Fault Line Forum

Volume 10, Number 4 • 1995

A Strategic Plan for Earthquake Safety in Utah

The 1994 Utah Legislature established the Utah Seismic Safety Commission (USSC) to help coordinate and lead the state's efforts to reduce losses from earthquakes. Part of the this mission was achieved with publication of the report *A Strategic Plan for Earthquake Safety in Utah* which was presented to the Legislature, the Governor, and the citizens of Utah in January. The executive summary and a summary of all the strategies contained in the report were printed in the last issue of the *Fault Line Forum.* In the next five issues we will reprint the individual strategies contained in each of the *Strategic Plan's* five key objectives:

1. Increase earthquake awareness and education.
2. Improve emergency response and recovery.
3. Improve the seismic safety of buildings and infrastructure.
4. Improve essential geoscience information.
5. Assess earthquake risk.

The strategies are not in order of priority and are not comprehensive. For each strategy, specific outputs are listed which can be measured to evaluate performance of the responsible parties in implementing the strategy. Also, the projected outcome is listed so that progress towards the ultimate goal of the strategy can be evaluated over time. Background information, a brief discussion of implementation, a list of responsible agencies, and an estimate of resources needed are included in each strategy. The latter is a rough estimate which will be refined once the strategy is considered for implementation. The list of strategies is meant to be a "living" list which can either be expanded as new actions are identified, or reduced as strategies are implemented and outcomes are achieved. We begin in this issue by highlighting the strategies of the first objective, to increase earthquake awareness and education.

Anyone interested in obtaining a copy of *A Strategic Plan for Earthquake Safety in Utah* can contact Janine Jarva, Utah Geological Survey, 2363 South Foothill Drive, Salt Lake City, UT 84109-1497, (801) 467-7970, fax (801) 467-4070, e-mail address: nrdomain.nrugs.jjarva@email.state.ut.us, or Judy Watanabe, Utah Division of Comprehensive Emergency Management, 1110 State Office Building, Salt Lake City, UT 84114, (801) 538-3400, fax (801) 538-3770.

The list of strategies is meant to be a "living" list which can either be expanded as new actions are identified, or reduced as strategies are implemented and outcomes are achieved.

STRATEGY: Inform citizens about earthquake hazards and risks.

Output: Information and training targeted to meet individual or collective needs.

Outcome: All citizens are better able to prepare for and respond to an earthquake.

Background

Different elements of Utah society have different needs for information and training to deal with mitigating and responding to the earthquake threat. There exists significant demand for earthquake education materials and services which should be appropriate, readily available, and user-friendly.

Implementation

Programs would be targeted to each of the following population segments with the corresponding products:

1. General public- A free Earthquake Awareness Guide of earthquake services and materials

widely distributed.
2. School teachers - Science and safety instructional materials.
3. Businesses - Guides and training for earthquake preparedness in the workplace for managers and employees, techniques to reduce losses and resume operations quickly after a disaster.
4. Architects, engineers, contractors - coordination of materials and training through professional associations and licensing agencies.
5. Local government - awareness program of materials, services, and information on laws, procedures, rules, and standards.

Responsible Agencies

Utah Division of Comprehensive Emergency Management
American Red Cross
University of Utah Seismograph Stations
Utah Geological Survey
Utah Office of Education
Utah Division of Occupational/Professional Licensing
Utah League of Cities and Towns
Uniform Building Code Commission
Structural Engineers Association of Utah
American Institute of Architects, Utah Chapter
American Society of Civil Engineers, Utah Chapter
Association of Engineering Geologists, Utah Chapter

Resources Needed

First year: two person years: $80,000; materials: $75,000.
On-going: training: (1-3 FTEs) $40,000 to $120,000; materials: $15,000.

STRATEGY: Incorporate earthquake education in school curricula.

Output: A multi-level curriculum for earthquake education in all public schools.

Outcome: All students are provided with earthquake science and safety training as a part of their regular education.

Background

More than 468,000 students (approximately 26% of Utahns) are in grades K-12 in Utah schools. Incorporation of earthquake science and safety in the school curriculum will better ensure student safety now and help produce educated citizens who will be able to make responsible decisions in the future.

Implementation

It would be most appropriate to focus efforts for lesson plans at grade levels 3, 5, and 9 in conjunction with earthquake science or related topics in the State Science Core Curriculum. The objective can be accomplished by doing the following: (1) educating the curriculum providers - district level school boards, school administrators, and teachers' unions - about the value of earthquake education in schools and the ease with which that can be implemented, (2) developing Utah-relevant earthquake education materials and a variety of options for implementation, (3) establishing certification standards for earthquake education programs, and (4) providing teacher in-service workshops. Resources to carry out this program must be provided or made available as opposed to redirecting existing resources.

Responsible Agencies

Earthquake Education Resource Group (includes Utah Geological Survey, University of Utah Seismograph Stations, and Utah Division of Comprehensive Emergency Management)
Utah Office of Education

Resources Needed

A task force composed of earthquake scientists and educators and members of the target audience (teachers and administrators) could develop and implement the entire project. Salaries would be needed for 1.5 FTE for three years as well as additional funds for office supplies and curriculum materials. The estimated total expenditure is $80,000 to $100,000 per year for three years.

STRATEGY: Disclose geologic hazards in real-estate transactions.

Output: Homebuyers are made aware of geologic hazards at a property prior to making a purchase.

Outcome: Homebuyers are more informed in their decisions.

Background

Buying a home is probably the greatest investment most families make in a lifetime. In making a decision on purchasing a home, they need accurate information. A commonly overlooked concern is geologic hazards because most homebuyers are unaware of geologic hazards and falsely assume that government would not allow homes to be built in hazardous areas. Homebuyers need to know the risks they are incurring. There is presently no easy way for homebuyers or real-estate agents to know if a property is vulnerable to geologic hazards.

A seller's disclosure form available to potential buyers would provide the necessary informa-

tion. The Utah Association of Realtors has a voluntary disclosure form which includes geologic hazards that they recommend be used by all realtors. The Utah Division of Real Estate is presently developing a "property condition" disclosure form including geologic hazards which will be required in all transactions involving a real-estate broker, but it will not be required in non-brokered transactions.

Implementation

Disclosure can be implemented at either the state or local government level. Uniformity statewide is desirable, and would require legislation. Accurate maps showing geologic hazards are useful to inform sellers, real-estate agents, and local governments of potential hazards, but aren't necessary to implement disclosure if only known hazards or damage from hazards are to be disclosed.

Responsible Agencies

Utah Division of Real Estate
Local governments
Utah Geological Survey (to provide hazards information)

Resources Needed

If responsibility for disclosure is placed with sellers or real-estate agents, no government funding is necessary.

Minimal costs may be incurred in handling paperwork. If the state places responsibility with local governments, state or local funds to handle additional paperwork may be required.

Utah Seismic Saftey Commission News

Utah Legislature Punts

Only one piece of "earthquake-related" legislation was presented to the 1995 Utah Legislature and it was a major focus of the Utah Seismic Safety Commission's (USSC) meeting on January 10, 1995. Representative Nora Stephens of Davis County, introduced a bill (H.B. 53) to create an emergency management trust fund and appropriate $250,00 for it. At the discretion of the Director of the Utah Division of Comprehensive Emergency Management, 45 percent of the money was to be used to educate the public about emergency preparedness, establish local government liaisons, and run state emergency-management programs like the Community Emergency Response Team (CERT) training program. The remainder of the fund was to pay for emergency-response operations when the Governor declares a state of emergency but there is no federal disaster declaration. The USSC voted unanimously to endorse and support H.B. 53 because of its potential to advance some of the high priorities in *A Strategic Plan for Earthquake Safety in Utah* (see related article, this issue). But the bill was defeated by one vote in the State and Local Affairs Committee meeting on January 23, 1995, mainly because the Committee believed that the amount requested was inadequate to be effective.

New Members Bring Federal Perspective

Chairman Youd introduced the USSC's two newest members, Dave Prothero, ex-officio representative of the Federal Emergency Management Agency (FEMA), and Randy Updike, ex-officio representative of the U.S. Geological Survey (USGS). Randy Updike reported to the Commission on the USGS efforts to update the national earthquake hazard maps, last issued in 1990. The USGS has conducted regional workshops to gather input on potential seismic sources and attenuation relations from local professionals at academic institutions, state surveys, and consulting firms. These workshops have been held in the Pacific Northwest, New England, the central United States, northern California, southern California, and the southeastern United States. The workshop for the Intermountain West (Utah, Nevada, Arizona, New Mexico, Idaho, Montana, Wyoming, and Colorado) was held February 16-17, 1995, in Salt Lake City. The workshops give attendees the opportunity to critique the approach being used as well as provide the most up-to-date local and regional data to the USGS for incorporation into the maps. The maps will be probabilistic, that is, based on the percent probability of exceedence in a given exposure time. They are being prepared for the 1997 National Earthquake Hazard Reduction Program (NEHRP) seismic provisions, and thus are especially useful to design engineers in evaluating building codes. Draft maps should be available for comment by the end of 1995; final versions are expected by mid-1996.

Mr. Updike was asked to comment on the future of the USGS in light of the Contract with America recommending its elimination. After discussion, the USSC unanimously voted to contact the Utah delegation to express their concerns over the possible decrease or elimination of the earthquake-related functions of the USGS. From 1983-1989, the USGS performed extensive work

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Regional Seminars Draw Large Audience

The USSC was a co-sponsor of a two-day seminar on seismic risk and earthquake engineering presented by the Earthquake Engineering Research Institute (EERI) on November 29 and 30, 1994 in Salt Lake City. The *Wasatch Front Seismic Risk Regional Seminar* was part of the ongoing EERI series on earthquake engineering issues funded by FEMA. The seminar was also co-sponsored by the Utah Geological Survey, the University of Utah Seismograph Stations, the Departments of Civil Engineering and Geology and Geophysics at the University of Utah, the Department of Civil and Environmental Engineering at Utah State University, and Brigham Young University's Civil and Environmental Engineering Department. Ann Becker of Woodward-Clyde Federal Services was chair of the organizing committee and chaired the workshops. Over 170 people attended the seminar.

The first day focused on the seismic risk in Utah as well as the economic impact of a large earthquake, and was directed at building officials, planners, and building owners. The program began with overviews of what seismic risk includes and what the seismic hazard is along the Wasatch Front, including earthquake recurrence and expected ground motions. An official of the International Conference of Building Officials discussed the philosophy of building codes, highlighting the life-safety intent of the Uniform Building Code. New research results on financial losses due to structural damage in Salt Lake County and projections for other Wasatch Front counties, estimates of nonstructural financial losses, and projections of the long-term regional economic impact followed. The cost effectiveness of structural retrofit and earthquake insurance was also discussed.

The second day emphasized earthquake research and mitigation and was intended primarily for earth sciences and engineering professionals. Presentations included results of studies underway at the Utah Geological Survey on the geologic characterization of Wasatch Front faults. Seismological issues discussed included the regional seismicity recorded by the University of Utah Seismograph Stations and advances in our understanding of strong ground motion. The current state-of-understanding of soil response and other geotechnical engineering issues was also addressed; structural engineering topics included energy-dissipation systems and performance-based seismic design. The status of lifelines and lifeline engineering along the Wasatch Front was also presented. Finally, Chairman T. Leslie Youd discussed the newly formed commission and its efforts in seismic-hazard reduction.

The workshop brought much media coverage to the earthquake threat in Utah. Subsequently, the Salt Lake Tribune published an editorial in support of responsible actions to reduce earthquake risks. The workshop did much to advance public awareness as well as to inform users of the latest information. The UGS has a limited number of the workshop proceedings. If you would like a copy, contact Janine Jarva at the Utah Geological Survey, (801) 467-7970, fax (801) 467-4070, e-mail address: nrdomain.nrugs.jjarva@email.state.ut.us.

CEM Offers Natural Disaster Workshops

The first two of three planned workshops, titled "Natural Disasters in Utah, How Can We Better Prepare," have been conducted by the Natural Hazards Section of the Utah Division of Comprehensive Emergency Management (CEM). The workshops addressed local concerns and helped participants develop mitigation plans for their communities.

The workshops were developed by the CEM Natural Hazards staff in response to the Federal Emergency Management Agency's (FEMA) National Mitigation Strategy directive. FEMA Director James Lee Witt is committed to the goal of making mitigation the foundation of emergency management. "The level of spending required for recovery efforts after the Midwest floods and California's earthquake has forced us to recognize that only premitigation planning on a regional basis will lessen the impact of future natural disasters," said Bob Carey, State Earthquake Program Manager.

Participants from Millard, Sanpete, Juab, Garfield, Piute, and Sevier Counties came to the first workshop, which was held in Richfield on November 9, 1994. The second workshop was held in Price February 23-24, 1995. Participants learned about mitigation, Utah's earthquake threat, developing business plans, and flood plain management.

The final workshop will be held in Cedar City April 26-27. These workshops are intended to encourage individuals, businesses, and local governments to implement mitigation strategies. For more information regarding these workshops, please call Judy Watanabe at (801) 538-3750.

Earthquakes Under the Microscope

The California Seismic Safety Commission

The following was excerpted from an invited comment by Frances E. Winslow, Emergency Management Commissioner, California Seismic Safety Commission, published in the Natural Hazards Observer, v. 19, no. 2, p. 1-2. -Ed.

The California Seismic Safety Commission (CSSC) has a dual role in earthquake research. Through its own efforts it collects and publishes significant information on earthquakes in California. Through its research plan it hopes to influence research conducted by others and funded by other agencies.

The CSSC is a policy advisory body made up of 15 members appointed by the governor and two members representing the state senate and state assembly. They apply their knowledge and experience in the fields of seismology, engineering, geology, fire protection, emergency services, local government, building code enforcement, planning, and architecture to help California manage earthquake risk. Through these efforts, the Commission has promoted substantial improvements in public policies and private activities to reduce earthquake risks from unsafe structures, refine emergency response, and plan for earthquake recovery.

Following the 1989 Loma Prieta earthquake there was a flurry of research that was uncoordinated and often redundant. Consequently, State Senator Alfred Alquist, a member of the Commission, sponsored SB 1835 in 1990, calling for a plan to coordinate and prioritize research and direct state and federal funding toward those efforts that would have the greatest potential for increasing public safety and mitigating property loss.

Following the Northridge earthquake, the Commission sponsored formal hearings in Van Nuys and Burbank to obtain testimony from first responders, governmental officials, and citizens. These hearings involved 96 community leaders who participated in the Northridge response and recovery effort.

During the hearings, Richard Andrews, Director of the Governor's Office of Emergency Services, presented the Commission with an executive order from the Governor. It directed the CSSC to investigate the issues related to seismic structural safety and land-use planning and to report to the governor by the fall of 1994.

Gathering valid factual information quickly after a major disaster is a challenge. A full-time project manager assembled four teams of expert advisors to examine: 1) buildings; 2) dams, bridges, and lifelines; 3) geosciences; and 4) land-use planning. After meeting throughout the spring, the groups each developed a series of reports on specific issues. The information contained in these documents will form the basis for the recommendations to the governor.

The final reports will include 39 background reports with comments. Each background report will contain a series of recommendations for actions, including a variety of future research projects. Topics to be covered include performance of hospitals, performance of steel buildings, significance of blind thrust faults, and pre-earthquake planning for post-earthquake recovery. Also, 20 consultants' reports will elaborate on the individual issues that will be more briefly addressed in the policy formulation document that will go to the governor.

In an effort to capture policy implications broader than those in the background reports, the Commissioners are also writing brief issue papers, each focusing on one topic. These issue papers will also provide a basis for legislation and changes to the state's earthquake hazard mitigation program outlined in *California At Risk*.

Together, these reports will provide a comprehensive record of the Northridge earthquake, informing public policy makers, and defining topics for future research in public policy, seismology, social science, and engineering. For information on how to obtain these reports, write to the CSSC, 1900 K St., Sacramento, CA 95814.

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Facing the Challenge

U.S. Report to the IDNDR Available

The National Research Council has published the official report presented by the United States at the International Decade for Natural Disaster Reduction (IDNDR) World Conference on Natural Disaster Reduction, which was held May 23-27, 1994, in Yokohama, Japan. The document, created by the U.S. National Committee for the IDNDR with help from numerous volunteer contributors, is titled *Facing the Challenge - The U.S. National Report*.

The 78-page document includes chapters on risk assessment, mitigation, warning systems, and international cooperation. Single copies of the report are available free of charge by contacting the National Research Council Board on Natural Disasters, 2101 Constitution Avenue, N.W., Washington, DC 20418. You may fax your request to (202) 334-3362.

Reprinted from EERI Newsletter, v. 28, no. 8, p. 4.

Brief Report on National Mitigation Strategy Forum
Boulder, Colorado - September 27, 1994

by Nancy Barr
Utah Division of Comprehensive
Emergency Management

FEMA has begun designing a new national natural hazards mitigation strategy as part of its effort to change the focus of this country's approach to disasters from response to prevention.

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The Federal Emergency Management Agency (FEMA) has begun designing a new national natural hazards mitigation strategy as part of its effort to change the focus of this country's approach to disasters from response to prevention. FEMA Director James Lee Witt has stated that he believes mitigation should be the cornerstone of a national program of emergency management, because it reduces the number of victims and the amount of property loss and environmental damage. To involve a wide variety of potentially affected constituencies in the development of this national mitigation strategy, FEMA wanted advice and recommendations from interested parties, including other federal agencies, state and local governments, private for-profit and nonprofit organizations, and citizens. To do that, FEMA sponsored "town meetings" in each of its 10 regions in September and October of 1994.

The National Mitigation Strategy Forum for FEMA Region VIII was held, Tuesday, September 27, 1994, in Boulder, Colorado. Approximately 250 people attended the meeting. This was the fifth of 10 nationally scheduled strategy meetings sponsored by FEMA as a part of a Presidential mitigation directive. The introductory speakers for this forum were Richard Moore, Associate Director for Mitigation, FEMA Headquarters, and Michael Armstrong, Regional Director, FEMA Region VIII.

Mr. Moore addressed coordinating efforts among federal, state, and local levels of government in mitigation. Mr. Moore stated the focus of this forum is predisaster planning. Mitigation strategies should be implemented at the local level with guidance from the state and federal governments. Mr. Moore also stated: mitigation should be focused on public awareness; mitigation should be practiced at the federal level and federal agencies should lead by example; we should utilize applied research and technology to promote mitigation; and we should amend the Stafford Act to encourage predisaster planning.

Mr. Armstrong suggested that mitigation is the lifeline of emergency management as it progresses into the 21st century. He also emphasized emergency management requires a partnership and sensitivity to state and local issues.

Following Mr. Armstrong's comments, the floor was opened and discussion was encouraged on the six questions presented to all participants prior to the forum. The questions and summary of responses are as follows:

1. How would you recommend that the public become better informed about their vulnerability to natural hazards and more knowledgeable about strategies and tools for mitigating natural hazards consequences?
   - Federal agencies should lead by example.
   - More one-on-one discussion about mitigation between different agencies (state & federal).
   - Work with other agencies to utilize their expertise to promote mitigation.
   - Promote local mitigation.

2. The paper *Toward a National Mitigation Strategy*, sets forth five-, 15-, and 25-year goals for natural hazards reduction. Are these reasonable? Do you have any suggestions for changes or additions?
   - This is an ongoing process and should be viewed as such.
   - Is five year planning useful when we talk in geologic terms?

3. What mitigation measures (such as acquisition/relocation, building codes, land use planning, public awareness, and education) have proved to be most successful/effective in your experience? Why?
   - Building officials and those involved in code enforcement should be trained in mitigation.
   - Enforcement of current building codes and ordinance compliances must be addressed. Suggested a permit system be established to address all code enforcement.
   - Establish a Natural Hazards Ordinance addressing specific hazards and encourage and promote mitigation through the ordinance.
   - Disclosure laws.
   - All strategies must be incorporated into local needs and concerns with appropriate funding made available.
   - Predisaster planning will guide response activities.

4. Do you believe that mitigation measures can be implemented consistently on a voluntary basis, or must they be mandated? Please give an

example of voluntary implementation which has been effective.

- NFIP is an excellent example of voluntary implementation of a mitigation effort.
- The federal government is not consistent on policies relating to disaster relief. In many instances this encourages rebuilding in areas with designated or obvious hazards.
- We should reflect on actual dollars spent after a disaster, then ensure through sound realistic mitigation planning that the impact from the next disaster will be less.

5.What incentives (such as tax credits, lower insurance rates, grants, low-cost loans) do you believe would encourage the implementation of mitigation measures or programs? Please describe any experiences you have had with incentive programs.

- The Community Rating System (CRS)/NFIP is an example of an incentive program that works.
- Through a Natural Hazards Insurance Pro gram, a grant system should be implemented to promote mitigation prior to the disaster.
- Encourage and enforce more stringent codes that would lessen the impact of a disaster.
- Promote public awareness of mitigation and cost-saving benefits of mitigating.

6.How would you recommend that mitigation measures be financed?

- At the federal level, increase funding for mitigation. This would lessen the need for funding in response and recovery activities.
- At the local level, encourage mitigation through foundations, educational systems, businesses, etc.
- Private insurance could add a surcharge designated for mitigation.
- Create a National Mitigation Fund, a cooperative effort between business and the federal government.

FEMA envisions a national policy that will offer innovative approaches for combining funds and coordinating activities with the private sector and citizens. Both the federal government and private sector would provide leadership, coordination, and research support, including financial incentives for communities, businesses, and individuals for mitigation activities. The emphasis will be on building safer communities now and implementing wiser land-use decisions.

Mitigation strategies should be implemented at the local level with guidance from the state and federal governments.

Status and Developments in Data Distribution and Exchange — University of Utah Regional Seismic Network

by S.J. Nava, W.J. Arabasz, J.C. Pechmann, and R.B. Smith
Department of Geology and Geophysics, University of Utah

The University of Utah (UU) has historically been a primary center for earthquake information and research in the four-state (Utah, Idaho, Wyoming, and Montana) Intermountain region. Data discussed here are from the UU's regional seismic network of ~100 short-period stations, extending from northwest Wyoming to southern Utah, with special focus on Utah's Wasatch Front region and Yellowstone National Park. Three broadband stations now operate in the Intermountain region: the UU station DUG, the U.S. Air Force station BW06, and the Lawrence Livermore National Lab station KNB. All three are or soon will be part of the U.S. National Seismic Network.

Traditional outlets for disseminating UU earthquake data include telephone alerts, press releases, quarterly bulletins, periodic catalogs, and customized epicentral maps and catalog searches (generally fee-based). Recent earthquake listings are accessible through the Internet via finger (~35 requests/day). Earthquake catalogs and station information are available via anonymous ftp (~15 requests/week). Digital waveform data (1981 to present) must be retrieved manually from archive tapes, which limits waveform retrieval for external users to small data requests. For the southeastern Idaho and western Wyoming regions, phase data are routinely exchanged via e-mail between network operators at the University of Utah, the U.S. Bureau of Reclamation, and the Montana Bureau of Mines and Technology; association is done manually, however.

By early 1995, we anticipate availability of the following services, now under development: (1) a World Wide Web Mosaic interface for Internet users, (2) automatic location of seismic events for pager and e-mail broadcasting, and (3) access of catalog and waveform data via the IRIS Data Management Center—pending a project now under way to transfer data from 659 9-track tapes to optical disk.

Presented at the American Geophysical Union Fall Meeting, December 1994, San Francisco. Abstract reprinted with permission from EOS, Transactions of the American Geophysical Union, v. 75, no. 44, p. 430.

Earthquake Activity in the Utah Region

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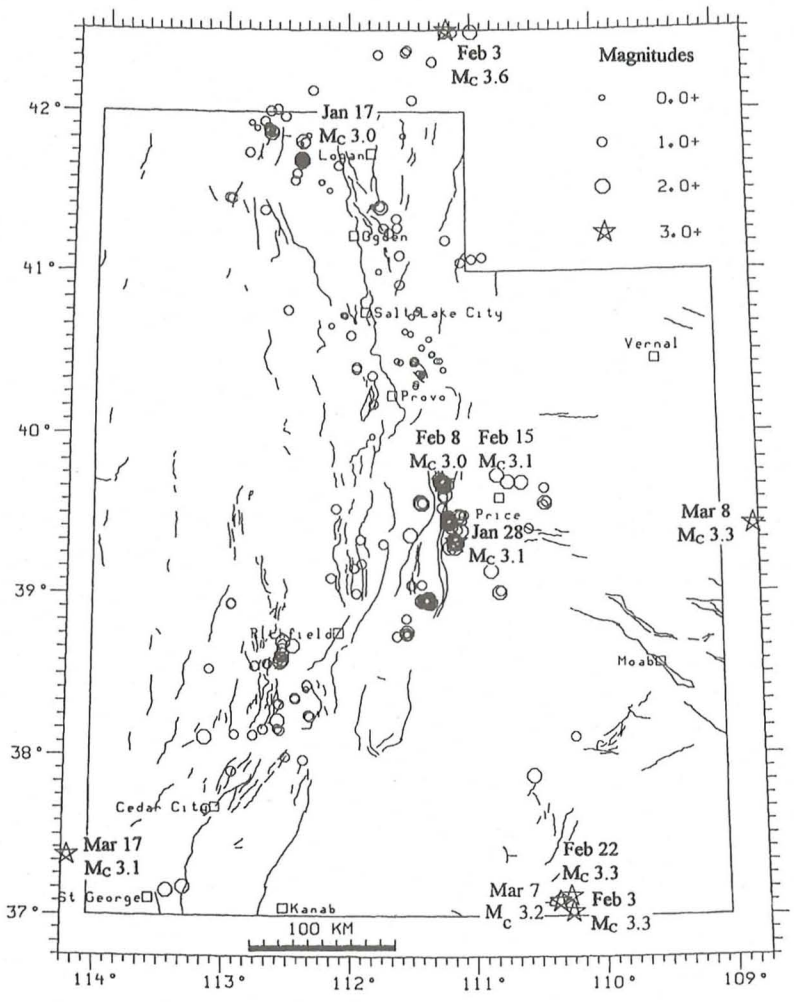

January 1 - March 31, 1994

During the three-month period January 1 through March 31, 1994, the University of Utah Seismograph Stations located 411 earthquakes within the Utah region. The total includes ten earthquakes in the magnitude 3 range and 184 in the magnitude 2 range. Earthquakes which have magnitudes of 3.0 or larger are plotted as stars and specifically labeled on the epicenter map. There were three earthquakes reported felt during the report period. Magnitude is either local magnitude, M_L, or coda magnitude, M_C. All times indicate are local time, which was Mountain Standard Time during this reporting period.

Significant Main Shocks and Clusters of Earthquakes

• Eastern Wasatch Plateau-Book Cliffs area near Price (coal-mining related): four clusters of seismic events (magnitude 0.4 to 3.1) make up 52% of the shocks that occurred in the Utah region during the report period. These clusters are located: (a) 25 miles WNW of Price, (b) 20 miles WSW of Price, (c) 30 miles SW of Price, and (d) 55 miles SW of Price. Significant earthquakes include:

M_C 3.1	January 28	3:47 p.m.	9 miles NW of Orangeville.
M_C 3.0	February 8	5:48 a.m.	11 miles NE of Fairview.
M_C 3.1	February 15	5:57 p.m.	11 miles NE of Fairview.

• Northern Utah: a cluster of nine earthquakes ($M \leq 2.1$) occurred 25 miles W of Garland (40 miles WNW of Logan). Most of the earthquakes in this series occurred during the month of January. A separate cluster of 41 shocks ($M \leq 3.0$) occurred 10 miles WSW of Tremonton (30 miles W of Logan), during the months of January and February. Significant earthquakes include:

M_C 3.0	January 17	4:03 a.m.	12 miles WSW of Tremonton; felt in Tremonton, Thatcher, Ogden, Logan, Lakepoint, and Thiokol.
M_C 2.8	January 17	4:14 a.m.	12 miles WSW of Tremonton; felt in Tremonton, Thatcher, Lakepoint, and Thiokol.
M_C 2.1	January 17	4:33 a.m.	12 miles WSW of Tremonton; felt in Tremonton, Thatcher, Lakepoint, and Thiokol.
M_C 3.6	February 3	3:09 a.m.	10 miles ENE of Georgetown, ID.

• Central Utah: a series of 12 earthquakes occurred 25 miles SW of Richfield. The shocks ranged in magnitude from 1.2 to 2.8. All but two of the earthquakes in this sequence occurred on March 29th. Significant earthquakes include:

M_C 3.3	March 8	4:40 a.m.	18 miles NNW of Fruita, CO.

• Southern Utah: a cluster of three earthquakes occurred along the Utah-Arizona border (130 miles E of Kanab) in a remote area located near Lake Powell. Significant earthquakes include:

M_C 3.3	February 3	12:08 p.m.	20 miles NNW of Kayenta, AZ.
M_C 3.3	February 22	2:26 p.m.	27 miles NNW of Kayenta, AZ.
M_C 3.2	March 7	6:34 p.m.	26 miles NNW of Kayenta, AZ.
M_C 3.1	March 17	6:18 a.m.	24 miles SE of Caliente, NV.

Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations.

Clinton Signs Executive Order on Seismic Safety of Existing Federal Buildings

On December 1, 1994, President Clinton signed Executive Order 12941, *Seismic Safety of Existing Federally Owned or Leased Buildings*. The order, developed by the Interagency Committee on Seismic Safety in Construction (ICSSC), adopts *Standards of Seismic Safety for Existing Federally Owned or Leased Buildings (Standards*, ICSSC RP4) as the minimum technical standard to be used by federal agencies in assessing the seismic safety of their owned and leased buildings and in mitigating unacceptable seismic risks in those buildings. Through this adoption, the order implements a modest program of evaluation and rehabilitation through "trigger" mechanisms identified in the *Standards*. The situations which will trigger a seismic evaluation in a federally owned or leased building (and, if necessary, rehabilitation) include:

- a change in function which results in an increase in seismic risk;
- a renovation costing 50 percent or more of the replacement value of the building;
- the occurrence of significant structural damage to the building, from any cause, natural or manmade;
- the identification by the owning or leasing agency of an exceptionally high risk; or
- the addition of the building to the federal inventory after the adoption of the *Standards*.

The order also calls for all affected agencies to develop a seismic inventory of their owned and leased buildings, and to estimate the cost of mitigating unacceptable seismic risks in those buildings. Agencies are given four years to develop a comprehensive report on how to achieve an adequate level of seismic safety in federally owned and leased buildings in an economically feasible manner. The report is due six years after the signing of the order, December 1, 2000.

The order requires the ICSSC to develop guidance for the affected agencies to use in inventorying their buildings and developing the cost estimates. This guidance, due one year after the signing of the order, December 1, 1995, will help to ensure that the collected information is consistent across the agencies.

Executive Order 12941 on seismic safety of existing federal buildings was developed in response to a mandate from Congress issued in Public Law 101-614, the NEHRP Reauthorization Act, that directed the President to adopt standards for assessing and enhancing the seismic safety of existing federally owned and leased buildings by December 1, 1994. The same law directed the ICSSC to develop the standards. Unlike Executive Order 12699 on seismic safety of *new* building construction, the order on existing buildings does not affect federally assisted or regulated buildings.

To receive a copy of the order or the *Standards*, fax your request to Diana Todd, (301) 869-6275 or mail it to her at the National Institute of Standards and Technology, Building 226, Room B158, Gaithersburg, MD 20899.

Reprinted from EERI Newsletter, v. 29, no. 1, p. 1.

ASCE 7-93 is Available

Minimum Design Loads for Buildings and Other Structures, in its latest edition (ASCE 7-93) includes a completely revamped section on seismic design, based largely on the 1991 edition of the *NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings*. The design procedure adopted in ASCE 7-93 permits the use of allowable stress design to implement the limit-states approach of the *NEHRP Recommended Provisions*. In a departure from past editions, the new seismic provisions include a significant section on nonload requirements, such as material and configuration limitations and detailing requirements.

The standard, which formerly was published by the American National Standards Institute as ANSI A58.1, continues to provide criteria for dead, live, soil, wind, snow, and rain loads and their combinations. ASCE 7-93 is intended to serve as a reference document for building codes and other design documents. The 150-page ASCE 7-93 document is available for $44 ($33 for ASCE members). To order, call ASCE Central at 800-548-ASCE and ask for publications.

Reprinted from EERI Newsletter, v. 28, no. 5, p. 12.

1995 Kobe, Japan Earthquake Report Available

The most devastating earthquake to hit Japan since the 1923 Tokyo earthquake occurred at 5:46 a.m. local time on January 17, 1995, in the port city of Kobe, 30 km west of Osaka. Over 5,000 people were killed, more than 26,000 injured, and over 300,000 left homeless. At the time of the earthquake, about 40 American engineers, scientists, and government officials were in Osaka for a joint U.S.-Japan Workshop on Urban Earthquake Hazard Reduction, funded by the National Science Foundation, and co-sponsored by the Earthquake Engineering Research Institute (EERI) and the Japan Institute of Social Safety Science. The workshop participants immediately undertook preliminary post-earthquake reconnaissance efforts.

A 120-page report, *Great Hanshin Earthquake Disaster—Hyogo-Ken Nanbu Earthquake Preliminary Report*, is now available from EERI. It summarizes preliminary information gathered by the workshop participants in the first week after the earthquake and includes pictures, figures, and observations on geoscience and geotechnical issues, architectural and planning background, damage to buildings and transportation structures, lifeline systems, emergency response, and societal and economic impacts. The damage caused by the magnitude 6.8 Hyogo-Ken Nanbu earthquake is so extensive that field investigations will continue for some time and more definitive information will become available in the months ahead.

Current EERI members will receive the preliminary report as part of their membership benefit. Non-members may purchase a copy from EERI for $15. To order, please contact EERI at 499 14th Street, Suite 320, Oakland, California 94612-1934, phone (510) 451-0905, fax (510)451-5411. All orders need to be prepaid by check, VISA or MasterCard. California residents must include 8.25% sales tax. For orders outside the U.S., add $2.50 shipping.

House Passes & President Signs Earthquake Hazards Reduction Act

On October 4, 1994, the U.S. House of Representatives passed the Senate Amendment to H.R. 3845, the Earthquake Hazards Reduction Act authorization. By October 20, the act had been signed by President Clinton. The bill authorizes spending in fiscal years 1995 and 1996 for the National Earthquake Hazards Reduction Program (NEHRP) and directs the President to assess U.S. capabilities in earthquake engineering research and testing.

The Federal Emergency Management Agency (FEMA), National Institute of Standards and Technology, National Science Foundation, and U.S. Geological Survey participate in NEHRP, with FEMA designated the lead agency. The Earthquake Hazards Reduction Act of 1977 created NEHRP, which supports research, applications, and emergency management to improve public safety during earthquakes. The bill authorizes $103.2 million for fiscal year 1995 and $106.3 million for fiscal year 1996.

The bill as signed directs the President to conduct an assessment of earthquake engineering and testing capabilities in the United States. "This assessment will address the growing concern that U.S. testing of building designs and construction methods cannot keep pace with the demand to test such structures and ensure public safety during earthquakes," explained Representative George E. Brown, Jr. (D-California), Chairman of the House Science Committee, which has jurisdiction over earthquake research. Copies of H.R. 3485, the Earthquake Hazards Reduction Act Authorization, are available from the committee's publication clerk at (202) 226-4530.

Reprinted from EERI Newsletter, v. 28, no. 11, p. 2.

ATC-33

The ATC-33 project, sponsored and funded by the Federal Emergency Management Agency (FEMA), seeks to develop guidelines and commentary for the seismic rehabilitation of buildings. The client for the project is the Building Seismic Safety Council (BSSC); the prime contractor is the Applied Technology Council (ATC).

The guidelines will discuss issues associated with performance objectives and selection of design procedures consistent with performance objectives. In addition, it will promote the use of simplified nonlinear analysis procedures not yet adopted in current seismic design codes for new construction. The 25 percent submittal for the project has recently been delivered to the BSSC. ATC-33 is due for completion within three years. Upon completion, the guidelines and commentary will constitute the first comprehensive document on the seismic retrofit of buildings published in the world.

The project is being directed by Daniel Shapiro of SOHA; other key individuals include William Homes of Rutherford & Chekene, Senior Technical Advisor, and Robert Bruce, ATC Technical Director. EERC Director Jack P. Moehle and Associate Director Andrew Whittaker are acting as consultants to ATC-33. Professor Moehle is a member of the Concrete Team, and Dr. Whittaker is a member of the New Technologies Team.

Reprinted from EERC News, v. 15, no. 3, p. 3.

Performance of Structures, Lifelines, & Fire Protection Systems

1994 Northridge Earthquake

The National Institute of Standards and Technology (NIST) has recently released NIST Special Publication 862, *1994 Northridge Earthquake—Performance of Structures, Lifelines, and Fire Protection Systems*, by Diana Todd, Nicholas Carino, Riley M. Chung, H.S. Lew, Andrew W. Taylor, William D. Walton, James D. Cooper, and Roland Nimis. This study documents the performance of buildings, bridges, lifelines, and fire-protection systems after the January 17, 1994 Northridge earthquake. The authors detail 21 specific conclusions and make 20 recommendations related to those conclusions.

In the preface the authors state, "The initial assessment of the Northridge earthquake of January 17, 1994, provides significant lessons for public policies and construction practices in earthquake-prone areas throughout the United States. While it was not in a category of large earthquakes in terms of its magnitude, the Northridge earthquake caused severe damage to a wide range of structural types because the epicenter was located in a populated urban area. Damaged structures revealed a number of deficiencies in current construction practices and areas needing improvements in code provisions. Implementing lessons learned about structural performance and postearthquake fires will reduce seismic hazards throughout the United States."

To receive a copy of the *1994 Northridge Earthquake—Performance of Structures, Lifelines, and Fire Protection Systems*, contact Diana Todd, National Institute of Standards and Technology, Building 226, Room B158, Gaithersburg, MD 20899, fax (301) 869-6275.

Directions for Research in the Next Decade

NSF Workshop Report Available

National Science Foundation (NSF) support of research in earthquake engineering in the areas of siting, design, and societal response, and of earthquake-related earth science in the areas of geophysics, seismology, and geology have been key elements of the National Earthquake Hazards Reduction Program (NEHRP). In June 1993, a workshop was held in Washington, D.C. to review accomplishments resulting from NSF funding, to assess directions and needs in the next decade and to examine policies and administrative procedures impacting the role of NSF in NEHRP. A short summary report and a proceedings of the workshop are available from J. O. Jirsa, University of Texas, Ferguson Structural Engineering Laboratory, PRC 177, 10100 Burnet Road, Austin, TX 78758, fax (512) 471-1944, e-mail jirsa@uts.cc.utexas.edu.

Reprinted from EERI Newsletter, v. 29, no. 2, p. 2.

Performance of Masonry Structures in Northridge

The Masonry Society (TMS) has published a 100-page report of the findings of its Northridge earthquake reconnaissance team. The report, *Performance of Masonry Structures in the Northridge, California Earthquake*, is available for $15 ($7.50 for TMS members) plus $2 shipping and handling from The Masonry Society, 2619 Spruce Street, Suite B, Boulder, CO 80302-3808.

The team found little distress in modern one-story reinforced masonry buildings, in multi-story reinforced bearing-wall buildings, or in freeway noise barrier walls. Unreinforced masonry structures that had been retrofitted in accordance with Division 88 requirements experienced less damage than similar structures that had not been retrofitted.

Reprinted from EERI Newsletter, v. 28, no. 12, p. 6.

Caltrans Report: Comparison of Caltrans-Japan Design Methods; Innovative Japanese Bridge Design

The California Department of Transportation (Caltrans) Office of Earthquake Engineering recently issued a series of four reports authored by Mark Yashinsky, who has recently returned from an extended visit to the Japanese Ministry of Construction's Public Works Research Institute (PWRI). In *Comparison of Caltrans' and Japan's Seismic Bridge Procedures*, an 18-page report, Yashinsky examines many technical aspects of bridge design, such as design response spectra, ductility versus strength requirements, and methods used for calculating stiffness, and compares the Caltrans and Japanese retrofit programs. He argues that some differences in the design approaches may be due to differing attitudes, economics, and political situations in the two societies.

The other three reports present first hand accounts of innovative procedures currently being used in the design and construction of bridges in Japan. *Scouring of Bridge Foundations in Japan* was co-authored by Michael Britt of the Federal Highway Administration. The other titles are *Construction of Innovative Japanese Bridge Foundations* and *New Developments Related to Soil Liquefaction in Japan*. To receive a copy of these reports, contact Mark Yashinsky, Caltrans Office of Earthquake Engineering, P.O. Box 942874, Sacramento, CA 9424-0001, or fax your request to (916) 227-8174.

Reprinted from EERI Newsletter, v. 28, no. 12, p. 6.

Principal Geotechnical Aspects of the January 17, 1994 Northridge Earthquake

Preliminary Report

"Although overall damage evaluations are not yet complete, the Northridge earthquake of January 17, 1994 appears to have been the most costly natural disaster in U.S. history . . .

Current estimates of damage directly attributable to this earthquake are on the order of $13 to $15 billion."

The Earthquake Engineering Research Center at the University of California at Berkeley has published the *Preliminary Report on the Principal Geotechnical Aspects of the January 17, 1994 Northridge Earthquake*, edited by J.P. Stewart, J.D. Bray, R.B. Seed, and Nicholas Sitar. The report was prepared to document preliminary geotechnical data gathered after the Northridge earthquake. The following comments were excerpted from the summary and conclusions of the report.

The widespread damages resulting from the earthquake included: (1) structural failures in residential, commercial, industrial, and transportation facilities, (2) thousands of breaks in water, gas, sewer, and other buried pipelines, (3) distressed geotechnical structures including dams and landfills, (4) numerous landslides in mountainous areas surrounding the epicentral region, (5) disruption of pavements from ground failure, and (6) damage to non-structural elements and contents of structures...Much of the damage was a result of the unfortuitous location of the fault rupture directly beneath a heavily developed and populated portion of Los Angeles. Large inertial forces associated with the very strong ground motions in the near-field simply overwhelmed many inadequately designed structures. However, high concentrations of damage also occurred in several geographically well-defined areas relatively distant from the zone of energy release. These concentrations of damage...appear to have been influenced by geologic factors such as soil amplification or basin effects.

Although overall damage evaluations are not yet complete, the Northridge earthquake of January 17, 1994 appears to have been the most costly natural disaster in U.S. history. Sixty-one fatalities and 18,500 injuries have been attributed to this earthquake, and more than 414,000 families were at least temporarily displaced from their homes. In addition to the well-publicized collapses of a number of highway structures, more than 14,000 buildings were damaged by the earthquake, and approximately 2,900 of these were sufficiently damaged as to be unsafe for entry. Current estimates of damage directly attributable to this earthquake are on the order of $13 to $15 billion.

These numbers reflect enormous losses, but these losses must be viewed in perspective. The Northridge event was a significant earthquake (M_W = 6.7) centered beneath one of the largest metropolitan areas of the United States. Although damage was widespread, loss of life was relatively low given the large population of the region. This was due in no small part to the fortuitous timing of the event in the early morning hours (4:30 a.m., PST), when many of the heavily damaged structures, including shopping malls and highway bridges, were largely deserted. However, the relatively low loss of life also serves as a testament to the significant advances made in earthquake engineering practice over the past 25 years. Nonetheless, the Northridge event has also demonstrated that much more remains to be done in this regard. The very high economic losses demonstrate a need to extend current practice in seismic design of general structures, which is based primarily on protection of life safety, to further consideration of preservation of structural serviceability and minimization of losses so as to insure repairability.

The Northridge earthquake of January 17, 1994 serves as a reminder of the unacceptably high level of seismic risk associated with the likely occurrence of larger and considerably more damaging future earthquakes both in the greater Los Angeles area and around the world. There is an urgent need to pursue the research opportunities provided by the Northridge earthquake, and to rapidly transfer the benefits of such research into the mainstream of professional practice. In addition, there is also an urgent need to educate policy makers, the insurance industry, and the general public, and to motivate them to undertake the often difficult actions necessary to begin to remediate the levels of seismic hazard exposure associated with existing conditions.

The 245 page *Preliminary Report on the Principal Geotechnical Aspects of the January 17, 1994 Northridge Earthquake*, Report No. UCB/EERC-94/08, is available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 or from the National Information Service for Earthquake Engineering (NISEE), 1301 South 46th Street, Richmond, CA 94804.

Program to Focus on Steel Moment Frame Structures

Before the January 17, 1994, Northridge earthquake, the steel moment frame (SMF) building was considered by many to be the best type of seismic-resistant construction. Although no steel buildings collapsed during the earthquake, the extensive fractures observed afterward in beam-column connections have caused an unprecedented loss of confidence in current building codes and professional practice for this type of structure. Additionally, economic considerations make unclear how to proceed with repair and retrofit as well as with new and planned construction. What is clear is a demand for new knowledge.

To address these problems, a 36-month program has been formulated by the SAC Joint Venture Partnership of the Structural Engineers Association of California (SEAOC), the Applied Technology Council (ATC), and the California Universities for Research in Earthquake Engineering (CUREe). The goal of the program is to develop professional practices and recommend standards for the inspection, repair, retrofit, and design of SMF buildings to provide reliable, cost-effective seismic performance in future earthquakes. Four thousand SEAOC members, the eight major earthquake engineering research universities of CUREe, and the national technical resources of the Applied Technology Council will together provide a formidable resource for meeting this challenge. EERC participants are expected to actively and meaningfully participate in this program.

The proposed program on SMF buildings will address both immediate and long-term needs. The entire range of steel frame structures will be considered, with highest priority given to major government and public buildings, hospitals, and schools. Immediate needs will focus on the inspection, evaluation, and repair of SMF buildings in Los Angeles. Interim guidelines will be developed and evaluated based in part on detailed field surveys carried out in the epicentral area of the earthquake, on an international workshop, and on evaluations and analyses of damage and undamaged public buildings. Work has begun on these tasks under funding from the Federal Emergency Management Agency, the California Office of Emergency Services, the American Iron and Steel Institute, and the National Institute of Standards and Technology.

Laboratory and field experiments, such as large-scale component, assemblage, and structure tests, will be conducted to gather information on performance. Investigations into the various technical factors contributing to seismic performance will include metallurgy, welding, structural system behavior, and nondestructive evaluation and inspection techniques.

Because steel-frame buildings were previously considered reliable, professional practices will be reviewed in order to develop recommendations of standards for repair, retrofit, and design. An extensive outreach effort will encourage implementation of guidelines and standards once developed.

The participating organizations of the joint venture are committed to using all resources, both national and international, to rapidly augment existing knowledge on the design and performance of SMF structures. Project investigation teams made up of multidisciplinary experts from the joint venture and other organizations will focus on particular problems. Project advisory boards will oversee the input of information, quality of technical investigations, and development of recommendations, and will assist in disseminating the information. Special efforts will be made to maintain liaison with the steel industry, fabricators and construction companies, code-writing organizations, insurance and risk-management groups, and federal and state agencies active in earthquake hazard mitigation efforts. Although the Northridge earthquake issued an unexpected and urgent challenge to the structural engineering community, the scope and concentration of this joint venture program should ultimately restore confidence in the seismic performance and safety of steel frame buildings.

Reprinted from EERC News, v. 15, no. 4, p. 3.

Steel Bridges & the Northridge Earthquake

The 1994 Northridge earthquake shook more than 120 steel bridges and overpasses in the Los Angeles area. Four steel bridges sustained structural damage in their substructure and connections of superstructure to substructure. A recently released report by A. Astaneh-Asl, B. Bolt, and four other researchers from the Department of Civil Engineering at Berkeley and ICF Kaiser in Oakland provides comprehensive information on performance, damage, analysis of damage, and repair strategies. To obtain a copy of the 300-page report, UCB/CE-Steel-94/01, *Seismic Performance of Steel Bridges During the 1994 Northridge Earthquake*, which includes 48 color photographs of damage and repair, send $40 to A. Astaneh-Asl, c/o Carol Wolf, 781 Davis Hall, Department of Civil Engineering, University of California, Berkeley, CA 94720-1710. Make checks payable to UC Regents.

Reprinted from EERI Newsletter, v. 28, no. 11, p. 6.

Video of Seminar on Performance of Steel Buildings Available

A 160 minute video tape of the seminar of the *Performance of Steel Building Structures During the Northridge Earthquake* is available for $25 from the Department of Civil Engineering at the University of Southern California (USC). The seminar was presented on April 29, 1994 by professors J.C. Anderson (USC), V.V. Bertero (University of California at Berkeley), and H. Krawinkler (Stanford University), and illustrates and discusses failures that were observed in steel buildings following the earthquake. Results from previous experimental tests conducted in the U.S. and Japan are summarized and methods of repair and/or upgrading are suggested. To order, send a check or money order payable to "USC Civil Engineering" to the Department of Civil Engineering, University of Southern California, University Park, KAP 210, Los Angeles, CA 90089-2531.

Reprinted from EERI Newsletter, v. 28, no. 7, p. 5.

Meetings and Conferences

- June 5-7, 1995, **Seventh Canadian Conference on Earthquake Engineering**, Montreal, Canada. Topics include seismicity and strong ground motion, seismic hazard and risk, lifelines, seismic analysis of structures, design of structures and components, experimental methods and testing, soil dynamics, liquefaction, slope stability, and foundations, observations of behavior during earthquakes, characteristics and impact of earthquakes in eastern North America, seismic code provisions, planning of emergency response, and repair and retrofitting of structures. For information, contact the Organizing Secretary, 7CCEE, Department of Civil Engineering, Ecole Polytechnique, University of Montreal Campus, P.O. Box 6079, Station "Centre-Ville," Montreal, Quebec, Canada H3C 3A7, (514) 340-3713, fax (514) 340-5881, e-mail judd@music.polymtl.ca.

- July 2-14, 1995, **International Union of Geodesy and Geophysics XXI General Assembly "Geophysics and the Environment"**, Boulder, Colorado. For further information, contact IUGG XXI General Assembly, c/o American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

- August 10-12, 1995, **Fourth U.S. Conference on Lifeline Earthquake Engineering**, San Francisco, California. Sponsored by the Technical Council on Lifeline Earthquake Engineering, American Society of Civil Engineers, the conference will feature sessions, exhibits, and field trips on the design, construction, social, and emergency-response impacts of earthquakes on lifelines (water and sewer, electric power, communications, transportation, and gas and liquid fuels). For more information, contact Jerry Isenberg, Weidlinger Associates, 333 7th Avenue, 13th floor, New York, NY 10001, (212) 563-5200 or Anne Kiremidjian, Civil Engineering Department, Terman 238, Stanford University, Stanford, CA 94305, (415) 723-4164.

- September 17-21, 1995, **American Nuclear Society Topical Meeting-FOCUS '95, Methods of Seismic Hazard Evaluation and Seismic Design**, Las Vegas, Nevada. Papers are solicited on the following topics: field data and analysis for ground motion and faulting, including data and analysis to support seismic source, fault displacement, and ground motion inputs to probabilistic seismic-hazard assessments for Yucca Mountain; paleoseismic history of faults, patterns of primary and secondary faulting, earthquake recurrence, ground-motion attenuation, site, and near-field effects; tectonic models, including alternative tectonic models, regional seismotectonic setting and tectonic stress field, relationship of tectonic models to uncertainties, and tectonic models for analog regions; engineering applications, including seismic engineering issues and applications, seismic design methodology, response of engineered structures to fault displacement, seismic design for fault displacement, earthquake damage to underground facilities and its relevance to design at Yucca Mountain; and postclosure impacts of tectonic activity, including potential for faulting and ground motion to change hydrologic properties, scenarios for tectonic activity to impact postclosure safety of repository, impact of faulting/ground motion on engineered system components, and methods for predicting tectonic activity for long time frames. Deadline for abstract submission is April 28, 1995. Submit to Ms. Sandra Trillo, TRW Environmental Safety Systems, Inc., 101 Convention Center Drive, Suite P-110, Las Vegas, NV 89109, (702) 794-7171.

- October 1-7, 1995, 1995 **Annual Meeting of the Association of Engineering Geologists, "Diversity in Groundwater and Engineering Geology,"** Hyatt Regency at Capitol Park, Sacramento, California. The conference, sponsored jointly by the Groundwater Resources Association of California, will include a technical session on seismic hazards and risk evaluation and a symposium on seismic risk in northern and southern California. Abstracts must be submitted by May 1, 1995 to Julie Turney, Technical Session Chairperson, 3037 Valkyrie Way, Sacramento, CA 95821, (916) 263-1006, fax (916) 263-1050, e-mail: jturney@trmx3.dot.ca.gov. For further conference information contact AEG/GRA '95, Jim Parsons (916) 421-5276 or Vicki Kretsinger (916) 661-0109, P.O. Box 220968, Sacramento, CA 95822-0968.

- October 17-19, 1995, **Fifth International Conference on Seismic Zonation**, Nice, France. The conference, sponsored jointly by the Earthquake Engineering Research Institute and the French Association of Earthquake Engineering, will provide a state-of-the-art assessment of the advances in seismic zonation, integrating earth sciences, engineering, planning, social sciences, and public policy. The program will include multidisciplinary discussions of how seismic zonation has been used as a tool in mitigation efforts in major seismic regions throughout the world. For further information, contact EERI at 499 14th Street, Suite 320, Oakland, CA 94612-1934, (510) 451-0905, fax (510) 451-5411.

- October 30-November 1, 1995, **1995 International Conference on Structural Stability and Design**, Sydney, Australia. For more information, contact ICSSD-95 Conference Secretariat, c/o Australian Institute of Steel Construction, P.O. Box 6366, North Sydney, NSW, Australia 2059, (61) 2-929-666, fax (61) 2-955-5406.

- November 6-9, 1995, **Geological Society of America Annual Meeting "Bridging the Gulf"**, New Orleans, Louisiana. For general information contact the GSA Meetings Department, (800) 472-1988 or (303) 447-2020, ext. 141.

- November 14-16, 1995, **First International Conference on Earthquake Geotechnical Engineering**, Tokyo, Japan. Sponsored by the Japanese Society of Soil Mechanics and Foundation Engineering and the Earthquake Geotechnical Engineering Committee of the International Society for Soil Mechanics and Foundation Engineering, themes include dynamic soil behavior, dynamic response of ground, liquefaction and associated phenomenon, seismic failure of embankments and slopes, and reports on recent earthquakes. For more information, contact Dr. Ilko Towhata, Department of Civil Engineering, University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113, Japan, phone 81-3-3812-2111, ext. 6121, fax 81-3-3818-5692.

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The Fault Line Forum (formerly Wasatch Front Forum) is published quarterly by the Utah Geological Survey (UGS). It makes information available to the public which may be preliminary or unavailable in other published form, but is considered to be of value. It may not necessarily conform to UGS policy, technical review, or editorial standards. Information, contributions, questions, and suggestions concerning future issues may be sent to the Editor at the following address:

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Publication supported by the U.S. Geological Survey (USGS), Department of the Interior, under USGS award number 1434-94-G-2486. The views and conclusions contained in this document are those of the authors, and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Deadlines for Future Issues
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v. 11, no. 4 .....October 31, 1995

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