page).

Several of these factors are being studied as part of MCEER’s highway and bridge research (http://mceer.buffalo.edu/research/HighwayPrj/default.asp), funded by the Federal Highway Administration. For instance, MCEER produced the Seismic Retrofitting Manual for Highway Structures and Seismic Retrofitting Guidelines for Complex Steel Truss Highway Bridges that were released in 2006. These contain an abundance of information about analysis of bridges similar to the I-35W bridge. Recently, engineers have realized that past research done to advance the state-of-the-art of bridge design for earthquake protection is also applicable to other extreme loads. In the future, MCEER’s research program is expected to lead to new, improved methods of bridge design.

Individuals interested in the use of seismic technologies for extreme loads should consider attending the Sixth National Conference on Bridges and Highways (see page 12).

International Study Evaluates Bridge Examination Procedures

Harry Capers, Jr., a member of MCEER’s Highway Project Advisory Panel and Corporate Bridge Engineer at Arora and Associates, P.C., led an international study tour that examined bridge evaluation quality assurance processes and procedures in Finland, Denmark, France and Germany. The results of the study trip, held during the first two weeks of June 2007, are intended to help bridge owners and the Federal Highway Administration to implement the provisions of the recently revised National Bridge Inspection Standards (NBIS) regulations.

This study is part of an international program undertaken cooperatively with the American Association of State Highway Transportation Officials (AASHTO) and its Select Committee on International Activities, and the Transportation Research Board’s (TRB) National Cooperative Highway Research Program Panel 20-36, the private sector, and academia. The final report is expected to be published and released late Spring 2008.

New Seismic Guide Specification Adopted for LRFD Design of Highway Bridges

At their annual meeting, held in July 2007, the AASHTO Subcommittee on Bridges and Structures voted to adopt a new seismic specification for the LRFD design of highway bridges. The new specification is largely based on the materials originally developed by the ATC-MCEER joint venture under Project NCHRP 12-49: Comprehensive Specifications for the Seismic Design of Bridges in 2003. The Subcommittee chose not to accept the 2003 recommendations as is. In 2004, MCEER initiated two exploratory tasks as part of its FHWA Highway Project to develop a road map for development and implementation of new criteria. Dr. Roy Imbsen, who is also an MCEER Advisory Panel Member, acted as PI on the tasks and subsequently led the consensus building and technical revisions that resulted in the new guide specification.

The approved two part ballot item updates the current force-based design specification to reflect the use of a 1,000 year return period and also presents a newly developed seismic guide specification that uses a displacement based approach. The vote was 47 states Yes, 1 state No, and 0 states abstaining. It was submitted to the full Subcommittee by Technical Committee-3 (T3) with unanimous support from T3 member states.

For more information, visit http://mceer.buffalo.edu/research/HighwayPrj/aashto/default.asp.
US-Italy Seismic Bridge Workshop Held in Pavia

The U.S.-Italy Seismic Bridge Workshop, held April 19-20, 2007, at the European Center for Training and Research in Earthquake Engineering (Eucentre) in Pavia, Italy brought bridge researchers from the U.S. and Italy together to discuss seismic design and assessment issues for bridges. The workshop was attended by over 35 participants, representing academia in Italy and the U.S., State DOTs, and the Federal Highway Administration. Reginald DesRoches, Georgia Tech, and Phil Yen, FHWA, co-chaired the U.S. team, and Gian Michele Calvi, Università degli Studi di Pavia, and Paolo E. Pinto, Università di Roma “La Sapienza,” co-chaired the Italian team.

The workshop consisted of 29 presentations focused on topics including earthquake ground motions, displacement based design, new code procedures, performance testing of bridges, soil-structure interaction, bridge fragility curves, regional seismic risk assessment, and innovative bridge retrofit methods. The presentations provided an overview of recent developments in each country, as well as areas for future development.

At the conclusion of the workshop, the Italian Ambassador to Pakistan, connected through a conference call, expressed his appreciation to the participants, in consideration of the relevant activity of Italians and Americans in general, and of Eucentre and the Rose School in particular, for the reduction of seismic risk in Pakistan after the recent earthquakes.

The workshop was hosted by the Eucentre and the Centre of Research and Graduate Studies in Earthquake Engineering and Engineering Seismology (Rose School) of the Istituto Universitario di Studi Superiori of Pavia. The U.S. delegation was supported by the FHWA, MCEER, and the National Science Foundation.

Papers and presentations are available at http://www.ce.gatech.edu/~rd72/italy/index.php.

Sixth National Seismic Conference to be held in Charleston, South Carolina

The Sixth National Seismic Conference on Bridges & Highways will be held July 27-30, 2008 in Charleston, South Carolina. Organized by the Federal Highway Administration (FHWA), the Transportation Research Board (TRB), the South Carolina Department of Transportation (SCDOT) and MCEER, University at Buffalo, under the theme “Seismic Technologies for Extreme Loads,” this conference will focus on earthquake risk and include discussions on hurricanes, flooding, and other hazards.

The program will feature over 75 technical presentations and keynote speakers from around the world. There will be two “best paper” and one “best poster” awards presented. The conference will include a student design competition, a poster session, an awards luncheon, and an optional boat tour of Charleston harbor and the recently completed Arthur Ravenel Jr. (Cooper River) Bridge. Papers and posters will be published on a Proceedings CD.

A workshop on recent changes adopted by the AASHTO subcommittee on Bridges and Structures will be held in conjunction with the conference.

For details, visit http://mceer.buffalo.edu/meetings/6nsc.
Gian Paolo Cimellaro is a Ph.D. candidate in the Department of Civil, Structural and Environmental Engineering at the University at Buffalo. Under the supervision of Professor Andrei Reinhorn and MCEER Director Michel Bruneau, Gian Paolo is working on a project entitled “Improving Seismic Resilience of Structures through Control Systems.” His research area is the quantification of seismic resilience, but he is also interested in the seismic retrofit of existing buildings with weakening and damping.

Gian Paolo’s interest in earthquake engineering began early in his graduate study in Italy at the University of Rome, right after the San Giuliano di Puglia earthquake in southern Italy destroyed an entire school, killing all the students inside.

In 2001, he won a three-year Research scholarship from the Italian Ministry of Education and Research and started to work at the University of Rome. After meeting Jeff Berman and other MCEER students during their Tri-Center Field Mission to Italy in 2003, Gian Paolo decided to continue his research activity at UB. In 2004, he got a scholarship for the “frequency of activity of improvement in a foreign country” from the University of Rome and finished his MS program at UB.

While working at MCEER, Gian Paolo is collaborating with the University of Pavia and the Italian National Institute of Nuclear Physics (INFN), where he received a two-year research grant supporting research activities in the ICARUS project1, directed by professor Carlo Rubbia (Nobel Prize Winner in Physics). In 2007, he received a Marie Curie Scholarship for the course “Semi-active Vibration Suppression - The Best from Active and Passive Technologies,” held at CISM (International Center for Mechanical Science), in Udine, Italy.

Gian Paolo has been a member of the MCEER Student Leadership Council since beginning his Ph.D. studies in 2004. After graduating in fall 2007, Gian Paolo hopes to obtain a faculty position in either the U.S. or in his native Italy.

In his free time, Gian Paolo plays tennis and enjoys sailing in Lake Erie during the summer with his friends. He also likes making them his favorite Italian cake: Tiramisu.

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1The ICARUS project is a physical experiment proposed in 1985 by Professor Carlo Rubbia and developed in The Gran Sasso physics laboratory. The project investigates proton decay and the physics of the neutrinos using the ICARUS detector.

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MCEER-SLC Activities

Three Students Receive CSEE Awards

Several Ph.D. candidates involved in MCEER research were honored by the Department of Civil, Structural and Environmental Engineering (CSEE) at the University at Buffalo in May 2007. Michael Polilino, President of the MCEER Student Leadership Council, received the CSEE Chair’s Recognition Award. Hongbo Wang received the UB Engineering Graduate School Ambassador Award.

Seda Dogruel won an honorable mention for her poster during the the first annual UB Engineering Graduate Research Day and Open House. The event was designed to promote familiarity among students and faculty at the School of Engineering and Applied Science with the research being performed throughout the school.

SLC Members Participate in Symposium on Multi-Hazard Engineering

Four University at Buffalo graduate students from MCEER’s Student Leadership Council, Gian Paolo Cimellaro, Seda Dogruel, Shuichi Fujikara and Bing Qu, attended the Symposium on Emerging Developments in Multi-Hazard Engineering, September 18, 2007, held in New York City (see related article on page 2). In addition to the UB representatives of MCEER’s SLC, a number of other students were provided funding to attend the conference through MCEER Education Grants.

The symposium provided the students with first-hand exposure to the fact that the most important step in reducing short- and long-term losses resulting from hazardous events, is the acceptance of the new and broader role of engineers in developing mitigation strategies and a new philosophy of multi-hazard preparedness. During the symposium, this complicated subject was presented with a clarity which was reinforced with excellent presentations that reflect the need to provide flexible, comprehensive, and interdisciplinary approaches to multi-hazard mitigation, rather than utilizing the current single hazard-specific performance assessment methods. It also gave students, researchers, and practitioners the opportunity to build a professional network among themselves. To conclude, the symposium was a very rewarding and enjoyable experience for all who attended.

-Submitted by Seda Dogruel, University at Buffalo
2007 Tri-Center Field Mission to Japan

The NSF-sponsored 2007 Tri-Center Field Mission comprised three educators and fourteen students from MCEER, MAE, PEER and NEES. The group visited Japan, one of the most seismically active regions in the world and a leader in earthquake engineering research, from July 21-28, 2007. The team, led by PEER’s Scott Ashford, included four MCEER SLC members, all Ph.D. students from the University at Buffalo (UB)-- Georgios Apostolakis, Seda Dogruel, Nurhan Ecemis and Bing Qu-- along with MCEER Director of Education, Sabanayagam Thevanayagam.

The trip began with a visit to the Center for Urban Earthquake Engineering (CUEE) at Tokyo Institute of Technology. Students participated in a MCEER SLC Participants, (from left): Bing Qu, Seda Dogruel, Nurhan Ecemis and Georgios Apostolakis, at E-Defense facilities in Miki City Japan-US-Taiwan Joint symposium on earthquake engineering, and made presentations on their Ph.D. research topics

The next day, participants took a boat tour of Tokyo Bay and observed construction projects of the Tokyo-wan Rinkai Bridge and the D-runway of the Tokyo International Airport. They proceeded to Port and Airport Research Institute (PARI) for a technical visit. PARI is an independent administrative institution with a primary goal of facilitating construction of ports and airports through research, by developing and improving technologies. Students viewed demonstration tests at major laboratory facilities: Underwater 3D Shaking Table; Simulation Tank for Oil Recovery in Marine Situations; laboratory for Coastal Ecotoxicology/Mesocosm; Geotechnical Centrifuge; Aircraft Load Simulator; and Large Hydro-Geo Flume (tsunami facility).

The group also organized a post-earthquake reconnaissance visit to Kashiwazaki city, the area most affected by the July 16, 2007 earthquake in Niigata, Japan. They visited damaged bridges; a collapsed concrete plant; areas with lateral spreading and liquefied soils; and collapsed/damaged wooden houses. Though tragic in nature, the devastation of earthquakes can serve as a real-life learning laboratory and the participants learned valuable lessons that brought new perspectives to their research agendas.

The next day, the group traveled to Kyoto, where they visited the Nijo Castle, a UNESCO world heritage site, originally built in 1603 as the official Kyoto residence of the

2007 REU Symposium held in Seattle

The 2007 REU Symposium was organized this year by MCEER and took place August 8-12 in Seattle, Washington. This year’s student group was significantly larger than in previous years, totaling forty-two undergraduate students from MAE, MCEER, NEES and PEER.

During the Symposium, the undergraduate scholars gave technical presentations and actively participated in a question/answer session on their research projects to fellow REU students and coordinating faculty members from the Centers. Other Symposium activities included two engineer-led site tours: Safeco Park, the Mariner’s baseball stadium, and Seattle’s downtown Public Library – both nationally-recognized engineering accomplishments; a scenic dinner cruise of Lake Union and Lake Washington affording views of Washington’s floating bridges and zoned floating home communities; and an afternoon session addressing ethical considerations associated with engineering projects, led by Professor Scott G. Rutherford of the University of Washington.

As always, the Symposium proved to be an excellent educational and social experience for the young scholars, giving them the opportunity to present their research findings in a formal setting, learn about the numerous research possibilities available to them in the field of earthquake engineering, be exposed to several local engineers and faculty, meet other young people from all over the country who might become their future colleagues and collaborators, and interact with earthquake engineering faculty from EERC and NEES institutions.

Proceedings are being compiled by MCEER and will be available from the MCEER website at http://mceer.buffalo.edu/education/reu/.

Continued on page 15
Ten Students Participate in 2007 MCEER REU Program

Ten MCEER-sponsored undergraduate students from the University at Buffalo (UB), Rensselaer Polytechnic Institute, Lafayette College, Harvey Mudd College, the City College of New York (CCNY) and Florida A&M University (FAMU) participated in the 2007 REU program. During the ten-week summer program, these students worked with faculty advisors and graduate student mentors at UB, CCNY and FAMU to participate in ongoing research projects conducted by MCEER-funded investigators.

The seven students studying at UB this summer received instructional sessions from the MCEER Information Service on databases including QUAKELINE®, ASCE and CompendexPlus. The UB students were also introduced to EndNote software (for references) and attended a half-day technical communication seminar led by William Grunert, from the School of Engineering and Applied Sciences’ External Affairs Department.

The summer program culminated in a symposium, held in Seattle (see review on page 14).

Students and Projects

<table>
<thead>
<tr>
<th>Student/ Home Institution</th>
<th>Host Institution</th>
<th>Project Title</th>
<th>Faculty Advisor/ Student Mentor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armando Ciprian, UB</td>
<td>UB</td>
<td>Resonance of Structures Under Sinusoidal Shaking</td>
<td>George Lee/ Yu-Chen Ou</td>
</tr>
<tr>
<td>Thomas Coyne, UB</td>
<td>UB</td>
<td>NEESWood: Framing to Sheathing Connection Texts</td>
<td>Andre Filiatrault/ Jianiis Christophorissis</td>
</tr>
<tr>
<td>Christopher Gonyo, RPI</td>
<td>UB</td>
<td>Experimental Study of a Small Scale Laminar Box for Soil Liquefaction Studies</td>
<td>S. Thevanagam/ Raghudeep Bethapudi</td>
</tr>
<tr>
<td>Krissin Denaye Hinds, FAMU</td>
<td>FAMU</td>
<td>Analytical Studies of the Suspended Zipper Frame and Control Devices</td>
<td>M. Abdullah/ Kenneth Walsh, Marlon Hill</td>
</tr>
<tr>
<td>Haridoyal Jawal, CCNY</td>
<td>CCNY</td>
<td>Analysis of Micro-Vibration in Buildings</td>
<td>Anil Agrawal</td>
</tr>
<tr>
<td>Christa Kelleher, UB</td>
<td>UB</td>
<td>Nonstructural Components and the Rainflow Counting Algorithm</td>
<td>Gilberto Mosquera/ Rodrigo Retamales</td>
</tr>
<tr>
<td>Shannon McKenna, Harvey Mudd College</td>
<td>UB</td>
<td>Preparation and Preliminary Testing of a Small Scale Laminar Box for a Study of Soil Liquefaction</td>
<td>S. Thevanagam/ Nurhan Ecemis and Raghudeep Bethapudi</td>
</tr>
<tr>
<td>Melissa E. Norlund, UB &amp; Stanford</td>
<td>UB &amp; Stanford</td>
<td>Sideways Collapse of Deteriorating Structural Systems under Seismic Excitations: Phase II Shake Table Collapse Test</td>
<td>Helmut Krawinkler, Andrew Whitaker and Andrei Reinhorn/ Dimitrios G. Lignos</td>
</tr>
<tr>
<td>Aaron Williams, FAMU</td>
<td>FAMU</td>
<td>Developing a Variable Stiffness System with Continuously Variable Transmission Technology</td>
<td>M. Abdullah/ Kenneth Walsh</td>
</tr>
<tr>
<td>Robert Wurstner, UB</td>
<td>UB</td>
<td>Property Test of Concrete Isolators</td>
<td>Michel Bruneau/ Shenlei Cui</td>
</tr>
</tbody>
</table>

Tri-Center Field Mission

first Tokugawa Shogun, Ieyasu. The group then toured the Disaster Prevention Research Institute (DPRI) at Kyoto University directed by Professor Susumu Iai. At Kyoto University, another Japan-US Joint symposium on earthquake engineering took place and students from both institutions presented their research. A technical visit to the DPRI experimental facilities followed. Professor Iai invited the group to dinner at a traditional Japanese restaurant where cultural and engineering experiences were exchanged with Japanese students.

The last day, the team visited the E-Defense facilities at Miki City, where they toured the laboratory which houses the largest seismic table in the world.

After E-Defense, the team visited the Hanshin Expressway Museum and had a unique opportunity to see components taken from the collapsed Hanshin Expressway during the January 17, 1995 Kobe earthquake and learned about the retrofit/redesign strategies and new technologies that were employed in its expeditious restoration. The final stop was at the 980m long Minato-Ohhashi Bridge in Osaka City, the world’s third longest truss bridge, and participants learned about the retrofits implemented after the earthquake in 1995.

Students are preparing reports focusing on different aspects of earthquake engineering based on new insights they gained from this Field Mission. An SLC seminar is planned for the 2007-2008 academic year. For more information, visit http://mceer.buffalo.edu/education/tricenter/2007Japan/default.asp.

-Submitted by Georgios Apostolakis, University at Buffalo
Report Recommends Protocols for Testing Structural and Nonstructural Building Components

Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components, FEMA 461, is now available from the Applied Technology Council (ATC) at http://www.atcouncil.org/pdfs/FEMA461.pdf. The report, a result of cooperative efforts between ATC, MCEER, Mid America Earthquake (MAE) Center and Pacific Earthquake Engineering Research (PEER) Center, documents the interim recommended protocols that were developed for testing of structural and nonstructural components and systems found in buildings to establish their seismic performance characteristics. Two interim protocol types are provided:

- Interim Protocol I – Quasi-Static Cyclic Testing, which should be used to determine performance characteristics of components whose behavior is primarily controlled by the application of seismic forces or seismic-induced displacements
- Interim Protocol II – Shake Table Testing, which should be used to assess performance characteristics of components whose behavior is affected by the dynamic response of the component itself, or whose behavior is velocity sensitive, or sensitive to strain-rate effects

The document also presents an overview of performance-based seismic design and discussions on a variety of topics and issues germane to these protocols. A Commentary is provided for each protocol, and an appendix is included that describes the process used to develop nonstructural component fragility functions based on laboratory testing.

The report is part of the ATC-58 project, which began October 2001 with funding from the Federal Emergency Management Agency (FEMA), Department of Homeland Security. The plan for development of the guidelines is defined in the companion FEMA 445 report, Next-Generation Performance-Based Seismic Design Guidelines, Program Plan for New and Existing Buildings, which was also prepared under the ATC-58 project and published by FEMA in 2006 (http://www.atcouncil.org/pdfs/FEMA445.pdf).

Hurricane Katrina Report Addresses Public Health Impacts

Public Health and Environmental Infrastructure Implications of Hurricanes Katrina and Rita by James N. Jensen and Pavani Ram is volume three in a series detailing post-Katrina field investigations organized by MCEER. The public health and environment team visited the Gulf Coast from October 17, 2005 to October 22, 2005. The team’s efforts extended from New Orleans to the parishes north of Lake Pontchartrain to the Louisiana-Texas border. The primary study areas were Orleans, Jefferson, St. Tammany, Washington, Calcasieu, and Cameron parishes. The report provides information on the public health aspects and reviews the environmental infrastructure observations.

The report, along with others in the Hurricane Katrina Report Series, can be ordered online at http://mceer.buffalo.edu/publications/Katrina/default.asp, or by contacting MCEER Publications at (716) 645-3395. Screen quality versions of the Hurricane Katrina reports are available for download from the website.

New MCEER Phone Numbers

MCEER has upgraded its phone system to Voice-over IP (VoIP) technology at its Red Jacket headquarters. This is part of an ongoing University at Buffalo system-wide upgrade. As a result of this change, MCEER staff may now be dialed directly. The center’s main telephone and fax numbers remain the same: (phone) 716-645-3391; (fax) 716-645-3399. MCEER’s Information Service may still be reached at: (phone) 716-645-3377; (fax) 716-645-3379.

MCEER’s new phone directory is available at http://mceer.buffalo.edu/about_MCEER/directory.asp.

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MCEER Movers & Shakers

Abdoun Awarded Shamsher Prakash Award
Tarek Abdoun, Associate Professor in the Department of Civil and Environmental Engineering, Associate Director, NEES-NSF Geotechnical Centrifuge Research Center at Rensselaer Polytechnic Institute and MCEER investigator is the 2008 recipient of the prestigious Shamsher Prakash Research Award for Excellence in the Practice of Geotechnical Engineering. The award is given to young engineers, scientists and researchers who have made significant, independent contributions and showed promise of excellence in geotechnical engineering and/or geotechnical earthquake engineering.

He also received the “Commander’s Award for Public Service” with an accompanying medal from the Chief, U.S. Army Corps of Engineers. This medal is one of the highest awards given by the U.S. Army to civilians who provide outstanding services. Tarek received the award for his support of New Orleans recovery through efforts with the Evaluation Task Force of the Hurricane Katrina Interagency Performance (IPET). He received the award November 28, 2007 at a ceremony held at Rensselaer Polytechnic Institute.

Renschler Wins Young Scholar Award
Christian Renschler, MCEER Remote Sensing Institute team member and Associate Professor of Geography at the University at Buffalo, received the 2007 Soil & Water Conservation Young Scholar Award from the Division of S06-Soil & Water Conservation of the Soil Science Society of America (SSSA). He received the award during the International Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, held November 4-8, 2007 in New Orleans. He also presented his latest research during a symposium entitled Katrina Disaster and Sustainable Coastal Development: An Integrated Perspective and the Role of Land and Water Sciences, which was held in conjunction with the annual meeting.

Eguchi Named EERI 2008 Distinguished Lecturer
Ronald T. Eguchi, President and CEO of ImageCat, Inc. and team leader of MCEER’s Remote Sensing Institute, will be EERI’s 2008 Distinguished Lecturer. During EERI’s 60th Annual Meeting in February in New Orleans. Ron will present a lecture entitled “Earthquakes, Hurricanes and Other Disasters: A View from Space.”

New Technical Reports
Seismic Behavior of Bidirectional-Resistant Ductile End Diaphragms with Unbonded Braces in Straight or Skewed Steel Bridges
By O.C. Celik and M. Bruneau, MCEER-07-0003, April 11, 2007, 204 pages, $35.00

This research aims to extend the ductile end diaphragm concept used on steel bridges to make it applicable for bidirectional earthquake excitations, using unbonded braces as ductile fuses. Two retrofit schemes are investigated to determine the best geometrical layout. Closed form solutions are sought for practical design purposes. Behavioral characteristics of the proposed retrofit schemes are quantified with an emphasis on hysteretic energy dissipation. Results show that the bidirectional loading, loading ratio (or the assumed combination rule), and skew angle have a pronounced effect on the end diaphragm’s inelastic behavior. Based on volumetric hysteretic energy dissipation, the effectiveness of the proposed retrofit schemes are compared under several loading cases for both non-skewed and skewed bridge superstructures.

Staff News: M. Tong Joins FEMA
Mai “Mike” Tong has accepted a position as a Physical Scientist in the Risk Reduction Branch of the Mitigation Division of FEMA. This Branch is responsible for FEMA’s NEHRP and other hazard mitigation programs. Among his many new responsibilities, Mike will manage the technical aspects of contracts, grant proposals, and cooperative agreements between FEMA and U.S. universities and other government agencies, industry and organizations; and plan and coordinate programs in unexplored areas where new technologies and approaches are needed to mitigate earthquake and related multi-hazard disaster issues. Mike served as a research scientist at MCEER for over 10 years. Co-workers at MCEER and the Department of Civil, Structural and Environmental Engineering treated Mike to a luncheon to congratulate him on his new position and to wish him success in all his future endeavors.

Mike Tong enjoyed a farewell luncheon with his co-workers from MCEER and the Department of Civil, Structural and Environmental Engineering at the University at Buffalo
Modeling Pile Behavior in Large Pile Groups Under Lateral Loading
by A.M. Dodds and G.R. Martin, MCEER-07-0004, April 16, 2007, 292 pages, $35.00

Large pile groups were examined using a three-dimensional finite difference based numerical modeling approach. The specific case of a large pile group subject to only translational loading at the groundline was considered. Research efforts focused on local pile-soil interaction using p-y curves as the primary assessment tool and p-multipliers to characterize group effects. Rationalization of a large pile group into a two-pile in-line configuration and a single pile with periodic boundaries was undertaken, representing typical leading and immediately trailing piles, and internal piles, respectively. Factors considered were: soil type; pile type; initial soil stress states; pile head restraint; and pile spacing.

Experimental Investigation of Blast Performance of Seismically Resistant Concrete-Filled Steel Tube Bridge Piers
by S. Fujikura, M. Bruneau and D. Lopez-Garcia, MCEER-07-0005, April 20, 2007, 212 pages, $35.00

The objective of this research is to develop and validate a multi-hazard bridge pier concept. A multi-column pier-bent with concrete-filled steel tube (CFST) columns is investigated experimentally to assess the adequacy of such a system under blast loading. This report describes the development of the multi-hazard pier concept, design of the prototype bridge pier under blast and seismic loading, specimen design, experimental set-up, and experimental results. Additionally, the results from the blast experiments are compared with the results from simplified methods of analysis considering an equivalent SDOF system with elastic-perfectly-plastic behavior.

Experimental Seismic-Performance Evaluation of Isolation/Restraint Systems for Mechanical Equipment; Part I: Heavy Equipment Study
by S. Fathali and A. Filatralaut, MCEER-07-0007, June 6, 2007, 174 pages, $30.00

This report describes experimental research aimed at evaluating the seismic performance of an isolation/restraint system, typical of the systems designed by the ASHRAE members, supporting heavy mechanical equipment. The ASHRAE-type isolation/restraint system consisted of coil springs and rubber snubbers constraining the displacement in the horizontal and vertical direction. The heavy HVAC-type mechanical equipment used as a test specimen was a centrifugal liquid chiller. System identification and seismic shake table tests were conducted on the test specimen mounted on four of the isolation/restraint systems. A companion report describing light mechanical equipment is under preparation.

Seismic Vulnerability of Timber Bridges and Timber Substructures
by A.A. Shama, J.B. Mander, I.M. Friedland and D.R. Allicock, MCEER-07-0008, June 7, 2007, 194 pages, $30.00

This report describes the seismic behavior of timber bridges. Theories are developed to predict the performance of timber piles under lateral loading. Theoretical predictions were verified by experimental studies on full-scale timber specimens, and timber pile-to-concrete cap connections. For braced timber pile bents, a prototype timber bridge was used to develop a near-full size physical model that was subjected to shaking table experiments and quasi-static reversed cyclic loading tests on the laboratory strong floor. A nonlinear force-displacement computational modeling study was also conducted as a companion effort to the experimental investigation. Based on the experimental and theoretical research, fragility curves were developed.

Design Recommendations for Perforated Steel Plate Shear Walls
by R. Purba and M. Bruneau, MCEER-07-0011, June 18, 2007, 204 pages, $35.00

This report presents the results of finite element analytical studies, using monotonic pushover analysis, to investigate the behavior of unstiffened thin steel plate shear walls (SPSW) with openings on the infill plate. Two infill plate options, the perforated and the cutout corner SPSW, are investigated. Recommendations and considerations are proposed to help design perforated and cutout corner SPSW. This research extends work reported in “Steel Plate Shear Walls for Seismic Design and Retrofit of Building Structures” by D. Vian and M. Bruneau, MCEER-05-0010. All analyses were performed using the finite element software ABAQUS/Standard.
Performance of Seismic Isolation Hardware Under Service and Seismic Loading

This report presents state-of-the-art knowledge on the behavior of contemporary seismic isolators (elastomeric and lead-rubber bearings; sliding isolators) and fluid viscous dampers, under both service and seismic loads. Specific problems addressed include the effects of ambient temperature, aging and history of loading, and the effects of frictional or hysteretic heating. The study focused on developing an understanding of the impact of these parameters on seismic isolators and dampers, to better understand how these devices will respond over a lifetime of use in seismically protected structures. Reviews of seismic protective systems as well as analysis and design methods for hardware are presented. The information presented herein may also form the basis for the development of a contemporary “Guide Specifications for Seismic Isolation Design.”

Experimental Evaluation of the Seismic Performance of Hospital Piping Subassemblies
by E.R. Goodwin, E.M. Maragakis and A.M. Itani, MCEER-07-0013, September 4, 2007, 200 pages, $35.00

This report describes an experimental research program conducted on hospital piping systems. The piping systems included typical valves, water heaters, and a heat exchanger modeled after a typical subassembly in a California hospital. The objectives were to understand the seismic behavior of typical braced and unbraced welded and threaded hospital piping systems, identify their drift capacities and failure modes, and provide data for calibration purposes in future analytical studies. The systems rested on a shake table and were hung from a stationary frame that rested on the lab floor. Two piping systems were developed, with identical geometries but different connection details. One had welded connections, while the other had threaded connections. Both systems were tested with and without seismic bracing. The seismic bracing used was a cable-style bracing commonly used in seismic applications.

Simulation Model of Urban Disaster Recovery and Resilience: Implementation for the 1994 Northridge Earthquake
by S. Miles and S.E. Chang, MCEER-07-0014, September 7, 2007, 130 pages, $25.00

This report describes a computer-based model of urban disaster recovery. The model simulates the recovery dynamics of households, businesses, neighborhoods, and the community as a whole following a disaster. The model was applied to the City of Los Angeles for the 1994 Northridge earthquake, using detailed data on the conditions and effects of the earthquake for testing and calibration purposes. Results indicated favorable performance in certain aspects of the model and identified areas where further refinements were needed. Examples of “what-if” explorations are provided to illustrate the types of analyses that can be conducted with this model. The report concludes with a discussion of potential applications, advances, limitations, and priorities for further research. The first-generation of this model was described in a previous MCEER report, “Urban Disaster Recovery: A Framework and Simulation Model,” by Scott B. Miles and Stephanie E. Chang, MCEER-03-0005.
Sixth National Seismic Conference on Bridges & Highways

The Sixth National Seismic Conference on Bridges & Highways will be held July 27-30, 2008 in Charleston, South Carolina. The conference is being organized by the Federal Highway Administration, the Transportation Research Board, the South Carolina Department of Transportation and MCEER.

For details, visit http://mceer.buffalo.edu/meetings/6nsb.

EERI 60th Annual Meeting

“Hurricane Katrina: Lessons for Earthquake Risk Reduction” is the theme of the 60th Annual Meeting of the Earthquake Engineering Research Institute, to be held February 6-9, 2008, in New Orleans, LA. With close to 30 presentations over three days, the program is designed to appeal to professionals and researchers in the multidisciplinary earthquake risk reduction fields.

For details, visit http://www.eeri.org/news/meetings/08AM/.

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