



**EARTHQUAKE ENGINEERING  
RESEARCH INSTITUTE**  
**NEWSLETTER**

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**News of the Institute**

**Tierney Presents 2006 Distinguished Lecture  
on the Value of Multidisciplinary Research**



*Kathleen Tierney (photo: M. Lew)*

Professor Kathleen Tierney presented the 2006 EERI Distinguished Lecture on April 20 during the 100<sup>th</sup> Anniversary Earthquake Conference at EERI's Annual Business Meeting in San Francisco, California. Tierney is director of the Natural Hazards Research and Applications Information Center at the University of Colorado, Boulder. The title of her lecture is "Expanding Boundaries: The Value of Multidisciplinary and Interdisciplinary Research for Disaster Loss Reduction."

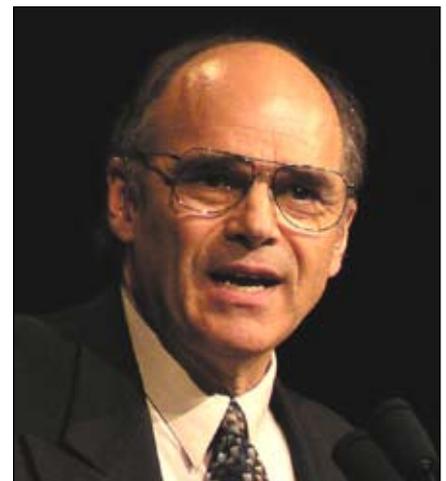
Tierney said that although many scientists and engineers prefer to work exclusively within their own disciplines, scientific and engineering research are becoming more multidisciplinary and interdisciplinary, owing to a growing appreciation of the value and potential impacts of research activities that involve collaboration across disciplines. Although barriers exist that are difficult to overcome, in recent years the situation has been improving, as new criteria in research programs are requiring collaboration in order to demonstrate a proposed program's societal impacts.

*continued on page 3*

**News of the Membership**

**Chris Poland Awarded 2006 Alquist Medal**

During the 100<sup>th</sup> Anniversary Earthquake Conference in San Francisco at the All-Conference Luncheon on April 18, Chris Rojahn of the California Earthquake Safety Foundation (CESF) awarded EERI past president, past treasurer, and honorary member Chris D. Poland the 2006 Alquist Medal for Achievement in Earthquake Safety. Chris was recognized for his effective and dedicated advocacy for earthquake safety in California. A registered civil and structural engineer, he has spent countless volunteer hours as an advisor on government programs for earthquake hazard mitigation and as an effective leader in related professional activities for more than 30 years.



*Chris Poland (photo: M. Lew)*

Citations mentioned in the ceremony included (1) Chris's leadership in developing the nation's current standard for evaluating the seismic resistance

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## Publication

### ATC-54 Report on Using Strong-Motion Data and Shakemaps

The Applied Technology Council (ATC) has announced the availability of the ATC-54 Report, *Guidelines for Using Strong-Motion Data and ShakeMaps in Post-Earthquake Response*. Funded by the California Strong Motion Instrumentation Program (CSMIP) of the California Geological Survey, the report addresses two main topics: (1) effective means for using computer-generated ground motion maps (ShakeMaps) in post-earthquake emergency response, and (2) procedures for rapidly evaluating (on a near real-time basis) strong-motion data from ground sites and instrumented buildings, bridges, and dams to determine the potential for earthquake-induced damage. The document also provides guidance

on the form, type, and extent of data to be collected from structures in the vicinity of strong-motion recordings, and pertinent supplemental information, including replacement of strong-motion instruments in, on, and near buildings, bridges, and dams.

The ShakeMap guidance describes data resources and procedures as well as real and hypothetical examples illustrating the use of ShakeMap products in emergency response. Topics addressed include (1) extent of damaged buildings and planning inspections; (2) condition of hospitals and other emergency response structures; (3) impact on utility systems and transportation networks; (4) extent of liquefaction, landslides, and inundation; (5) casualties and

the associated needs for their extraction from damaged structures; (6) extent of debris from collapsed structures; (7) sheltering needs; (8) extent of possible hazardous materials release; (9) insurance claims; and (10) other ramifications.

The report provides nine specific procedures for using strong-motion records to evaluate the performance of buildings. Guidance is offered on applicability, execution time, expertise and data required, steps to be taken, outputs, and example applications. The report treats bridges and dams in a more general way, but shows the applicability of procedures described in the section on buildings.

The report can be ordered online at [www.ATCouncil.org](http://www.ATCouncil.org) for \$48 (plus sales tax for California residents and shipping), by phone: 650/595-1542, or e-mail: [atc@atcouncil.org](mailto:atc@atcouncil.org).

## News of the Institute

### Two 2004 Spectra Outstanding Papers

The *Earthquake Spectra* Editorial Board and the EERI Honors Committee decided that two papers deserved 2004 *Earthquake Spectra* Outstanding Paper Awards. Both papers are in the May 2004 issue.

“Applied Incremental Dynamic Analysis (IDA),” by Dimitrios Vamvatsikos and C. Allin Cornell, was cited as a useful tool for professionals, providing a clear and insightful user’s guide to applying IDA within a performance-based earthquake engineering framework. The authors offer a step-by-step description of how they conduct their analysis and interpret results. In 2002 Vamvatsikos received a Ph.D. from Stanford University in civil and environmental engineering, and in 2005 joined the faculty of the University of Cyprus, where he teaches design of steel structures

and earthquake engineering. Cornell supervises graduate student research at Stanford and is also an independent engineering consultant.

The findings in the paper “Displacement Spectra for Long Periods,” by Ezio Faccioli, Roberto Paolucci, and Julien Rey, are believed to be particularly useful in the formulation of design elastic displacement spectra for seismic codes and in zoning studies of seismic hazard for long-period structures. The authors used selected sets of high-quality long-period range are functions of digital strong motion data from different regions (Taiwan, Japan, Italy, and Greece) to illustrate that the salient features of displacement response spectra in the

magnitude, source distance, and site conditions. Present formulations of elastic displacement spectrum for design may be revised in light of this study.

Faccioli is professor of earthquake engineering at the Technical University of Milan, Italy; at the same university, Paolucci is associate professor of structural mechanics and earthquake engineering. Rey is an engineer in the Seismic Risks Unit, Development Planning and Natural Risks Division, BRGM, Orléans, France.



Cornell and Vamvatsikos receive award from Farzad Naeim (photo: M. Lew).

## Tierney Presents 2006 Distinguished Lecture

*continued from page 1*

The field of disaster loss reduction can be a leading force for holistic research because of the problem-focused nature of its disciplines and the urgent need to reduce future disaster losses. Examples include research in the areas of loss estimation and vulnerability science, warning systems and emergency communication, and knowledge and technology transfer. Loss estimation model elements include hazards, exposures, fragilities, damage, direct losses and their impacts, and indirect losses and their ripple effects. These elements involve climatology, hydrology, seismology, geology, structural engineering, life-line engineering, risk and reliability engineering, systems engineering, fire modeling, hazmat modeling, economics, sociology, demography, epidemiology, public health, and regional science.

In the multidisciplinary field of vulnerability science, losses result from the intersection of three sets of factors: place-based vulnerability, vulnerability of the built environment, and social vulnerability—a construct that includes social class, race, health status, integration into

“mainstream” society, and social and cultural capital.

Research into integrated warning systems has components related to technology (data collection and analysis), governance (system effectiveness), public education (emergency communications cycle), and preparedness (self-protective action).

Factors that encourage successful collaboration include recognition that the nature of the problem requires collaborative solutions, respect for the value of contributions from other disciplines, equality and respect among collaborators; multidisciplinary participation in all phases of research, common conceptual and methodological approaches, long-term engagement, support from funding agencies, and a new generation of researchers and practitioners who are able to analyze and solve problems using strategies that blend physical science, social science, and engineering approaches.

This lecture will be presented as a nationwide series throughout the year and will be published in *Earthquake Spectra*. If you wish to invite Tierney to present it to a group, contact the EERI office.

## Announcement

### Bridges and Highways Conference

The Federal Highway Administration, the Transportation Research Board, and the California Department of Transportation are key organizers of the 5th National Seismic Conference on Bridges and Highways, to be held September 18-20, 2006, in San Mateo, California. The Multidisciplinary Center for Earthquake Engineering Research at the University at Buffalo is orchestrating the event. With the theme of “Innovations in Earthquake Engineering for Highway Structures,” the conference’s goals are to increase awareness of hazards and to enhance professional technical expertise.

A total of 60 papers will be presented at two concurrent technical sessions. Researchers will share their findings from recent large-scale testing enabled by NEES funding, code developers will explain the maturing practice of performance-based design and the importance of good seismic detailing, and practicing engineers will share insights from completed seismic retrofit projects and from the design of major structures. Equal attention will be given both to areas of low-to-moderate seismicity and to areas of high seismicity. Poster displays will detail other interesting projects and studies. Both oral and poster presentations will be published on a proceedings CD.

In conjunction with the conference, FHWA is also delivering a workshop for the seismic retrofitting of existing bridges, based on the new *Seismic Retrofitting Manual* that is being released this year. On the last day, there will be two optional technical tours organized by Caltrans.

The deadline for early-bird registration is July 1. For more information, visit <http://mceer.buffalo.edu/meetings/5nsc>.

## News of the Institute

### Endowment Fund Donors

EERI would like to thank the donors to the Endowment Fund and acknowledge their recent contributions. EERI’s Endowment supports innovative projects that ensure the Institute’s continuing leadership in the earthquake engineering professions.

#### \$1,100

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## Call for Papers

### **Engineering Structures Special Issue**

EERI's Heritage and Existing Structures Committee is pleased to announce plans for a special edition of the journal *Engineering Structures* to be devoted to seismic reliability analysis and protection of historic buildings, heritage sites, and other cultural artifacts, with Debra F. Laefer and Erol Kalkan as guest editors.

Contributions are welcome on all aspects of the subject, including the following:

- building code issues in historic preservation
- scenarios and actions for the prevention of earthquake damage
- earthquake hazards of historical structures
- retrofitting strategies and real-world applications of protection
- seismic performance and safety criteria
- effective computational methods
- dynamic local and global demand hazard analysis
- computer modeling and simulations for seismic performance assessment
- epistemic uncertainty in, for example, properties and models, and its implications
- seismic fragility curves for historical structures and monuments
- effective ground-motion selection and scaling
- nonlinear dynamic demand and capacity prediction
- post-earthquake safety assessment of historical structures

The deadline for submission of manuscripts is November 30, 2006. Manuscripts received after this deadline will be considered if space and time permit.

For more information, contact Debra F. Laefer, University College Dublin, Ireland, e-mail: [Debra.Laefer@ucd.ie](mailto:Debra.Laefer@ucd.ie); or Erol Kalkan, California Geological Survey, [Erol.Kalkan@conservation.ca.gov](mailto:Erol.Kalkan@conservation.ca.gov).

### **Urban Transportation Modeling Sessions**

The Institute for Operations Research and the Management Sciences (INFORMS) has issued a call for papers for Urban Transportation Modeling sessions at its 2006 annual meeting to be held in Pittsburgh, Pennsylvania, November 5-8. These sessions are sponsored by the INFORMS Transportation Science and Logistics Section.

Submissions are invited in all areas of the field, broadly defined, particularly in areas that illustrate the use of operations research and the management sciences in novel ways or in nontraditional fields. The deadline is May 31, but abstracts will continue to be accepted after the deadline as long as space is available. Authors who will submit after the deadline are encouraged to send a title and presenting author's name as soon as possible to James E. Moore, e-mail [jmoore@usc.edu](mailto:jmoore@usc.edu). For more information, visit <http://www2.informs.org/Conf/Pittsburgh06/>.

## Announcements

### **2006 ASEE Workshop**

The American Society of Engineering Education will hold its 3rd Annual Workshop on K-12 Engineering Education on Saturday, June 17, 2006, 8 a.m. to 3 p.m. at the Hyatt Regency Chicago-Riverside Center, Chicago, Illinois. Attendees will participate in interactive technical sessions given by providers of K-12 engineering education products and services. Registration for the event is \$30. For more information,

visit [www.engineeringk12.org/k12workshop](http://www.engineeringk12.org/k12workshop).

### **Ports 2007**

The Coasts, Oceans, Ports and Rivers Institute (COPRI) of the American Society of Civil Engineers (ASCE) is hosting the Ports 2007 Conference in San Diego, California, March 25-28, 2007. It is the 11th in a series of international port and harbor development specialty conferences held every three years since 1977. Port and harbor facilities development is undergoing challenges in response to the world's ever-changing conditions and events. The conference provides a practical international and national forum for presenting issues related to ports and harbors, inland waterways, and navigational improvements. The four-day conference will include plenary sessions, technical sessions, panel discussions, workshops, commercial exhibits, and a technical tour.

For a list of conference topics, visit [www.portsconference.org](http://www.portsconference.org).

## Subscribing Member Posting

### **Senior Structural Engineer Opportunity**

Wiss, Janney, Elstner Associates (WJE) seeks a senior structural engineer for their Emeryville office. WJE is a nationwide firm whose focus is on the evaluation and repair of structures. The firm's projects include complex structural problems, collapse investigations, forensic studies, and seismic evaluations of historic structures. WJE performs damage assessments after earthquakes worldwide and after disasters such as Hurricane Katrina and 9/11. The firm offers outstanding compensation.

Interested candidates are encouraged to send a cover letter and resume to [ksasaki@wje.com](mailto:ksasaki@wje.com).

PLEASE POST IMMEDIATELY



## Earthquake Hazards Reduction Fellowship Announced

Under a cooperative agreement established with FEMA, the Earthquake Engineering Research Institute is pleased to offer the **2007 Professional Fellowship** to provide an opportunity for a practicing professional to gain greater skills and broader expertise in earthquake hazards reduction, either by enhancing knowledge in the applicant's own field or by broadening the applicant's knowledge in a related but unfamiliar discipline.

### Who Should Apply?

This unique fellowship is designed to bring together an experienced career professional with other professionals conducting significant research, thereby providing opportunities to both enrich the applicant's knowledge and skills and to broaden the research base with challenges faced in practice. The Professional Fellowship is *not* intended to fund work towards a degree.

### The Award

The fellowship provides a stipend of \$30,000, commencing in January 2007, to cover tuition, fees, and relocation and living expenses. The fellowship will be awarded on the basis of a specific project, with the proposed work or course of study to be carried out over a period of up to one year. The recipient will have the flexibility to work less than full time with the host institution and academic sponsor, with the understanding that the effort will result in a report by the end of twelve months.

### Criteria

Applicants must provide a detailed work plan for a research project that would be carried out in the twelve-month period. The fellow will be expected to produce a written report upon completion of the project. All applications must be accompanied by a professional resume and letter of nomination from the faculty host at the cooperating educational institution. Faculty members should also indicate the institution's ability to provide research facilities, including library, work space, telephone, and computer access. Applicants must hold U.S. citizenship or permanent resident status.

### To Apply

Candidates may obtain an application form from the Earthquake Engineering Research Institute, 499 14th Street, Suite 320, Oakland, California 94612-1934, tel: (510) 451-0905, fax: (510) 451-5411, e-mail: [eeri@eeri.org](mailto:eeri@eeri.org), or from EERI's web site at [http://www.eeri.org/home/Profell\\_application.pdf](http://www.eeri.org/home/Profell_application.pdf).

**Deadline for receipt of all application materials at EERI is September 5, 2006.**

**Announcement of the award will be made October 16, 2006.**

## Chris Poland Awarded 2006 Alquist Medal

*continued from page 1*

of existing buildings; (2) his tireless service as an advisor on government programs for earthquake hazard mitigation, including the Strong-Motion Instrumentation Program of the California Geological Survey and the Advanced National Seismic System of the U.S. Geological Survey; (3) his effective advocacy, while president of EERI, for the significant expansion of the federally funded National Earthquake Hazards Reduction Program, and (4) his leadership as chairman of the 100<sup>th</sup> Anniversary Earthquake Conference.

Chris is a graduate of the University of Redlands in mathematics and has an M.S. in civil (structural) engineering from Stanford University. His career began as a summer intern and led to his current position as chairman, president, and chief executive officer of Degenkolb Engineers in San Francisco. His professional ex-

perience includes projects of all construction types, ranging from new design and seismic retrofit and rehabilitation to historic preservation.

One of his most important contributions to the advancement of structural and earthquake engineering practice was his service as principal-in-charge of the project to develop procedures for detailed seismic evaluation of existing buildings, which his firm prepared for the Applied Technology Council (ATC) with funding from the National Science Foundation.

That effort resulted in the publication of the ATC-14 Report, *Evaluating the Seismic Resistance of Existing Buildings*, which evolved into FEMA 310 and ultimately into the ASCE 31 Standard, *Seismic Evaluation of Existing Buildings*. He also led the development of the FEMA

356 *Prestandard and Commentary for the Seismic Rehabilitation of Buildings*, which was based on the *NEHRP Guidelines for the Seismic Rehabilitation of Buildings* (FEMA 273 Report), developed earlier by ATC for the Building Seismic Safety Council with funding from the Federal Emergency Management Agency. Currently, he is chairman of the American Society of Civil Engineers Standards Committee on Seismic Rehabilitation, which is converting the FEMA 356 Prestandard into an ASCE Standard (ASCE 41).

CESF's mission is to raise the level of public awareness and commitment to earthquake safety in California. For more information, visit [www.calesf.org](http://www.calesf.org). The Alquist Medal is given annually in honor of State Senator Alfred Alquist, who had a long and distinguished career supporting earthquake safety in the California legislature (see his obituary on page 2 of the April Newsletter).

## Lawson Receives TCA Achievement Award

EERI member John W. Lawson of Kramer & Lawson Structural Engineers, Inc., in Tustin, California, is the recipient of a 2006 Tilt-Up Concrete Association (TCA) Engineering Achievement Award, which was bestowed in January at the World of Concrete Convention in Las Vegas. The mission of TCA is to expand and improve the use of site-cast tilt-up concrete construction and engineering practices. Lawson was selected for the award because of his efforts to correct and clarify seismic elements of the building code related to tilt-up buildings and to improve the standards that deal with seismic issues. He is an ICBO seismic design example author and Tilt-Up Ad-Hoc Committee Chairman with the Structural Engineers Association of California (SEAOC). Lawson is a member of the newly created TCA Seismic Task Group.

"The structural design of tilt-ups is being impacted more and more by complex seismic codes," said Lawson's partner Dave Kramer. "John has been indispensable in providing engineering guidance, not only to our office, but also unselfishly to all engineers with his various speaking engagements, his authorship of SEAOC's tilt-up seismic design examples, and his willingness to provide guidance to other engineers who call and ask John for his opinion. With very few engineering publications on tilt-ups, his contributions to SEAOC's Structural/Seismic Design Manual series under both the UBC and IBC have filled a sorely needed gap in our profession."

*ripples  
in my morning coffee  
earthquake country*

— Haiku by Allen McGill, Mexico

## News of the Profession

### WTC Study Spurs Improvement of Codes

When the National Institute of Standards and Technology (NIST) released the final report in October 2005 from its technical investigation of the fires and collapses of the World Trade Center (WTC) towers on Sept. 11, 2001, included were 30 recommendations for improving building and occupant safety. On March 24, 2006, the first 19 proposed changes to model building codes were submitted to the International Code Council (ICC).

"Taken together, they are a robust, reasonable and appropriate set of advancements and, if adopted, would represent a significant improvement in public safety over current practice," says WTC Lead

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## CALENDAR

Items that have appeared previously are severely abbreviated. The issue containing the first appearance, or the most informative, is indicated at the entry's end. Items listed for the first time are shown in **bold**.

### JUNE

8-10. Int'l Sym. on Technology & Society, New York, NY. Info: [www.ieee.org/ssit](http://www.ieee.org/ssit) (12/05)

15-17 Int'l Wkshop on Base-Isolated High-Rise Buildings, Yerevan, Armenia. Info: [kavaneso@aua.am](mailto:kavaneso@aua.am) (3/06)

**17. 3rd Annual Workshop on K-12 Engineering Education**, Chicago, Illinois. See page 4. (6/06)

18-21. ECl Geohazards Conf., Lillehammer, Norway. Info: [www.engconfintl.org/6ag.html](http://www.engconfintl.org/6ag.html) (9/05)

18-21. 16th World Conf. on Disaster Management, Toronto, Canada. Info: [www.wcdm.org](http://www.wcdm.org) (11/05)

19-21. Risk Analysis 2006, Malta. [www.wessex.ac.uk/conferences/2006/risk06/index.html](http://www.wessex.ac.uk/conferences/2006/risk06/index.html) (12/05)

21-23. 4th NEES Annual Meeting, Washington, D.C. Info: [www.nees.org/4am/](http://www.nees.org/4am/) (11/05, 5/06)

### JULY

11-13. The 4th World Conf. on Structural Control and Monitoring (4WCSCM), UC San Diego. Info: [www.usc.edu/4wcscm](http://www.usc.edu/4wcscm) (3/06)

16-22. Minisymposium on Modeling and Simulation of EQ Phenomena at 7th World Congress on Computational Mechanics, Los Angeles, CA. Info: <http://www.wccm2006.northwestern.edu> (3/06)

### AUGUST

8-12. 2nd Latin-American Congress of Seismology, Bogotá, Colombia. Info: <http://www.geoslac.org/congreso/english/index.html> (4/06)

14-17. 5th Int'l Conf. on Behavior of Steel Structs. in Seismic Areas (STESSA), Tokyo, Japan. Info: [www.serc.titech.ac.jp/stessa2006](http://www.serc.titech.ac.jp/stessa2006) (2/05)

27-Sep. 1. Int'l Disaster Reduction

Conference (IDRC), Davos, Switzerland. [www.davos2006.ch](http://www.davos2006.ch) (2/06)

### SEPTEMBER

3-8. 1st European Conf. on EQ Eng. & Seismology, Geneva, Switzerland. Info: [www.ecees.org](http://www.ecees.org) (1/05, 1/06)

8-9. Int'l Conf. on Earthquake Engineering, Lahore, Pakistan. Info: [www.uet.edu.pk/icee/](http://www.uet.edu.pk/icee/) (4/06)

10-14. 23rd Ann'l Conf. of the Association of State Dam Safety Officials (ASDSO), Boston, MA. Info: [www.damsafety.org](http://www.damsafety.org) (2/06)

10-15. Int'l Conf. on Infrastructure Development and the Environment (ICIDEN), Abuja, Nigeria. [www.iseg.giees.uncc.edu/abuja2006/callabstracts.cfm](http://www.iseg.giees.uncc.edu/abuja2006/callabstracts.cfm) (2/06)

18-19. UB-NEES Training Workshop, University at Buffalo, NY. Info: [www.nees.org/4am/](http://www.nees.org/4am/) (5/06)

18-20. 5th Nat'l Seismic Conf. on Bridges and Highways, San Francisco, CA. Info: [mceer.buffalo.edu/meetings/5nsc/](http://mceer.buffalo.edu/meetings/5nsc/). See page 3. (1/06, 6/06)

25-Oct. 7. 8th Wkshp. on 3-D Modeling of Seismic Wave Generation, Propagation, and Inversion, Miramare, Italy. Info: [agenda.ictp.it/smr.php?1775](http://agenda.ictp.it/smr.php?1775) (1/06)

### OCTOBER

4-6. Deep Fdn. Inst. Annual Conf., Washington, D.C. Info: [www.deep-foundations06.org](http://www.deep-foundations06.org) (12/05)

11-13. 7th Int'l Cong. on Advances Civil Eng., Istanbul, Turkey. Info: [www.ace2006.yildiz.edu.tr/](http://www.ace2006.yildiz.edu.tr/) (12/05)

12-13. 4th Int'l Conf. on EQ Eng. (4ICEE), Taipei, Taiwan. Info: [icee2006.ncrec.org.tw/](http://icee2006.ncrec.org.tw/) (10/05)

### NOVEMBER

**5-8. INFORMS Annual Meeting, Urban Transportation Modeling Session**, Pittsburgh, PA. See page 4. (6/06)

### 2007

#### FEBRUARY

7-10. EERI Annual Meeting, Los An-

geles, CA (3/06)

### MARCH

**25-28. Ports™ 2007**, San Diego, CA. See page 4. (6/06)

### MAY

13-20. Coastal Sediments 07, New Orleans, LA. [www.asce.org/conferences/cs07/abstract.cfm](http://www.asce.org/conferences/cs07/abstract.cfm) (5/06)

### JUNE

1-3. 10th North American Masonry Conference, University of Missouri at Rolla. <http://www.masonrysociety.org/NAMC/index.html> (3/06)

25-28. 4th Int'l Conf. on EQ Geotech. Eng. (4ICEGE), Thessaloniki, Greece. Info: [www.secreteriat@4icege.org](http://www.secreteriat@4icege.org) (2/06)

27-29. 9th Canadian Conf. on EQ Eng. (9CCEE), Ottawa, Canada. Info: [www.9ccee.ca](http://www.9ccee.ca) (2/06)

### 2008

#### AUGUST

6-9. 6th Int'l Conf. on Case Histories in Geotech. Eng. (6ICCHGE), Washington DC. <http://campus.umd.edu/6icchge/index.html> (4/06)

#### OCTOBER

12-17. 14th World Conf. on EQ Eng., Beijing, China. Info: [www.14wcee.org](http://www.14wcee.org) (12/05)

## WTC Study

*continued from page 6*

Investigator Shyam Sunder.

All ICC members will have the opportunity to vote on the proposals at hearings scheduled for this fall. All changes that pass and those that do not pass but for which public comments are received will then be up for approval—and inclusion in the ICC codes—when ICC government member representatives meet in the spring of 2007. For more information, including a web-based system for tracking the progress toward implementing all of the NIST WTC recommendations, visit <http://wtc.nist.gov>.

## Learning from Earthquakes

# Darb-e-Astaneh (Silakhor), Iran, Earthquake of March 31, 2006

*This summary report was submitted by A. S. Moghadam, assistant professor at the International Institute of Earthquake Engineering and Seismology (IIEES) in Tehran, Iran.*

At 4:47 a.m. on March 31, 2006, a  $M_L 6.1$  earthquake with several foreshocks occurred south of Borujerd (a city in western Iran). About 63 fatalities, 1,450 injuries, and building damage to 330 villages of the Silakhor region, including the two main cities of Borujerd and Dorud, were reported. This earthquake occurred near the main Zagros fault, in one of the more seismically active areas in Iran. On the day of the earthquake, IIEES dispatched teams to the region to identify the area that was strongly shaken, classify damage to structures, and install a temporary network of six seismic stations in the region.

The majority of buildings in the cities of the region are engineered, although poor compliance with building codes is widespread. The damage was mainly nonstructural, such

as wide cracks in walls and partitions. Most of the damage was in the city of Borujerd. A government-funded project for damage assessment and seismic retrofitting of almost 15,000 homes in that city, with the help of private consultant engineering firms, was under way at the time of the quake. There was also some damage to heritage structures such as ancient mosques.

In villages, buildings are mainly non-engineered adobe or unreinforced masonry structures and were heavily damaged in areas near the epicenter. Inadequate connections between walls and out-of-plane wall failure were common modes of damage to these buildings.

There was limited damage to such lifelines as telephone communication facilities and distribution substations. Major causes of line disruption were battery rack toppling. There was substantial damage to the equipment of some factories in the region due to the fall of heavy infill walls.

For more information on this earthquake, visit [http://www.iiees.ac.ir/English/index\\_e.asp](http://www.iiees.ac.ir/English/index_e.asp).



*Damage to traditional houses in villages of the region.*



*Substantial damage to the equipment of a sugar factory caused by fall of masonry infill panels.*



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