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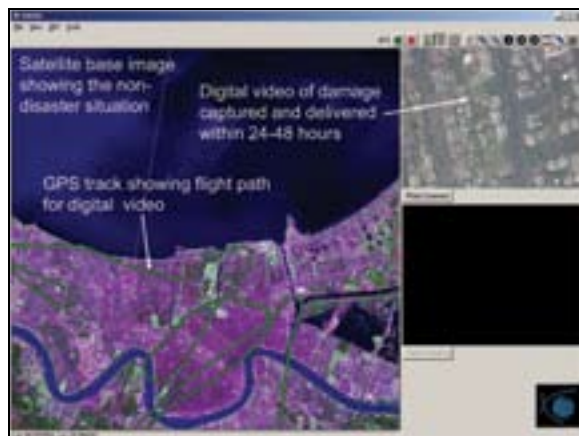
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Remote Sensing Institute to Focus on Real World Applications

A new Remote Sensing Institute (RSI) was officially launched in June during MCEER’s 2006 Annual Meeting. The RSI will serve as a platform for developing and operationally implementing innovative multi-hazard techniques, strategies and products for rapidly assessing post-disaster impacts, modeling and quantifying the built environment, and monitoring recovery.



The PDV program delivers post-disaster damage data within 24-48 hours of the event

Ron Eguchi, RSI Task Force team leader, MCEER investigator and CEO of ImageCat, Inc., commented “the RSI is a first of its kind, bridging industry, the research community and government agencies in examining important issues, opportunities and challenges to institutionalizing the use of remote sensing technologies for disaster response.” Other members of the Task Force are Beverley Adams, ImageCat, Inc., Michel Bruneau, MCEER, Thomas O’Rourke, Cornell University, Chris S. Renschler, University at Buffalo and Masanobu Shinozuka, University of California at Irvine.

RSI is currently pursuing opportunities with a range of government agencies, industry leaders from the emergency management and Re/Insurance sectors, and international organizations involved in risk and loss assessment, disaster mitigation, response and recovery.

Building on previous reserach achievements, RSI offers clients a wealth of

remote sensing and GIS-based capabilities and scientific expertise. The institute will continue to embrace fundamental and applied research activities to develop innovative new approaches to short- and long-term disaster management. Commercial products and services developed by MCEER researchers and available through RSI include: 24-48 hour post-disaster damage assessment under the PDV™ (Post-disaster Damage Verification) program; near real-time flood, surge, hurricane, earthquake and tsunami damage assessment through remote sensing-based damage scales and advanced image analysis techniques; and forensic GPS-registered damage assessment using the in-field VIEWS™ data collection and visualization system.

Through sponsored activities such as the *International Workshop Series on Remote Sensing for Disaster Response*

Partner News

Strategic Partners/Collaborations Pave Paths to Real-World Solutions

Researcher-Partner exchanges help focus research plan



Perhaps Cargill's slogan says it best: "At Cargill, we collaborate, create and succeed with our customers." At

MCEER we too work to "collaborate, create and succeed" with partners in business, industry and government. It's these types of exchanges – between center researchers and strategic partners – that help drive the center's research program and

bring about "Resilient" solutions to real-world problems posed by earthquakes and other hazards.

While the majority of these interactions take place in informal fashion, the calendar over the past several months has been dotted with engagements more formal in nature. Several articles in this issue highlight the activities of the Strategic

Partnerships Network, Industry Advisory Board (IAB), and Strategic Industry Consortia. These include participation in the MCEER Annual Meeting (page 5), Summative Site Review and Offshore seminar (opposite page), as well as research participation in the ASHRAE Consortium (below) and the NEESWood project (page 4).

Visit <http://mceer.buffalo.edu/partnerships/default.asp> for more about the MCEER Strategic Partnerships Network.

ASHRAE Consortium Investigates Performance of Roof-Top Air Handling Unit

MCEER's ASHRAE Consortium is gearing up for Phase II studies involving shake table testing of a rigidly anchored and vibration isolated roof-top air handling unit. Testing will begin in March of this year in the Structural Engineering and Earthquake Simulation Laboratory (SEESL) at the University at Buffalo. Studies are focusing on developing a specialized numerical model capable of analyzing the seismic response of various types of HVAC equipment mounted on ASHRAE-type isolation/restraint systems. In addition, results of this research will help advance MCEER's program to improve understanding and performance of nonstructural components. The experimental program is conducted by University at Buffalo Ph.D. candidate Saeed Fathali under the direction of MCEER Deputy Director and UB Professor Andre Filiatrault.

The ASHRAE Consortium comprises members of the American Society of Heating, Refrigerating and Air-Conditioning Engineers' Technical Committee 2.7, which focuses on fundamental scientific and engineering design principles for seismic and wind restraint design of building mechanical and electrical service systems. MCEER's ASHRAE Consortium was established in 2004 with studies of seismic performance of generic ASHRAE-Type isolators/restraints used for different types of equipment.

More on the ASHRAE consortium is available at: <http://mceer.buffalo.edu/research/ASHRAE/default.asp>.

Remote Sensing Institute

Continued from p. 1

(<http://mceer.buffalo.edu/publications/workshop/05-SP03/>), RSI will continue to provide a successful forum for industry, the research community and government organizations to discuss the issues, opportunities and challenges in institutionalizing the use of remote sensing technologies for disaster management. The fifth workshop in the series will be held in Washington DC during the fall of 2007.

The Task Force is currently identifying prospective members of an Advisory Board that will help to guide RSI outreach activities and the development of new strategic partnerships. Additional information on the Institute is available at http://mceer.buffalo.edu/research/remote_sensing/default.asp.

For more information on MCEER's Strategic Partnerships Network, contact Don Goralski at (716) 645-3391, ext. 108 or goralski@buffalo.edu

NSF Site Review Celebrates MCEER's History

With the theme, *A Decade as a National Science Foundation Engineering Research Center*, MCEER hosted a summative site review on October 26 - 27, 2006 in Buffalo, New York. The day-and-half long event featured a full day of presentations on MCEER's research and education plans, accomplishments, and activities. The site team was led by Vilas Mujumdar, NSF Program Officer, and participants included MCEER investigators, University at Buffalo officials, Industry Advisory Board (IAB) members, and students and former students.

Representatives of Facility Risk Consultants, FM Global, Kinetics Noise Control, KPFF Consulting Engineers, Terra Firm Earthquake Preparedness, Taylor Devices, Weidlinger Associates, as well as Bonneville Power Administration, Los Angeles Department of Water and Power, and New York State Department of Transportation, participated in the event. Glenn Singley, Ellis Stanley and Douglas Taylor made presentations.

Following the Site Review, IAB members joined nearly 20 MCEER investigators, engaging in discussions under the theme of "Capturing Research and Emerging Opportunities: Nurturing IAB/Investigator Synergies." Issues relating to nonstructural components took center stage in the discussion, including a presentation by Steve Eder (Facility Risk Consultants) on the work of the Seismic Qualification Utility Group. IAB members also discussed the prospect of forming a specialty interest group focusing on nonstructural components. Conversations also included the work of MCEER's Electric Utility Consortium

(EUC), focusing on issues regarding qualification of substation equipment to meet and improve IEEE 693 standards.

SLC students also played an active part in the site visit, with 14 students presenting their research posters. A panel of former and current SLC members made formal presentations and engaged in a question and answer session with the NSF panel, regarding their experiences as part of MCEER. The student panelists included Michael Pollino, Ph.D candidate, University at Buffalo, Jeffrey Berman, Assistant Professor, University of Washington, Terri Norton, Aerospace Corporation, and Rory Connell, Innovative Emergency Management, Inc..



After the presentations, a formal dinner was held at the Buffalo and Erie County Historical Society. On the second day, the site review team toured the University at Buffalo's Structural Engineering and Earthquake Simulation Laboratory (SEESL), a NEES Equipment Site, before writing their reports.

MCEER and Structural Control Partners Explore "Offshore" Opportunities

Several of MCEER's structural control technology partners joined with center investigators on December 14, 2006 at a seminar for representatives of the offshore oil industry, in Houston, Texas. *Advanced Technologies for the Seismic and Multi-Hazard Design*



and Retrofit of Offshore Structures, Industrial Structures and LNG Tanks focused on the development and application of structural control technologies such as seismic isolation and damping in both civil infrastructure and on oil and gas industry structures. The program attracted more than 30 participants, including MCEER Strategic Partnerships Network members Dynamic Isolation Systems, Earthquake Protection Systems and Taylor Devices. MCEER extends a special thanks to ExxonMobil for hosting the program at its Upstream Technical Training Center.

For more information, contact Don Goralski at (716) 645-3391, ext. 108 or goralski@buffalo.edu.

NEES Update

NEESWood Project Draws International Media Attention

On November 14, 2006, the UB-NEES equipment site, part of the Structural Engineering and Earthquake Simulation Laboratory (SEESL), was used to subject a fully furnished 1800 sq. ft. wood frame townhouse to a 6.7 magnitude earthquake. A large crowd of observers, including members of the local, national and international media, attended the event.

The Media Day program featured an overview of the experimental program by Andre Filiatrault, Professor in the Department of Civil, Structural and Environmental Engineering and MCEER Deputy Director at the University at Buffalo (UB), and co-PI of the project. The shake table testing followed, and can be viewed at <http://nees.buffalo.edu/projects/NEESWood/>.

The initial phases of the project involved a series of shake table tests at the UB-NEES equipment site. Part of the testing included equipping the townhouse with silicon fluid dampers, developed and provided by MCEER Flagship Partner, Taylor Devices.

Following the final testing phase and as a result of the media coverage, Taylor Devices made the first sale of these seismic dampers to the residential housing market. The dampers will be installed on a \$35 million home being built in southern California.

NEESWood is a consortium of researchers led by John W. van de Lindt, Colorado State University. Co-principal investigators include Rachel Davidson, Cornell University, Andre Filiatrault, UB, David V. Rosowsky, Texas A&M University and Michael Symans, Rensselaer Polytechnic Institute.



Testing of a fully furnished wood frame house attracted a large crowd of observers to the UB-NEES facility

Michael Symans is a graduate of UB, where he earned his Ph.D. based on MCEER-funded research on experimental and analytical investigations of the seismic response of structures with supplemental fluid viscous dampers.

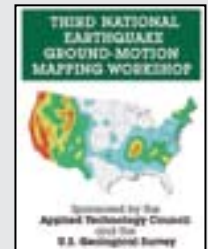
Other UB team members include post-doctoral researcher Assawin Wanitkorkul, who also participates in MCEER's

research program, and graduate student Jianis Christovasilis, as well as several undergraduate REU students. The construction of the test building included students from Erie Community College, a local two-year school granting associate degrees in Construction Technology.

Visit <http://www.engr.colostate.edu/NEESWood/> for more information about the project.

National Earthquake Ground-Motion Mapping Workshop

The third ATC-35/USGS *Workshop on National Earthquake Ground-Motion Mapping* was held December 7-8, 2006 in San Mateo, California. The Workshop was convened by the Applied Technology Council (ATC) and the U.S. Geological Survey (USGS) and a number of co-sponsoring organizations, including MCEER. Like the first and second ATC-35/USGS workshops held in 1995 and 2001, respectively, this workshop provided input from the structural engineering, geotechnical engineering, geosciences, and risk modeling professions to the USGS on key issues that affect the preparation and use of the next round of national earthquake ground motion maps (and related products).



The workshop also provided input to organizations responsible for the selection and adoption of ground motion maps in model seismic regulations and actual seismic codes governing the design of buildings, bridges, and other structures. In addition, the workshop discussed potential new map-related products.

A proceedings that includes a summary of the discussions, copies of the presentations and some papers is planned. Additional information is available on ATC's website at <http://www.atccouncil.org/rel091206.shtml> or by contacting ATC via email at ATC@ATCCouncil.org.

Defining and Measuring Disaster Resilience is Focus of 2006 MCEER Annual Meeting

MCEER carried its message of making disaster resilience measurable to the nation's Capital with its *2006 Annual Meeting*. The program, which took place June 29-30, in Arlington, Virginia, attracted nearly 120 participants from within and beyond the capital beltway.

The meeting kicked off with an all-day program on June 29 that defined the concept of resilience, and explored fundamental resilience metrics – **robustness, redundancy, resourcefulness** and **rapidity** – by which disaster resilience can be better measured and improved. The concept and foundational metrics for resilience were developed initially by MCEER researchers for earthquake hazards mitigation. These same metrics are now being applied by MCEER and its industry and government partners, to other hazards and extreme events.

Titled *Enhancing Resilience against Multiple Hazards*, the program drew participation from representatives of federal agencies, congressional staff, policy think tanks, and the practicing community of architects, engineers, owners, other corporate stakeholders, and emergency managers from around the United States.

They were joined by MCEER industry partners in business, industry and government, as well as center investigators



Michel Bruneau and Kathleen Tierney gave a joint presentation on resilience metrics

and students. A review of the MCEER SLC participation is provided on page 12.

Presentations illustrated how the use of resilience metrics guide MCEER's applied research program. Three breakout sessions discussed these metrics in greater detail, drawing upon research developments and practitioners' perspectives for applying resilience metrics to:

- Disaster planning, response and recovery via remote sensing technologies
- Evaluation & retrofit of geographically distributed life-line (utility) systems
- Design & retrofit of critical infrastructure and facilities (hospitals, highways & other structures)

A luncheon presentation by Gilberto Mosqueda (University at Buffalo), Lucy Arendt (University of Wisconsin, Green Bay), and Ryan Shannon (Tulane University medical student) chronicled observations from MCEER's Post-Hurricane Katrina Reconnaissance investigations.

A banquet presentation on the National Earthquake Hazards Reduction Program (NEHRP) was delivered by NEHRP Director, John (Jack) R. Hayes Jr., of the National Institute of Standards and Technology.

Hayes provided background information on the program, discussing the roles and responsibilities of involved federal agencies, and changes to the NEHRP organizational and operational structure.



Jack Hayes discussed the NEHRP program at the banquet presentation

The second day included presentations by MCEER's partners in business, industry and government, as they discussed challenging issues faced by practitioners.

15 Strategic Partnerships Network and Industry Advisory Board (IAB) members, including Degenkolb Engineers, Facility Risk Consultants, ISAT Seismic Bracing, Johnson Controls, KPFF Consulting Engineers, Los Angeles Department of Water and Power, Los Angeles Emergency Preparedness Department, Terra Firm Earthquake Preparedness, and Weidlinger Associates, made presentations at the event. Armstrong World Industries, and East Bay Municipal Utilities District contributed to discussions. The majority of presentations focused attention on nonstructural component issues, an area of prime emphasis in updated building codes and within MCEER's research program.

The meeting recap at <http://mceer.buffalo.edu/meetings/2006AnnualMeeting/> includes photos, presentations, student posters and more.

Ryan Shannon shared his experiences as a Tulane University medical student during and immediately following Hurricane Katrina in New Orleans



ANCER Activities

Young Researchers from China and the US Gather at Earthquake Engineering Forum

From May 27-June 7, 2006, about 25 young researchers from the US and China participated in the *PRC-US Earthquake Engineering Forum for Young Researchers*. The purpose of the Forum was to establish professional opportunities and foster long-term partnerships in the form of continued technical communications and research collaboration.

George C. Lee and Xiaozhai Qi served as the coordinators, and Amjad Aref was the US team leader. US participants were Larry Fahnestock (University of Illinois at Urbana Champaign - UIUC), Gilberto Mosqueda (University at Buffalo - UB), Scott Olson (UIUC), Scott Robinson (University of Texas at Dallas), S. Thevanayagam (UB), Deborah Thomas (University of Colorado at Denver) and Ken Walsh (Bradley University).

The Forum included a formal technical program, technical tours in three cities: Harbin (Institute of Engineering Mechanics, Harbin Institute of Technology), Beijing (Beijing University of Technology and Academy of Building Research) and Shanghai (Tongji University), and selected sightseeing in these cities. Dr. Zifa Wang, Director of IEM, delivered the introductory lecture, which included a segment on Chinese culture.



Participants in front of IEM in Harbin, China

The Forum was organized as an ANCER activity between two of its member Centers, the Institute of Engineering Mechanics, China Earthquake Administration and MCEER. It was primarily sponsored by

the US National Science Foundation, Huixian Earthquake Engineering Foundation, Heilongjiang, China and the Chinese Association of Earthquake Engineering (CAEE).

Vargas wins Best Student Paper Award

Ramiro Vargas, who completed his Ph.D. studies in the Department of Civil, Structural and Environmental Engineering at the University at Buffalo last February, won the annual Best Student Article Competition for his paper, "Seismic Response of Hybrid Systems with Metallic and Viscous Dampers." His paper was one of ten published in *Student Research Accomplishments: 2004-2005*, the fifth in a series featuring the work of MCEER SLC students on topics ranging from traditional civil and lifeline engineering to applications of advanced technologies, to social impacts and economic modeling.

Members of MCEER's Industry Advisory Board (IAB) selected the winner and two honorable mentions, T. Shenthan and Dong Wang, both from the University of Buffalo. Our thanks go to Steve Eder, Facility Risk Consultants, Inc., Andy Taylor, KPFF Consulting Engineers, Doug Taylor, Taylor Devices, Inc., Walterio Lopez, Rutherford and Chekene, and Ali Porbaha, CSU, California for their reviews and recommendations.

The award was presented at the MCEER Annual Meeting in Washington, DC, where Ramiro, now a Professor in the civil engineering department of the Technological University of Panama, presented his research to meeting participants.

Visit <http://mceer.buffalo.edu/publications/resaccom/06-SP04/default.asp>. Ramiro was also featured in the Summer 2006 Student Spotlight column, available at http://mceer.buffalo.edu/publications/bulletin/06/20-02/17_Spotlight_Vargas.asp.



Ramiro Vargas (left) receives his award from MCEER Education Director "Theva" Thevanayagam (center) and MCEER Director Michel Bruneau (right)

US delegation at the Juyongguan Pass, near the Great Wall of China



Fifth National Seismic Conference on Bridges and Highways Focuses on Innovations in Earthquake Engineering

Nearly 500 transportation professionals from eleven countries and 36 states attended the *Fifth National Seismic Conference on Bridges and Highways*, held September 18-20, 2006 in San Francisco, California. The biennial conference was organized by the Federal Highway Administration (FHWA), California Department of Transportation (Caltrans), the Transportation Research Board and MCEER. Myint Lwin, Director, Office of Bridge Technology, FHWA and Rick Land, Chief Engineer, Caltrans, were honorary co-chairs.

Roy Imbsen was one of over 20 researchers participating in the poster session



Under the theme *Innovations in Earthquake Engineering for Highway Structures*, the conference featured prominent international leaders in both academia and industry as keynote speakers. Invited speakers included Rick Land, Myint Lwin, Kazuhiko Kawashima, Tokyo Institute of Technology, Lichu Fan, Tongjii University, T.J. Zhu, Buckland

The exhibit area was crowded during breaks, where participants could learn more about products and support services



Bob Tanaka, left, and Jerry O'Connor on the technical boat tour of San Francisco area bridges

and Taylor, Ltd., Lars Hauge, COWI, K.C. Chang, National Taiwan University, Charles Seim, Consulting Bridge Engineer, and Roy Imbsen, Imbsen Consulting.

The conference program included over 60 technical papers and more than 20 posters on topics related to improving the seismic safety of the US highway system, including seismic risk assessment of highway networks, lessons learned from recent earthquakes, design and analysis of major bridges, foundations and geotechnical considerations, and several others. In addition, there was an open discussion panel on multiple hazard design, and a full-day *Seismic Retrofit Workshop* (see page 9) held the day before the conference.

Other program highlights included two best paper awards, given in memory of James Cooper, a champion of seismic safety at FHWA, and James Roberts (see page 9), who had a long and distinguished career with Caltrans. Stephen Mahin, UC California, Berkeley and his co-authors received the James Cooper award for "Use of Partially Prestressed Reinforced Concrete Columns

to Reduce Post Earthquake Residual Displacements of Bridges," the paper judged to have the greatest potential impact, contribution to society and best overall quality. The James Roberts award, given for work containing a deployable research

innovation expected to have a significant impact on the practice of the bridge engineering profession, went to Brian Chiou of Caltrans and his team for "An Overview of the Project of Next Generation of Ground Motion Attenuation Models for Shallow Crustal Earthquakes in Active Tectonic Regions."

More than 20 companies showcased their products and services in the exhibit area, and support from platinum level sponsors, HNTB, Parsons Brinkerhoff, T.Y. Lin International, Washington Group International and the University Transportation Center at the University of Missouri-Rolla, helped make the conference enjoyable and technically comprehensive. A post-conference technical boat tour arranged by Caltrans took 100 participants to the San Francisco Oakland Bay Bridge project, which features a segmental concrete bridge and a self anchored suspension span, the Golden Gate Bridge, the Richmond - San Rafael Bridge, and the Carquinez Straits Bridge.

Visit <http://mceer.buffalo.edu/meetings/5nsc/default.asp> for more information and to order the conference proceedings.

Fourth PRC-US Workshop Held in “City of Bridges”

With the special theme of “Advancing Bridge Technologies in Research, Design, Construction and Preservation,” the fourth PRC-US Workshop on Seismic Analysis and Design of Special Bridges was held in Chongqing, China, known as the City of Bridges, on June 19-20, 2006. Hosted by workshop co-chair Professor Li Zhang of the Chongqing Communications Research and Design Institute (CCRDI), this year’s workshop was expanded to include bridge management and construction, in addition to seismic analysis and design of long-span and special highway bridges. George C. Lee (MCEER, University at Buffalo) and Lichu Fan (Tongji Univer-



Participants at the fourth PRC-US Workshop pose for a group picture

sity) also served as co-chairs. The workshop was primarily sponsored by the Chinese Ministry of Communications (MOC) and the US Federal Highway Administration (FHWA).

About 40 participants exchanged state-of-the-art information on highway bridge technologies and discussed

plans to develop future cooperative research projects between the US and China. Topics for future collaborative research include comparative studies of seismic design specifications, high performance concrete and steel bridges and bridge substructure systems, and bridge design data collection. In addition, the group plans to explore the development of mechanisms to assist visiting teams in disaster reconnaissance and/or large construction/restoration projects and to facilitate cooperation in terms of defining specific projects by the government agencies and providing possible resources.

Maorun Feng, Chief Engineer, MOC and Myint Lwin, Director, Office of Bridge Technologies, FHWA, served as honorary co-chairs of the event. The Steering Committee was chaired by Shengying Chen, Department of Highway Administration, MOC and Philip Yen, FHWA.

In conjunction with the workshop, many of the participants took a technical tour of the 3-Gorge Dam, which will be the site of the largest hydropower station and dam in the world.

The next workshop is planned for 2008. Visit <http://mceer.buffalo.edu/meetings/PRC-US/default.asp> for reviews, proceedings and more information about all four workshops.

Second US-Taiwan Workshop Focuses on Bridge Engineering

Transportation engineers, researchers, and high level government officials convened in San Francisco for the second bridge engineering workshop, held jointly between Taiwan and the United States. The event, held Sept 21-22, 2006, was sponsored by the Federal Highway Administration and included about 40 invited participants. Phil Yen, FHWA, was the conference chair. It was organized by MCEER, University at Buffalo and the Taiwan Construction Research Institute.



Participants visited the Devil's Slide construction site

The workshop built upon the first gathering in Taipei in 2005 which had a focus on “Bridge Maintenance.” The theme of the 2006 workshop was “Bridge Engineering.” There was much discussion on the seismic design of highway bridges and the repair of bridges damaged by earthquakes, flooding and landslides. There were also presentations on bridge maintenance and bridge management systems that extended the discussions initiated at the 2005 workshop.

Engineers from Caltrans played a significant role in the technical program. They also hosted a technical tour of construction sites for the Taiwan delegation following the formal sessions.

A CD of the papers and presentations will be available from MCEER in the near future. A third workshop is planned for 2007 in Taiwan. See <http://mceer.buffalo.edu/publications/workshop/06-0014/default.asp> for more information.

Latest Techniques for Seismic Retrofit of Bridges Presented

Over the past several months, the Federal Highway Administration (FHWA) and MCEER have held several workshops on the seismic retrofitting of bridges, based on the newly released "Seismic Retrofitting Manual for Highway Structures" (see page 10). Phil Yen and John O'Fallon, both FHWA contracting office technical representatives (COTRs), have overseen MCEER's highway project research, the development of the retrofitting manuals, and subsequently, the content of the workshops.

A one-day *Seismic Retrofit of Bridges* workshop was held in San Mateo, California on September 17, 2006, as part of the *Fifth National Seismic Conference on Bridges and Highways* (see page 7 for a review of the conference). Over 60 participants, representing several state departments of transportation and engineering consultants, attended the full day event.

Session moderator Derrell Manceaux, FHWA, was pleased with the turnout and enthusiastic participation of the attendees. Presenters were Phillip Yen, FHWA, Ian Buckle, University of Nevada Reno, Peter Dusicka, Portland State University, Anoosh Shamsabadi, Caltrans and Richard Nutt, Structural Engineering Consultant. Geoff Martin, University of Southern California, and Earth Mechanics and Jerry O'Connor, MCEER, contributed behind the scenes.

The workshop covered the performance-based philosophy described in the manual as well as an overview of seismic and geotechnical hazards, geotechnical modeling and capacity assessment, and retrofitting strategies and approaches with



From left: Ian Buckle, Peter Dusica, Phil Yen, Darrel Manceau, Richard Nutt, Anoosh Shamsabadi and Jerry O'Connor

specific examples to illustrate the concepts.

On June 13, 2006, FHWA and MCEER convened *Seismic Design and Retrofit of Bridges* in Pittsburgh, Pennsylvania as part of the *International Bridge Conference*. About 60 engineers were updated on what is considered state-of-the-art in the seismic design of new bridges, seismic retrofitting, response modification, and geotechnical considerations.

Presenters were Roy Imbsen, Consulting Engineer; Phillip Yen, FHWA; Andrew Whitaker, University at Buffalo; and Ken Fishman, McMahan and Mann, Consulting Engineers.

The workshop presenters emphasized the implications of adopting performance based design/retrofit objectives and the inherent need for deformation-based, rather than the traditional force-based, methods of analysis. Advantages and limitations of simplified methods were described as well as alternative approaches involving more rigorous methods and corresponding requirements in terms of computational effort, site characterization, and soil modeling.

Visit http://mceer.buffalo.edu/research/HighwayPrj/Workshops/seismic_retrofit.asp for more information about the workshops.

James E. "Jim" Roberts, who served as the state's top bridge engineer at Caltrans, passed away at the age of 75 on July 6, 2006. Mr. Roberts, who retired in 2001 as the Department's Chief Deputy Director, served as a structural engineer at Caltrans for more than half a century, including 15 years as California's State Bridge Engineer. He spearheaded the Department's \$4.5 billion seismic retrofit program and oversaw nearly \$50 million in seismic research projects. He was also named to the National Academy of Engineering in 1996, the only state-employed engineer to be so honored.



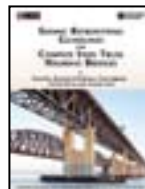
James E. Roberts

Jim was an early supporter of MCEER's highway project (at the time known as NCEER), and served as an active participant on the project's external Highway Seismic Research Council (HSRC). His advice and input during the formative stages of the project was very valuable and appreciated. We will miss his dedication, wise counsel and good humor very much.

New Bridge Reports Showcase State-of-the-Art Research

Over the past decade, MCEER has carried out a research program on the design and retrofit of bridges and highway structures. This research, sponsored by the Federal Highway Administration (FHWA) and overseen by FHWA technical representatives John O'Fallon and Phillip Yen, has led to the publication of several new manuals and guidelines, all available from MCEER. Topics include improved seismic design, evaluation and retrofit methodologies, and strategies for new and existing bridges and other highway structures.

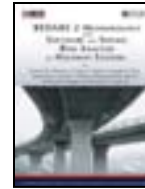
Seismic Retrofitting Guidelines for Complex Steel Truss Highway Bridges, by T. Ho, R. Donikian, T. Ingham, C. Seim and A. Pan (MCEER-06-SP05), presents the state of the practice, through 2005, for retrofitting steel truss bridges in the US. A performance-based seismic retrofit philosophy is used. The guidelines cover all major aspects pertinent to the seismic retrofitting of steel truss bridges, with a focus on superstructure retrofit. Case studies are provided. These guidelines are a supplement to the 2006 FHWA *Seismic Retrofitting Manual for Highway Structures* for "unusual or "long span" steel trusses.



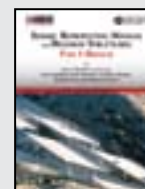
Seismic Isolation of Highway Bridges, by I.G. Buckle, M. Constantinou, M. Dicleli and H. Ghasemi (MCEER-06-SP07), presents the principles of isolation for bridges, develops step by step methods of analysis, explains material and design issues for elastomeric and sliding isolators, and gives detailed examples of their application to standard highway bridges. The manual is a supplement to the Guide Specifications for *Seismic Isolation Design* published by AASHTO in 1999.



REDARS 2: Methodology and Software for Seismic Risk Analysis of Highway Systems, by S.D. Werner, C.E. Taylor, S. Cho, J-P. Lavoie, C. Huyck, C. Eitzel, H. Chung and R.T. Eguchi (MCEER-06-SP08), provides the basic framework and a demonstration application of the Seismic Risk Analysis (SRA) methodology and its modules. The main modules of the REDARS 2 SRA methodology include hazards, components, system and economic. The northern Los Angeles, California highway system is used as a demonstration application of the SRA methodology.



Seismic Retrofitting Manual for Highway Structures, Part 1 – Bridges, by Ian G. Buckle (lead author), Ian Friedland, John Mander, Geoffrey Martin, Richard Nutt and Maurice Power (MCEER-06-SP10), provides procedures for screening, evaluating, and retrofitting highway bridges. The manual introduces a performance-based retrofit philosophy similar to that used for the performance-based design of new buildings and bridges. It extends the guidance provided in the earlier FHWA manuals (originally issued 1983 and updated in 1995), based on recent experiences in California, Japan, and other countries, as well as the results of comprehensive research programs that have been sponsored by FHWA, MCEER, Caltrans, and other agencies.



Seismic Retrofitting Manual for Highway Structures, Part 2 - Retaining Structures, Slopes, Tunnels, Culverts and Roadways by Maurice Power (lead author), Kenneth Fishman, Rowland Richards, Faiz Makdisi, Samuel Musser and T. Leslie Youd (MCEER-06-SP11), includes new procedures for determining the seismic vulnerability of other important highway system structures, namely, retaining structures, slopes, tunnels, culverts, and roadways. Guidance is provided on screening for potential seismic vulnerabilities; conducting a detailed evaluation; and describing strategies for retrofit design. In addition, discussion is provided for classifying each structure by type, construction, or expected performance.



The Seismic Retrofitting Manuals are also available from the Federal Highway Administration.

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MCEER-SLC Competes in Sixth Annual APEC-IDEERS Seismic Design Competition in Taiwan

In the Fall of 2006, 24 teams of graduate students from Taiwan, China, Malaysia, Vietnam, Hong Kong, and the United States competed in the 2006 *Asia-Pacific Economic Cooperation-Introduction and Demonstration of Earthquake Engineering Research in Schools (APEC-IDEERS) Seismic Design Competition*. The event was held September 22-24, 2006 at the National Center for Research on Earthquake Engineering (NCEE) in Taipei, Taiwan. Held since 2001, the event aims to generate student interest in structural engineering and disaster mitigation. In addition to the graduate teams, 36 undergraduate and 36 high school teams participated in the competition.

The goal of the graduate competition was for each team to retrofit a two-story benchmark model. All teams constructed the model with materials provided by NCEE and were asked to add some form of energy dissipation to increase its performance. The model buildings were designed to carry a 10 kg mass on each floor and were subjected to earthquakes ranging from 400 -1200 gal. While increasing the seismic performance of the model, the main goal was for the design to



Over 200 students from around the world participated in the competition

sustain a 1000 gal (1.02 g) earthquake. Not only was each team judged on the seismic performance and architectural features of their buildings, but also on an oral presentation of their design.

Marlon Hill (Florida A&M University), Bing Qu and Yu-Chen Ou (University at Buffalo) represented the MCEER SLC at the competition. The team designed a roller bearing base isolation system with viscous dampers. Scoring for the graduate competition was based on a multiple of the presentation,



The MCEER team (from left): Bing Qu, Marlon Hill and Yu Chen Ou

the mass, and the performance of the structure. The MCEER SLC team, the only American team to participate, placed 11th out of 24 teams overall and won first place for best presentation and most creative design.

--Submitted by Marlon Hill, Florida A&M University

Six positions are available in the Research Experiences for Undergraduates (REU) Program and five in the MCEER REU Diversity Program.

<http://mceer.buffalo.edu/education/reu/2007.asp>

2006 REU Symposium Held in Sunriver, Oregon

The 2006 Annual Tri-Center Earthquake Engineering Symposium for Young Researchers was held August 10-13, 2006 in Sunriver, Oregon and organized by PEER. This year's group was significantly larger, totaling thirty-four undergraduate students from MAE, MCEER, PEER, and newcomer NEES. All of the participants presented their research conducted during the 10-week long summer program, Research Experiences for Undergraduates (REU).



The MCEER-sponsored REU students enjoyed an afternoon tour at the foothills of the Cascade mountains

MCEER sponsored nine REU students this summer. Seven completed their programs at the University at Buffalo (UB): Lisa Armbruster, Jesse Gotham, Jayce Grefrath, and Donald Taylor from UB; Alma Garcia from California Polytechnic State University; Tony Kim from Bradley University; and Sean Eosefow from Rensselaer Polytechnic Institute; Kristn Denaye Hinds and Aaron Williams remained at their home institute, Florida State University, to conduct their research.

Symposium proceedings will be available from PEER. More information can be found at <http://mceer.buffalo.edu/education/reu/>.

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Seminar Series

Temporary Structures during Construction

Peter K. Ostrowski
September 28, 2006

State of the Art of Shaking Table Tests of Wood Buildings in Japan

Dr. Hiroshi Isoda
August 25, 2006

Seismic Analysis of Woodframe Structures

Dr. Bryan Folz
June 9, 2006

Smart Structures Based on Variable Stiffness and Damping Systems

Dr. Satish Nagarajaiah
April 28, 2006

View archived webcasts, abstracts and more on the series at <http://civil.eng.buffalo.edu/webcast/>.

SLC Members Participate in MCEER Annual Meeting

Seventeen members of MCEER's Student Leadership Council from six different universities participated in the 2006 MCEER Annual Meeting June 29-30, held in Arlington, Virginia, attending the program and presenting their own research in the student poster session (see article on page 5).

On the second day, the SLC met to discuss the Annual SLC Retreat, the Tri-Center Field Mission to New Zealand, the 2005-2006 Student Research Accomplishments Volume (SRA), the 2007 Undergraduate Seismic Design Competition (USDC) and other business. The SLC Retreat was tentatively scheduled to be held either at Cornell University or New Jersey Institute of Technology in the Spring of 2007. Seda Dogruel and Rodrigo Retamales, both from the University



SLC members (from left): Saeed Fathali, Seda Dogruel and Cagdas Kafali, presented research posters at the meeting

at Buffalo, volunteered to edit the SRA. Also, students from each of the MCEER institutions represented at the meeting agreed to assist in forming and advising undergraduate students from their university to participate in the Undergraduate Seismic Design Competition, which will be held in Los Angeles, CA in conjunction with the 2007 EERI Annual Meeting.

Attendees included: Cuong Nguyen, California State University at Los Angeles; Cagdas Kafali and Taronne Tabucchi, Cornell University; Marlon Hill, Florida A&M University; Navid Allahverdi Pur, New Jersey Institute of Technology; Gian Paolo Cimellaro, Seda Dogruel, Saeed Fathali, Yufeng Hu, Xiaobo Luo, Michael Polino, Hongbo Wang, Bing Qu, Rodrigo Retamales and Dong Wang, University at Buffalo; Robert Corbin, University of Nevada-Reno; and Sung-Han Sim, University of Illinois at Urbana-Champaign.

To view the student posters, visit <http://mceer.buffalo.edu/meetings/2006AnnualMeeting/2006Student/default.asp>.

-Submitted by Gian Paolo Cimellaro, University at Buffalo

Robert Corbin graduated with a Master of Science degree from the University of Nevada, Reno (UNR) in December 2006, after successfully defending "Experimental Evaluation of the Seismic Performance of Hospital Copper Piping Systems." Dr. "Manos" Maragakis was his advisor in the Department of Civil and Environmental Engineering.

Robert's interest in earthquake engineering began with "structures such as skyscrapers and bridges, especially those that could withstand earthquakes such as the 1994 Northridge Earthquake." A Las Vegas native, he chose the highly-ranked Civil Engineering Department at Reno to stay in Nevada, and was pleased to later discover that the structural staff and facilities were responsible for a large part of the department's popularity. After completing his undergraduate degree, he was given the opportunity to test a replica of a hospital piping system using the shake table in the James E. Rogers & Louis Weiner, Jr. Large-Scale Structures Laboratory at UNR.

"This experience gave me the knowledge needed to further my understanding of how we as engineers can enhance the seismic resiliency of past, present, and future structures as well as their nonstructural components," Robert explains, describing the importance of research to his career. He is currently considering several job opportunities at structural engineering firms in the Reno/Tahoe area. In February, he will oversee the next set of experiments involving the testing of a copper piping system as a part-time engineering consultant at UNR.

An avid soccer player, Robert is a member of teams in Reno, Lake Tahoe, Carson City and Trukee (California). He also likes to travel and snowboard.



Robert Corbin

Filiatrault Co-Authors Book on Passive Energy Dissipation and Base Isolation Systems

Constantin Christopoulos, University of Toronto, and MCEER's Deputy Director Andre Filiatrault, are co-authors of a newly published book entitled "Principles of Passive Supplemental Damping and Seismic Isolation." The book provides theoretical and applied knowledge on various supplemental damping and seismic isolation systems that have demonstrated potential at raising the performance of buildings and bridges under earthquake ground motions while keeping construction costs reasonable. The focus of the book is on passive energy dissipation and base isolation systems.

IUSS Press, a Publishing House recently created by the Institute of Advanced Study of Pavia, Italy, is the publisher. The hard cover book can be ordered at <http://www.iusspress.it/Default.Asp?Lingua=Eng>.

2006 Tri-Center Field Mission Visits New Zealand

A group of 13 students and five educators visited seismically and volcanically active New Zealand on the 2006 Tri-Center Field Mission. The NSF-sponsored trip took place August 15-23, 2006. The team, led by MCEER education director S. Thevanayagam, included four MCEER SLC members: Shuichi Fujikura, Dong Wang, Gian Paolo Cimellaro, and Michael Pollino, all from University at Buffalo.

The group's first stop was the the University of Canterbury (UC) in Christchurch where John Mander, chair of structural engineering and former UB faculty member and MCEER investigator, organized a research exchange. Each of the EERC students gave presentations, along with nine students from UC. Topics included geotechnical engineering, structural control, structures, and rocking structures. The students viewed demonstration shake table tests and quasi-static tests of post-tensioned beam-column connections. They also visited scenic areas in the Southern Alps while traveling through Arthur's Pass, stopping at the Otira Viaduct, which crosses one of the largest seismic faults on South Island.

Travel continued to Wellington, the country's capital, on the North Island. At the Geo-



Field Mission participants at Arthur's Pass

logical and Nuclear Sciences Research Institute (GNS), they heard presentations on seismic hazard modeling, GNS' active faults database, volcanoes, loss modeling, and other topics. Dr. Andrew King arranged the GNS program.

The group then went on a technical tour along the Wellington fault line. They visited Thorndon Motorway, which passes directly over a fault and is designed to protect against fault rupture. At the University of Victoria, participants toured the Rankin Brown Library Building,

retrofitted with base isolation techniques using elastomeric, lead-core bearings. Next, the students toured the under-construction Wellington Hospital, seismically designed with base isolation using a combination of flat friction and elastomeric bearings.

The final stop was the University of Auckland, arranged by professors Michael Pender, and Sri Sritharan. Students gave research presentations, took a tour of the laboratory facilities and attended a lecture. Sightseeing activities in Auckland included a visit to Sky Tower and hiking to the top of Rangitoto Island.

Student reports and a photo journal will be posted on the SLC website at <http://mceer.buffalo.edu/education/tricenter/default.asp>.

-Submitted by Michael Pollino,
University at Buffalo

Multihazard Risk Profile for New York State

Students in the Multi-Hazard Comparison Planning Studio taught by Ernest Sternberg, Professor, Department of Urban and Regional Planning, University at Buffalo (UB), presented preliminary findings of a multihazard risk profile at the Nelson A. Rockefeller Institute of Government in Albany, NY on December 11, 2006. Over 40 people attended the event, including officials from state agencies such as Homeland Security, the State Emergency Management Office/Hazard Mitigation, and the Department of Health/Hazardous Substance Materials Surveillance.

The students discussed the catastrophic potential of sea surges, terrorist attacks and the outbreak of a pandemic flu for New York State, alongside the continual threats of technological failures and other severe weather events. This research was conducted as an MCEER educational activity. The research was collected, compiled and presented by Lindsay Allen, Melissa Fratello, Julie Gotham, Hao Huang, Elea Mihou, Jody Pollot, Pavan Yadav and Carol Yamarino, all graduate students in the Department of Urban and Regional Planning at UB. A presentation was also given at UB on December 6, 2006.



(Top photo): Wellington Hospital construction site with base isolation seismic protection and (right photo): MCEER SLC participants at the site



MCEER Movers & Shakers

ATC-61 Project Team Receives Excellence Award

On behalf of the ATC-61 Project Team, Ronald T. Eguchi accepted an *ATC Award of Excellence for Extraordinary Achievement in Assessment of Future Savings from Mitigation Activities* at a black tie dinner April 17, 2006 in San Francisco. The award was presented in recognition of his leadership as Project Director of the Research Team who authored "Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, Volume 1 – Findings, Conclusions and Recommendations." The research team was assembled by the Applied Technology Council (ATC) on a contract from the Multihazard Mitigation Council (MMC) of the National Institute for Building Sciences. Other MCEER investigators who participated on the Research Team include Adam Rose, Stephanie Chang and Charles Huyck. Bill Petak served on the Internal Project Review Team and Kathleen Tierney serves on the MMC Project Management Committee. Sponsored by ATC and Engineering News Record, the event celebrated 100 years of seismic structural engineering and construction in the U.S. A complete list of awards is on ATC's website at: <http://www.atcouncil.org/2006DinnerDescription.shtml>.

Seim Receives Lifetime Achievement Award



C. Seim

Charles "Chuck" Seim, a MCEER Highway Project investigator, is the 2006 recipient of the John A. Roebling Medal for Lifetime Achievement in Bridge Engineering. Mr. Seim's 50 year career with Caltrans and T.Y. Lin International was full of innovation in bridge engineering and construction. As supervising engineer for Caltrans and later bridge maintenance engineer for California State owned toll bridges, he has supervised an array of repairs and new construction of many major structures in California. With T.Y. Lin, his portfolio included the design of many international projects. He is a distinguished presenter and author on the topics of elastic stability problems, earthquake considerations, orthotropic steel decks and composite elements in bridge construction.

TY Lin International Wins Bridge Award



Dagu bridge

Tom Ho, Vice President of T.Y. Lin International and MCEER Highway Project investigator, accepted the Eugene C. Figg Jr. Medal on behalf of the Dagu Bridge project team at the *23rd Annual International Bridge Conference* on June 12, 2006 in Pittsburgh, Pennsylvania. The Dagu Bridge is located in the center of the city of Tianjin, China, and is part of a larger effort to redevelop the city's urban core. Its asymmetric, inclined plane, twin tied arches represent the sun and the moon dancing with the golden dragon over the Haihe River. The honor is bestowed annually to a signature bridge which represents a "single, recent, outstanding achievement in bridge engineering that, through vision and innovation, provides an icon to the community for which it was designed."

John Kulicki Elected to the National Academy of Engineering (NAE)



J. Kulicki

Modjeski and Masters' President/CEO and Chief Engineer, John M. Kulicki, Ph.D., P.E., was among 76 new members and nine foreign associates elected to the National Academy of Engineering. He was chosen by his peers for his contribution to the design of major bridges and for leadership in the development of load and resistance factor design specifications. Mr. Kulicki chairs MCEER's Highway Seismic Research Council.

Reinhorn Receives Exceptional Scholar Award



A. Reinhorn

Andrei M. Reinhorn, Professor, Department of Civil, Structural, and Environmental Engineering, and long-time MCEER investigator, received the *Exceptional Scholar -- Sustained Achievement Award*, from the School of Engineering and Applied Science, University at Buffalo. He was one of 12 faculty members to receive the honor created to recognize long-term contribution to science and/or engineering.

New Technical Reports

Multi-Dimensional Fragility of Structures: Formulation and Evaluation

By G.P. Cimellaro, A.M. Reinhorn, M. Bruneau and A. Rutenberg, MCEER-06-0002, March 1, 2006, 162 pages, \$30.00

This report presents a method of developing fragility curves of buildings (for health care facilities) on the basis of structural and statistical analyses. This research is part of MCEER's Thrust Area 2 project on improving the seismic resilience of hospitals. A generalized formula is proposed for evaluating the fragility of structures with respect to multiple control parameters using multiple thresholds limit states. Various options were considered to exemplify the sensitivity of this formulation. A case study of the MCEER west coast Demonstration Hospital [W70], located in Southern California, is considered to show the applicability of this technique.

Analytical Investigation of the Structural Fuse Concept

By R. E. Vargas and M. Bruneau, MCEER-06-0004, March 16, 2006, 388 pages, \$35.00

This report presents an analytical study of the structural fuse concept, which is a system that is designed to concentrate seismic damage in easy-to-replace devices, in this case metallic dampers, to allow the primary structure to remain elastic. A comprehensive parametric study was conducted to investigate the range of validity of this concept, and identify combinations of key parameters essential to ensure adequate performance under seismic conditions. Several types of metallic dampers, including Buckling-restrained Braces (BRBs), Triangular Added Damping and Stiffness (T-ADAS), and Shear Panels (SP) were investigated for use in design and retrofit. A companion study provides the experimental validation of the analytical models developed in this report (see Technical report MCEER-06-0005).



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Experimental Investigation of the Structural Fuse Concept

By R. E. Vargas and M. Bruneau, MCEER-06-0005, March 17, 2006, 210 pages, \$35.00

This report presents the experimental research program developed in conjunction with analytical research on the use of metallic dampers as structural fuses to reduce structural damage due to earthquakes (see technical report MCEER-06-0004). The results of a proof-of-concept experimental program to validate the proposed design procedure, which involved testing of two types of Buckling Restrained Braces (BRBs) on the shake table at the University at Buffalo, are provided. The first BRB had moment-resisting connections made by Nippon Steel Corporation (Japan) and the second had pin connections, manufactured by Star Seismic (US). The main objectives of the testing were to: assess the replaceability of BRBs designed to be sacrificed and easy-to-repair members; investigate the behavior of a special type of connector, which is attached to the frame by a removable and eccentric gusset plate, designed to prevent performance problems observed in other experimental research; and examine the use of seismic isolation devices to protect nonstructural components from severe floor vibrations. Good agreement was generally observed between the experimental results and seismic response predicted through analytical models.

Further Development of Tubular Eccentrically Braced Frame Links for the Seismic Retrofit of Braced Steel Truss Bridge Piers

By J. W. Berman and M. Bruneau, MCEER-06-0006, March 27, 2006, 320 pages, \$35.00

This report is a continuation of research on eccentrically braced frames with self-stabilizing tubular links for use as both a retrofit alternative and seismic load resisting system for new bridges (see technical report MCEER-05-0004). A finite element parametric study was performed to investigate the effects of key design parameters for rectangular link cross-sections on link rotation capacity, energy dissipation, and overstrength. Results from this parametric study were used to develop proposed design recommendations and provide insight into the behavior of tubular links. An experimental program was developed to test fourteen links with cross-sections that were at the revised limits for web and flange compactness and four different link lengths. Results indicate that the design recommendations are successful in achieving links that can sustain their target rotation prior to strength degradation from local buckling. Recommendations for design requirements for tubular links for implementation in bridge and building seismic design codes are provided.

Conceptual Design and Experimental Investigation of Polymer Matrix Composite Infill Panels for Seismic Retrofitting

By W. Jung, M. Chiewanichakorn and A.J. Aref, MCEER-06-0010, September 21, 2006, 350 pages, \$40.00

In this research, three prefabricated PMC infill panel systems for seismic retrofitting were studied using experimental and analytical methods to assess their effectiveness and response under simulated earthquake loading. The concept of combined interface damping layers, which include honeycomb and solid viscoelastic materials, was applied to these panel systems and was found to be highly feasible for use in seismic applications. Design and fabrication procedures for each PMC infill panel are presented, as well as the results from a conceptual trial design using finite element (FE) analysis. Both monotonic and cyclic loading tests were performed on full-scale models to validate these systems in real situations. The results show that PMC infill panel systems offer the potential to increase the damping as well as the lateral resistance of steel frames, with a relatively low cost of retrofitting.

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Symposium on Emerging Developments in Multi-Hazard Engineering

A *Symposium on Emerging Developments in Multi-Hazard Engineering* will be organized jointly by the Architectural Engineering Institute (AEI) of ASCE and MCEER on September 18, 2007 in New York City at the McGraw-Hill Conference Center.

The Steering Committee for the event is co-chaired by Mohammed Ettouney, Ph.D., P.E., President of AEI, and Michel Bruneau, Ph.D., P.Eng., Director of MCEER, and includes representatives from NIST, NSF, FHWA, FEMA, USACE, the State Emergency Management Office of New York State, and the Steel Institute of New York.

Further details will be announced at AEI and MCEER's websites at <http://content.aeoinstitute.org/intro.html> and <http://mceer.buffalo.edu/meetings/default.asp>.

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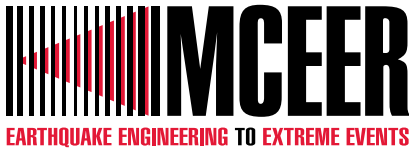
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