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WAITING FOR THE S WAVES

EXECUTIVE DIRECTOR'S REMARKS

When people experience a strong earthquake, they sometimes assume the initial P waves are the whole event, only to realize their mistake a few seconds later when the S waves arrive. 1995 was a very energetic year for CUREe, but as 1996 develops it is obvious from the increasing demands the organization is experiencing that the shear waves are only now arriving.

1996 Challenges

As noted in a separate story [see page 2], CUREe's main priority for 1996 is to facilitate the development of a successful proposal by the California universities in response to the expected NSF issuance of an RFP for one or more earthquake research centers.

Project Updates

Important projects that have recently concluded include the following. The CUREe portion of the SAC Phase 1 Steel Project was completed; the Housner Symposium was held [see page 3]; a CUREe Field Study team was dispatched to the October 1995 earthquake in Mexico [see story page 5]; the Northridge Earthquake Research Coordination Project for FEMA was completed. Projects that are still continuing include the second phase of Kajima research projects, US Panel on Structural Control activities, and the SAC Steel Project Phase II.

Proposals

Important proposals developed in 1995 include the following. A \$6 million Northridge Hazard Mitigation Grant Program proposal was submitted by

CUREe to California OES on woodframe construction; the proposal for SAC Phase II was successfully submitted to FEMA by the SAC Joint Venture partners—SEAOC, ATC, and CUREe. Plans were laid for the third phase of multi-year Kajima-funded projects. A January 1997 conference on Northridge Earthquake research is in the planning stages with NSF.

New Directors Brandow and Fenves

CUREe welcomes two new members to the Board of Directors: Gregg Brandow, of Brandow and Johnston, and Prof. Gregory Fenves of UC Berkeley. The Board voted statements of appreciation to outgoing Directors Philip Richter and Robin Shepherd at its January 27, 1996 meeting at UC Davis.

Internal Operations

Last year CUREe set up an efficient office in space provided by the UC Berkeley Earthquake Engineering Research Center; hired an executive director, an administrative specialist, and a secretary-receptionist; financial control policies were established that exceed NSF requirements; DCAA completed an audit establishing a federally-approved indirect rate for the organization of 13.1%, an admirably low figure; professional services were arranged from two law firms, one accounting firm, and a payroll service company, and three kinds of insurance were obtained. Thus CUREe's capacity, as well as the demand for its services, has been increased.

-BOB REITHERMAN

NSF Expected to Issue Earthquake Engineering Research Centers RFP

In August of 1995 NSF convened the Future Directions II Workshop in Washington, DC, which concluded that "the advantages for a national earthquake engineering research center outweighed the disadvantages, and in the future there should be between one and three centers. However, there was a strong desire for change from the existing situation of one center drawing primarily from the resources of one region of the U.S.A."

NSF has not yet officially issued a Request for Proposals for such a center or centers, but CUREe and its member universities have been "doing their homework" in anticipation of that eventuality. A brief update follows.

President Mahin appointed Paul Jennings of Caltech to chair a Task Group on the subject in December of 1995, and it has met several times to evolve a strong consensus behind an organizing theme and an organizational structure for a center involving CUREe's member universities. The

Task Group includes one representative from each of the eight CUREe member universities:

Professor Gary Hart, UCLA
 Professor Wilfred Iwan, Caltech
 Professor Anne Kiremidjian, Stanford
 Professor Bruce Kutter, UC Davis
 Professor Jack Moehle, UCB
 Professor Geoffrey Martin, USC
 Professor Gerard Pardoan, UC Irvine
 Professor Nigel Priestley, UCSD

After these eight representatives convened with fellow faculty members at their respective universities, they met on January 13 in Los Angeles, and all eight stated that his or her institution wanted to pursue a unified approach through CUREe's auspices.

On January 27, 1996, the CUREe Board of Directors voted unanimously to endorse this consensus and committed CUREe to facilitating the development of a successful proposal representing the California universities. The possibility of including institutions from

other states was left open and hinges around their ability to obtain financial support, which in turn relates to the expected NSF requirement for matching funds.

To obtain State of California matching funds the California Seismic Safety Commission, under the direction of Chair Lloyd Cluff, has already taken the initiative. The Commission's Research Committee has named CUREe as the organization with which it will work to ensure a unified proposal. The Commission and CUREe have collaborated in the drafting of a bill, introduced into the California Legislature by State Senator Alfred Alquist, to provide the necessary matching funds. State agencies have been briefed on the need for the bill by Commission Chair Lloyd Cluff and Harry Hallenbeck, Director of Seismic Safety Implementation for the State and Consumer Affairs Agency.

As further news unfolds, *CUREe News* will keep its readers informed.

Project Updates

Bertero Symposium Set For January 31-February 1, 1997

CUREe will be co-sponsoring with the UC Berkeley Earthquake Engineering Research Center a Symposium in Honor of Vitelmo Bertero. The event will occur January 31 - February 1, 1997, at the Berkeley Marina Marriott Hotel. (Please note that this is a revision from the dates previously announced in the EERI Newsletter). Conference announcements will be mailed shortly, but please save these dates.

SAC Steel Project

The first issue of *SAC Steel Project Update* has been released. If you received the *Update*, you are on the mailing list and will receive future issues. All CUREe members will receive future issues. If you wish to receive a copy, please contact the CUREe office.

As described in *Update*, the SAC Steel Project has entered Phase II, which will last three years. Reports from SAC Phase I, which concluded in March 1996, are now becoming available, as described in *Update* and on page 6 of this newsletter.

Qualifications Solicited for Kajima Phase III Research Projects

Qualifications have been solicited from CUREe members interested in conducting projects to be funded in a Phase III CUREe-Kajima program of research, CUREe-Kajima Joint Research Program on Total System Engineering for Disaster Mitigation. The deadline for submittals was April 22.

CUREe researchers and topics that match up well with corresponding Kajima capabilities and interests will be combined into two CUREe-Kajima project teams. One team will deal with Social and Economic topics, while the other will focus on Near-Field Ground Motion.

In addition, proposals for small research projects to explore innovative concepts related to the Phase III theme have been solicited.

CUREe is represented by a Project Oversight Committee consisting of Wilfred Iwan, Stephen Mahin, and Hareesh Shah. Akira Endoh, of the Kabori Research Institute of Kajima Corporation, manages Kajima's sponsorship and research involvement. Kajima Corporation is also represented by Takuji Kabori and Yoichi Nogiri.

Corrected Calendar Date For Thanksgiving: Nov. 28

CUREe made an error in its 1996 Calendar in printing the date of Thanksgiving. Please correct your 1996 Calendar by striking out the current Thanksgiving listing and instead writing it in on **November 28**.

Highlights of the CUREe Symposium in Honor of George Housner

On October 27 and 28, 1995, the CUREe Symposium in Honor of George Housner was held in Pasadena. Cosponsored by the California Institute of Technology, the Symposium featured presentations by leading experts from the United States and other countries on progress that has been achieved in areas pioneered by Professor Housner, as well as thoughts and discussions on what the future may hold.

The Symposium provided an opportunity for those who have known Prof. Housner, and others interested in the advancement of earthquake engineering, to gather with him to honor the contributions of his career over the past 50 years.



Ray Clough delivers a presentation on the *Early Years of Earthquake Engineering*. Also pictured are (left to right): S. Mahin (obscured), P. Jennings, D. Hudson, R. Johnston, and T. Paulay

The Symposium was the first in a series that will become a CUREe tradition of honoring lifelong contributions to earthquake engineering and the understanding of

earthquakes. In the near future, CUREe will be involved with two more symposia, honoring Vitelmo Bertero of U.C. Berkeley (see page 2), and Haresh Shah of Stanford.

Speakers and Session Chairs



Back row, left to right: Stephen Mahin, Mihran Agbabian, Thomas Heaton, Ronald Scott, Bruce Bolt, Thomas Paulay, Paul Jennings, Hiroo Kanamori, Joseph Penzien, William Hall, John Hall, Sami Masri, George Housner, James Roberts, I. M. Idriss, Edward Wilson, Vernon Persson, Clarence Allen, Frank McClure, Tsu T. Soong. **Front row, left to right:** Nigel Priestley, Richard Wright, James Yao, Anil Chopra, Donald Hudson, Navin Nigam, Haresh Shah, Helmut Krawinkler, Luis Esteva, Roy Johnston, Robert Hanson, James Beck, Robin Shepherd, Kenzo Toki. **Speakers and session chairs not pictured:** Ray Clough, Ahmed Abdel-Ghaffar, Luis Esteva, Jack Moehle, Gary Hart, Dan Abrams, Frieder Seible, Chris Poland, Wilfred Iwan, Medhat Haroun.

of the transportation network for post-disaster planning and emergency management. This project focuses on bridges as the critical components of the transportation system. Network analysis methods are utilized to identify the critical bridges for emergency response and socio-economic loss estimations.

The methodology developed in this project is illustrated through an application to the city of Palo Alto, California. This region was selected because it is in close proximity to major active faults and it contains a wide variety of structures that are present in many California cities. The results of the analysis,

GIS map overlay methodology for regional earthquake loss estimation
credit: Stanford University; for updates on this project consult the John A. Blume Earthquake Engineering Center at: <http://blume.stanford.edu>

in tabular and map format, will show regional distributions of hazards, damage, and loss for scenario events and for probable events over specified future time periods. The results will be useful for purposes such as emergency preparedness planning, development of earthquake risk mitigation policies, studies of retrofit strategies, and land use planning decisions.

October 9, 1995 Manzanillo Earthquake Field Study

Professor Ronaldo Borja and Alex Barron
Stanford University

Professor Filip Filippou and Amador Teran
University of California at Berkeley

In response to the October 9, 1995 Manzanillo, Mexico earthquake, CUREe rapidly sent a Field Study Team to Mexico. Two professor/Ph.D. student pairs constituted the team. Representing structural engineering were Professor Filip Filippou and Amador Teran of the University of California at Berkeley, while Professor Ronaldo Borja and Alex Barron of Stanford University were the geotechnical contingent.

The Field Study was not motivated by the traditional goal of producing a reconnaissance report. Instead, its purposes were: 1) To develop the interests and capabilities of professors and graduate students in the earthquake field, and to determine whether such Field Studies have the intended positive effect of increasing the team members' motivation to develop their careers in this field; and 2) to investigate opportunities for multi-university and in this case, international research collaboration to study the effects of this earthquake, by rapidly collecting perishable data and visiting the site of the disaster. The CUREe Field Study Team was joined in Manzanillo by Professor Mario Rodriguez of UNAM. A small study grant has been requested from NSF to cover the travel cost of the Field Study.

At 9:37 am local time on October 9, 1995, an earthquake with a surface-wave magnitude $M=7.6$ (Centro Sismologico Nacional) occurred about 20 km southeast of the Pacific coast port of Manzanillo, Mexico. The offshore epicenter had a depth of 33 km, and the source was a subduction zone where the North American, Cocos, and Riviera plates intersect. Several non-engineered and a few engineered buildings suffered heavy damage or collapse, resulting in at least 58 fatalities.

Downtown Manzanillo consists mainly of small tourist shops and commercial buildings built with concrete masonry unit walls. Older hotels were made of reinforced concrete frames infilled with brick. Some of the newer construction is being built with steel frames.

Although it is difficult to assess the intensity of the ground motions near the epicentral regions without the availability of records, some observations made during the

inspection of damaged engineered buildings near the epicentral region suggest that these motions did not have a high intensity in spite of the high magnitude associated with the earthquake. Detailed post-earthquake inspection of the contents of damaged buildings revealed that most of the furniture in these buildings remained in their original locations and positions, and that the majority of shelf contents remained in place.

Although the damage did not appear to be very extensive, the engineered construction most affected were larger facilities including hotels, the local hospital, the central bus station, and some roads. Most residential areas were not severely affected. A small area near the Laguna de Cuyutlan experienced liquefaction problems.

The structure most severely damaged by the earthquake was the Hotel Costa Real in Manzanillo. This 12-story concrete frame building collapsed completely, killing over 40 people. In downtown Manzanillo, the central bus station collapsed completely, and some facilities inside the thermoelectric power plant were damaged. The apparent factor which caused the collapse of the bus station was under-reinforcement of concrete

and the lack of adequate ties in the columns, which are crucial to providing proper confinement of the concrete. At the power plant slabs cracked due to inadequate compaction. A local clinic suffered from differential settlements and ground rupture. Some evidence of liquefied sands were present. One house sited on San Pedrito Beach collapsed when the tsunami (three gradual inflows and outflows of the sea, peaking at about 4 meters) undermined its foundation.

Although there were examples of collapse, the majority of engineered buildings survived the Manzanillo earthquake without significant or even moderate structural damage. This may be partly due to the generally low-intensity ground motions. Stiff unreinforced masonry infills were extensively damaged, which constitutes an economic failure because of the cost associated with repair and modification of the nonstructural elements.

The Field Study Team concluded that future similar efforts will have a significant benefit in relation to the educational and long-term research goals stated above.



Residence that collapsed on access road to Costa Real Hotel, Manzanillo, Mexico

Publications

The **1996 CUREe Calendar** is still available for \$13. Contact the CUREe office for more information.

SAC Design Advisory #3 is available free through ATC, (415) 595-1542.

Interim Guidelines: Evaluation, Repair, Modification and Design of Welded Steel Moment Frame Structures (FEMA 267, SAC 95-01, August 1995) is available free. Contact FEMA at 800-480-2520.

The following SAC reports are now available. Contact the Applied Technology Council, 415-595-1542, for ordering information and cost:

SAC 95-03: *Characterization of Ground Motions During the Northridge Earthquake of January 17, 1994*. P. Somerville, R. Graves, and C. Saikia

SAC 95-04: *Analytical and Field Investigations of Buildings Affected by the Northridge Earthquake of January 17,*

1994, Part I and Part II. Contributions by A. Alali, J. Anderson, J. Beck, K. Benuska, D. Bonowitz, R. DiJulio, J. Dunlea, T. Eimani, M. Englehardt, F. Filippou, G. Hart, L. Ho, S. Huang, A. Husain, A. Jain, J. Kariotis, H. Kim, K. Kim, H. Krawinkler, C. Lee, C. Li, R. Lobo, B. May, F. Naeim, T. Paret, D. Polidori, A. Reinhorn, T. Sabol, A. Sadre, K. Sasaki, J. Stewart, C. Thiel, C. Uang, J. Uzarski, M. Vanik, M. Van Winkler, N. Youssef, and Q. Yu

SAC 95-05: *Parametric Analytical Investigations of Ground Motion and Structural Response, Northridge Earthquake of January 17, 1994*. Contributions by S. Campbell, M. Englehardt, J. Hall, G. Hart, L. Ho, S. Huang, A. Husain, W. Iwan, H. Kim, K. Kim, R. Lobo, T. Sabol, M. Skokan, J. Uzarski

SAC 95-06: *Surveys and Assessment of Damage to Buildings Affected by the Northridge Earthquake of January 17, 1994*. Contributions by D. Bonowitz, M. Durkin, W. Gates, M. Morden, and N. Youssef

Seismic Events

1996 Board of Directors meetings

May 10 - U.S.C.
August 2 - Stanford
November 1 - UC San Diego

Bertero Symposium

January 31 - February 1, 1997
Berkeley, CA

New CUREe Members

Caltech

Thomas Heaton

Stanford

Roger Borcherdt
Martin McCann
Richard Meehan
Piotr Moncarz

UC Berkeley

Gary Black
Sanjay Govindje
Dwight Jaffee
Claudia Ostertag
Brady Williamson

UCSD

Robert Englekirk

USC

Masanobu Shinozuka
Ray Ruichong Zhang

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CALIFORNIA INSTITUTE OF TECHNOLOGY

Professor Wilfred D. Iwan

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Professor Haresh C. Shah

UNIVERSITY OF CALIFORNIA AT BERKELEY

Professor Stephen A. Mahin

UNIVERSITY OF CALIFORNIA AT DAVIS

Professor Bruce L. Kutter

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Professor Gerard C. Pardo

UNIVERSITY OF CALIFORNIA AT LOS ANGELES

Professor Mladen Vucetic

UNIVERSITY OF CALIFORNIA AT SAN DIEGO

Professor Chia-Ming Uang

UNIVERSITY OF SOUTHERN CALIFORNIA

Professor Geoffrey R. Martin

MEMBERS ELECTED AT-LARGE

Professor James L. Beck

Professor Greg L. Fenves

Professor Anne S. Kiremidjian

Professor Helmut Krawinkler

MEMBERS REPRESENTING SEAOC

Gregg E. Brandow

Robert C. Thacker

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APRIL 19, 1996

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