WASATCH FRONT FORUM

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EARTHQUAKE HAZARDS PROGRAM

FROM THE EDITORS OF THE WASATCH FRONT FORUM:

The U.S. Geological Survey recently awarded a grant to William Spangle and Associates, Inc. to assist Wasatch Front governments implement programs to reduce potential earthquake damage. William Spangle and Associates, located in Portola Valley, California, is a consulting firm in urban and regional planning which emphasizes land use planning in areas with geologic and seismic hazards.

Principal Planners Martha Blair-Tyler and George G. Mader will work directly with local officials during 1989. They have conducted research on seismic safety programs and prepared several plans and ordinances for local governments in California to reduce losses from geologic hazards. Their experience would be useful to us as we move forward into the implementation phase of the earthquake hazards reduction program in Utah.

We urge all interested local government officials to read their statement and complete and return the questionnaire, bound in the center of this issue. Let them know what you need so that we all receive the maximum benefit from this opportunity.

We would also like to welcome two new Associate Editors. William J. Kockelman of the USGS in Menlo Park, California and Brian A. Cowan of FEMA in Washington, D.C. both graciously agreed to participate in the Forum. They will solicit contributions to the Forum and inform us of federal-level activities. They will be on board for the Spring. We are grateful to have them as part of our team!

And finally, a number of former readers of the Forum will not be receiving this issue because they did not return the Survey/Address Verification form from the Spring-Summer 1988 issue. If you know of anyone who would like to be reinstated, have them contact Janine Jarva, Utah Geological and Mineral Survey, 606 Black Hawk Way, Salt Lake City, Utah, 84108-1280, (801) 518-6831.

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FIFTH ANNUAL WORKSHOP ON EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH

The Fifth Annual Wasatch Front Earthquake Workshop, sponsored by UGMS, CEM, USGS, and FEMA, was held January 31- February 2, 1989 at the University Park Hotel in Salt Lake City. Walt Hays called the Workshop a "significant milestone in Utah - a chance to celebrate the numerous achievements made in a comprehensive, multi-partner, multi-disciplinary research and implementation program conducted during the past five years under the auspices of the National Earthquake Hazards Reduction Program (NEHRP)." It was also an opportunity to focus on the future, including the need for further studies in Utah and Utah's participation in the U.S. Decade for Natural Disaster Reduction (the Decade) in the 1990's.

More than 200 scientists, engineers, architects, building officials, emergency managers, emergency responders, and city and county planners were welcomed by Utah Lieutenant Governor Val Oveson. Walt Hays of the USGS and Fred Krimgold, Associate Dean at Virginia Polytechnic Institute, gave a presentation that compared the devastating Armenian earthquake of December 7, 1988 with the major earthquakes many experts believe will occur in Utah along the Wasatch Front. Both men were part of a 19-member U.S. team sent to Armenia from December 19-28, 1988, to assist Soviet scientists with post-earthquake field investigations and fact finding . They pointed out similarities between the Armenian earthquake and potential Utah earthquakes: in both Armenia and Utah's Wasatch Front, the earthquake sources are near heavily populated areas; the reinforced concrete frame buildings and unreinforced masonry buildings that collapsed in Armenia are common in Utah; the severe winter weather conditions that significantly hampered rescue and relief efforts in Armenia, are similar to conditions experienced in Utah winters; ground shaking from earthquakes in Utah could be stronger than expected by some local officials just as the ground shaking in the Armenian earthquake was stronger than Soviet experts had believed was likely. It was a very sobering briefing.

After the opening plenary session, the participants divided into two working groups. One working group consisted of more than 125 participants representing a spectrum of professions involved in implementing earthquake loss reduction measures and responding in the event of an earthquake emergency. They participated in a number of topical sessions to improve their understanding of earthquakes in Utah and their stategies for dealing with post-earthquake damage. The topics included heavy urban rescue, risk assessment, seismically resistant structural design, case studies of successful methods of approaching decisionmakers, and community planning stategies utilizing federal and state resources. Participants were enthusiastic about the quality and usefulness of these sessions.

The objective of the other working group was to complete the consensus development process initiated in September, 1988. A draft consensus document, "Reducing losses from the physical effects of earthquakes expected in Utah," was prepared by Walt Arabasz, Don Mabey and Walt Hays and revised from summary statements written by small working groups that met in Salt Lake City in November of 1988. The purpose of this document is "to motivate and guide actions that will reduce losses from future moderate-to-large (magnitude 5.5 to 7.5) earthquakes in Utah, with primary emphasis on Utah's densely populated Wasatch Front region. The document is intended for use by public officials and decisionmakers in Utah who need practical and reliable information for that purpose." The document is comprised of three parts. Part I affirms that Utah is ready to take action to reduce its earthquake risk. It is argued that focused efforts during the last five years have created sufficient scientific information and social awareness for implementing earthquake hazard reduction measures in Utah. Part II outlines basic stategies that communities in Utah must adopt to reduce their vulnerability to earthquake losses and to keep expected losses within acceptable limits. Part III is a summary of the nature and extent of the physical effects that can be expected from earthquakes in Utah.

Based on the most up-to-date information and representing the consensus judgement of scientific and engineering experts involved in studies of Utah's earthquake problems, it should provide a basis for realistic actions to reduce potential losses.

Nearly two days was spent revising this draft document, section by section. A finalized version should be completed in April of 1989, even though some scientific and technical issues may not yet be fully resolved. For this reason the document is expected to be a dynamic one, and discussions also identified the optimal research agenda for Utah in the period 1989-2000.

Following the working group sessions, all participants reconvened in final sessions on the last two days of the Workshop to summarize their results, to present where the Utah program stands and what remains to be accomplished, and to discuss the directions the Utah program will take in the next decade. A brief summary of comments made in these final sessions is given below for general information only. Persons quoted here have not reviewed this summary for accuracy, so readers are encouraged to contact these individuals or await publication of the "consensus document" before using these results for any specific purpose.

In characterizing our present understanding of "where" the next Utah earthquake will occur, Walt Arabasz (UUSS) delineated two classes of threat. There are the small to moderate earthquakes of magnitudes up to 6.5 that are not energetic enough to cause surface rupture and are therefore not preserved in the geologic record. There are many such earthquakes in Utah, spatially distributed throughout the state. Then there are the larger magnitude, surface faulting events that occur most repetitively along the Wasatch fault, but it must be emphasized that other active faults in Utah are capable of greater than magnitude 6.5 events. Arabasz went on to point out that Utah is in serious need of an "instrumentation initiative" because Utah's seismic network instrumentation is out of date, seriously inadequate, and increasingly unreliable. This makes it increasingly difficult for the University of Utah Seismograph Stations to provide necessary information to the emergency response community, public safety professionals, and the general public. The current seismic network is losing large amounts of information that takes decades to acquire because of the relatively low frequency of earthquakes in Utah. Intrinsically large costs are involved in modernization and will require funding at federal, state, and local levels. Utah's needs include: upgrading the University of Utah seismograph network and interfacing it with the national seismic network; establishing a strong-motion instrumentation program; replacing current Seismograph Stations computers for seismographic recording/analysis/research; acquiring equipment for improved portable array studies and to improve correlations between subsurface geology and focal mechanisms; and incorporating specialized emergency response equipment such as communication links and equipment for near-real-time transfer of earthquake information to public-safety officials. We need the capability for detection levels low enough, recorded over long enough periods of observation to get more data and more accurate data. Toward this end, Arabasz, Genevieve Atwood (UGMS) and Jim Tingey (CEM) will present briefings to key appropriations committees of the Utah Legislature in February. Their goal will be to educate important Utah legislators about Utah's earthquake programs and to motivate a special subcommittee to study the state's needs for earthquake-related instrumentation. Arabasz pointed out that if enough key people can be convinced to take the long range view of this problem, Utah has a great opportunity to have a "showcase" earthquake program, with modern and future-oriented earthquake instrumentation. This could be one of Utah's significant contributions toward the Decade.

In addressing the "what" and "when" of the next Utah surface-faultingearthquake, Mike Machette (USGS) said that the maximum most-likely event is a large, 7-7.5 magnitude earthquake on one of the segments of the Wasatch fault. The expected lengths of

rupture in the region could be as little as 20 km and as much as 70 km in any large, single earthquake event on any of the segments. Single event displacements of 2-5 m across a zone of deformation up to 500 m wide are evident in the local geologic record. Such events have occurred repeatedly in the last 6000 years with some regularity along some segments but seemingly randomly along neighboring segments. Each segment that has ruptured repeatedly during the Holocene averages an event about every 2000 years, with one event affecting the Wasatch Front on average every 450 years. The last event occurred between 350 and 500 years ago so we are approaching or have exceeded the average recurrence interval. In the last 1500 years, the geologic record reveals an accelerated phase of faulting with a surface rupturing event somewhere along the Wasatch fault every 250 years. We do not know if this phase will continue but we fully expect that a magnitude 7.5 event could occur in the near future. On average, we can expect a damaging event of magnitude 5.5 or greater every 14-40 years within the Wasatch Front, more frequently if we consider the entire state of Utah. Machette summarized by saying the worst case scenario is that "a very large earthquake could occur along any segment of the Wasatch fault at any time." The best case scenario is that "it didn't happen last year so it might not happen this year."

One significant contribution that has already come out of the Utah program is the refinement and first successful applications of the thermoluminescence (TL) dating technique by Steve Foreman (UC Boulder) and Jim McCalpin (USU). The technique has been used to date material as old as 200,000 years. This technique is applicable throughout the Great Basin and in other arid regions where radiocarbon dating has limited usefulness because of the scarcity of organic material. Looking toward the future of paleoseismicity studies in Utah, Machette, Bill Lund (UGMS), and Dave Schwartz (USGS) discussed the early stages of their "megatrench" planning. Though we have a good understanding of the earthquake history of the Wasatch fault in the last 6000 years, we need to extend that record back another 6-12,000 years in order to obtain a higher degree of confidence in the paleoseismic record we already have, to better constrain physical models of Wasatch fault behavior, to determine if there is a regular pattern of activity, and to identify the relative surface fault rupture hazards on the various segments of the fault to better allocate resources for hazard mitigation. To date, trenches excavated with backhoes have depths limited to about 20 m which is not enough to reach early Holocene and late Pleistocene (Lake Bonneville) stratigraphy. To excavate a 30-40 m deep trench would entail more complex procedures and the use of bulldozers and scrapers and will therefore be far more costly. But knowing more about recurrence intervals could represent savings in terms of risk management. And according to Lund, "megatrench represents our best opportunity to understand the long-term earthquake behavior on the Wasatch fault zone and would have significance to development of an understanding of normal faults in general." Though the Wasatch fault will remain the focus of the program, we need to identify other capable faults in the region such as the West Valley fault and Oquirrh Mountain faults and generate similar information for them. The first "megatrench" would necessarily be a pilot project but could be designed as well to be a showcase/training program for the Decade. Wasatch fault trenches have already been visited by teams of geologists from Italy, China, and Japan.

With regard to earthquake-induced ground failure hazards, Loren Anderson (USU) reported that liquefaction potential mapping is completed or nearly completed for Davis, Salt Lake, Utah, Weber, Box Elder, Cache, Juab, Sanpete, Sevier, and Millard Counties and for the critical areas of Wasatch and Summit Counties. Earthquake-induced landslide potential maps are completed for Salt Lake and Davis Counties. Work has been done to model failure modes induced by liquefaction and on rockfall threshold accelerations, but these are areas requiring further investigations. In addition, hazards associated with combustible gases and collapse of underground

voids due to ground failures need to be addressed in future studies.

Anderson proposed that the next step for Utah should be the development of seismic microzonation maps, and he summarized his proposal for a Utah microzonation project. Seismic microzonation is the division of a region into smaller areas expected to experience the same relative severity of an earthquake hazard such as ground shaking, surface fault rupture, earthquake-induced ground failure, or tectonic deformation. It is an important part of the process of evaluating earthquake hazards and assessing the risk in urban areas. Seismic microzonation has been performed in many countries throughout the world and provides criteria with which to select the most suitable part of an area for a proposed use. However, there is no standard procedure for seismic microzonation, and the results have varied widely from country to country. Therefore, the goal of the Utah microzonation project would be to devise a set of standard procedures that could be used throughout the world to produce seismic microzonation products. These products would have application to land-use planning, building codes, improved design and construction practices, repair and strengthening of existing buildings, and improved response and recovery planning. This could be Utah's greatest contribution to the Decade. Utah is an ideal place to conduct the proposed microzonation study because it has just completed the initial phase of the NEHRP and has a database that is large enough to carry out the program. The size of Utah's database is probably more representative of most of the U.S. than California's much larger database. In addition, the success of NEHRP in Utah during the last five years has created not only the critical mass of data that are needed, but also a critical mass of "champions", scientists, engineers, and planners who are willing to work together to carry out a microzonation project. The Utah study area also has well-defined geographic boundaries, well-defined geologic boundaries with widely differing ground response characteristics, a concentration of population, and a significant knowledge about earthquake hazards. The project will focus on ground shaking because ground shaking appears to be the single greatest information "gap" in Utah's database. This information is needed before building codes can be changed to accommodate local conditions such as focusing and directivity effects as well as local site response. The specific purpose of the project is really to integrate science and public policy, leading to better building codes, better facility siting, and better engineering practices.

Al Rogers (USGS) summarized the preliminary results of current Utah probabilistic models in saying that the probablility of a magnitude 7.5 event occurring in the next 50 years along the Wasatch Front is 9-17%. Accelerations of 0.4 g on rock sites and 0.6 g on soft sediments would be expected within 10 km of the epicenter. Within 20 km of the epicenter, accelerations of 0.2 g on rock sites and 0.3 g on soft sediment sites would be expected. For distant earthquake events, accelerations in the Salt Lake Valley could be up to a factor of ten greater than on rock sites. Rogers pointed out that similar, probabilistic statements need to be made for the more frequent, smaller events that occur in Utah.

E.V. Leyendecker (USGS) detailed current loss estimates for building inventories in Weber, Davis, Salt Lake, and Utah Counties. For the $24 billion building inventory contained in these four counties, a loss of $5.5 billion is expected for a 7.5 magnitude event rupturing on the Salt Lake City segment, and a $1.9 billion loss is expected for an event of 5.5 magnitude. He estimated that these losses may represent about 20% of total expected losses because they do not include loss of life, lost business and productivity, or loss of lifelines, utilities, and transportation corridors. A study by Thayne Robeson to be released soon by the University of Utah indicates that lost productivity of economic institutions from a 7.5 magnitude event may approach several billion dollars. The Financial Institutions Emergency Preparedness Committee (FIEPC) estimates that the threshold "down time" leading to economic

collapse could be less than a week following a large earthquake event, especially without backup data systems in place.

Jim Tingey (CEM) pointed out that among our utility systems, the natural gas system appears to be the most resilient and redundant and therefore likely to suffer the least impact but that the petroleum products refineries and delivery systems are more vulnerable. Tingey said that CEM expects to have a detailed Wasatch Front master plan, like the one that was prepared in California, ready in 18 months, with overlays of transportation lines, lifelines, buildings, and critical facilities. Sites are being evaluated for master disaster field offices and satellite offices. CEM is preparing now for the 1991 opportunity to change building codes in Utah. And by July of this year the Northern Utah Handbook for Earthquake Risk being prepared by Fred May (CEM), will be completed. It is expected that this manual will be used by communities as supporting justification for mitigation activities and their associated costs. Walt Hays reminded everyone that only the added value of new data and more and better training of personnel could help flatten out the exponential rise of the risk curves through time in Utah.

Finally, on behalf of USGS, FEMA, UGMS, and CEM, Genevieve Atwood and Salt Lake City Mayor Palmer DePaulis presented Certificates of Appreciation to the following Utahns in acknowledgement of their accomplishments in fostering the implementation of measures to reduce losses due to earthquakes in the State of Utah:

Palmer DePaulis, Mayor, Salt Lake City
Jerold S. Lyon, Deputy City Engineer, Department of Public Works, Salt Lake City

Mayor DePaulis' administration has been active in preparing the city for a damaging earthquake by commissioning studies to evaluate the seismic resistance of city buildings and funding strengthening/relocation where necessary. One example is the base isolation retrofit of the City-County Building. Jerry has headed up Mayor DePaulis' seismic upgrade program and has seen that seismic considerations are incorporated into all new construction and remodeling, has begun the work of retrofiting critical facilities, and been instrumental in moving critical services such as fire and police to safer quarters.

Craig V. Nelson, Salt Lake County Planning
Mike Lowe, Davis County Planning
Robert M. Robison, Utah County Planning

The three Wasatch Front county geologists have been a major factor in facilitating the implementation of loss reduction measures through their close work with planners and local government officials. They have worked closely together and with the UGMS to ensure uniform approaches to loss reduction along the Wasatch Front, and maintained contacts with researchers to see that the most current information is used.

William R. Lund, Utah Geological and Mineral Survey

Bill has worked closely with Dave Schwartz, Mike Machette, Alan Nelson, and Steve Personius of the USGS and Jim McCalpin of USU in Wasatch fault trenching studies, and coordinated the joint UGMS/USGS trenching work of 1986 and subsequent joint trenching projects along the Wasatch fault. He handled logistical arrangements, organized field trips, and is presently organizing a program to publish the results. The field trips held to inform local government officials and the press of the results of the studies have contributed greatly toward their understanding of earthquake hazards and the science involved in assessing hazards.

Fred May, Utah Division of Comprehensive Emergency Management

Fred has been instrumental in implementing CEM's earthquake program

through his advice to communities regarding hazards mitigation and his role as Utah's State Hazards Mitigation Officer. He is presently completing a handbook to aid local governments in assessing risks and estimating losses due to earthquakes.

Wendy Hassibe, U.S. Geological Survey
Janine Jarva, Utah Geological and Mineral Survey

As editors of the Wasatch Front Forum, Wendy and Janine have contributed to the dissemination of information which is so vital in implementing loss reduction measures. Both have spent much time and effort in soliciting contributions, tracking research, and maintaining the Forum as a useful vehicle for the transfer of timely information.

Several new publications were made available by the USGS to Workshop participants, including "Reducing Earthquake Hazards in Utah: the Crucial Connection Between Researchers and Practitioners" by William J. Kockelman. This report will be part of the USGS Professional Paper on the Wasatch Front and parts of it will be excerpted in future issues of the Forum. Volumes III and IV of "Assessment of Regional Earthquake Hazards and Risk Along the Wasatch Front, Utah" will also be incorporated into the USGS Professional Paper. (Volumes I and II were distributed to participants at last year's Wasatch Front Workshop, December 1-2, 1987. See Wasatch Front Forum, Autumn-Winter, 1987, vol. IV, no. 1-2, p. 1.) The Table of Contents of the two new volumes are listed here for your information:

VOLUME III

Earthquake Losses in Central Utah
by S. Theodore Algermissen, E.P. Arnold, Karl V. Steinbrugge, M.G. Hopper, and Maurice S. Powers

Isoseismals of Some Historical Earthquakes Affecting the Wasatch Front Area, Utah
by Margaret G. Hopper

Seismic Risk Methods and Estimates for Utility Systems and State-Owned Buildings Along the Wasatch Front
by Craig E. Taylor, Delbert B. Ward, and Jerold M. Harber

VOLUME IV

A Data Base Designed for Urban Seismic Hazards Studies
by Arthur C. Tarr

An Interpretation of Recent Findings on the Directivity Effects of a Surface-Faulting Earthquake on the Wasatch Fault
by Philip C. Emmi

Microzonation of Ground Shaking Intensity for Salt Lake County, Utah
by Philip C. Emmi

Surface Fault Rupture, Utah and Juab Counties, Utah
by Robert M. Robison

Tectonic Subsidence, Utah and Juab Counties
by Robert M. Robison

Landslide Hazards, Davis County, Utah
by Robert M. Robison and Michael V. Lowe

Rock-Fall Hazards, Salt Lake County, Utah
by Craig V. Nelson

Debris-Flow Hazards, Davis County, Utah
by Michael V. Lowe

Other Ground-Failure and Flood Hazards Associated with Earthquakes, Davis County, Utah
by Michael V. Lowe

Liquefaction Hazards, Davis County, Utah
by Michael V. Lowe

Wasatch Front County Hazards Geologist Program
by Gary E. Christenson

A limited number of copies of Kockelman's report and Volumes III and IV are still available and can be obtained from the USGS

Public Inquiries Office, 8105 Federal Building, 125 South State Street, Salt Lake City, UT 84138, (801) 524-5652. All the aforementioned publications are also available for review at UGMS, 606 Black Hawk Way, Salt Lake City, UT 84108, (801) 581-6831.

UTAH COUNTY NATURAL HAZARDS OVERLAY ZONE: INTEGRATING GEOLOGIC HAZARD MITIGATION INTO A ZONING ORDINANCE

by Robert M. Robison
Utah County Geologist

The Utah County Planning Commission is currently contracted with Dudley and Associates, a Provo based engineering and consulting firm, to rewrite and update the Utah County zoning ordinance. Because natural hazards were not previously addressed in the ordinance, this provided an excellent opportunity for the introduction of a natural hazards section. The ordinance is currently under review and is about 50% complete. The final version should be adopted in early summer. The natural hazards section of this ordinance is somewhat different from other natural hazards ordinances in Utah. The guidelines establish what type of development is allowed, as opposed to what is not allowed, within various study zones, with provisions for Board of Adjustment consent for other construction based on recommendations from a technical review of the site.

The Natural Hazards Overlay zone is specific to rock fall, debris flow, landslide, and surface fault rupture hazards. Shallow ground water, liquefaction, and earthquake ground shaking will be addressed by the Utah County Building Inspection Department through adopted regulations in the Uniform Building Code, primarily chapters 23, 29 and 70. Provisions in the ordinance allow for updating of maps if new or more accurate information becomes available. Questions or comments may be sent to Robert M. Robison, Utah County Geologist, Rm. 3800, 100 East Center, Provo, Utah 84606, (801) 370-8344.

STRUCTURAL ENGINEERS ASSOCIATION OF UTAH POSITION PAPER ON GOING TO UBC SEISMIC ZONE 4 ON THE WASATCH FRONT

Submitted by Kenneth W. Karren,
Past President
Structural Engineers Association of Utah

It is the considered opinion of the majority of the members of the 1987-1988 Structural Engineers Association of Utah (SEAU) Ad Hoc Seismic Committee, that the International Conference of Building Officials should not increase the seismic zone along the Wasatch Front from zone 3 to zone 4. The reasoning for this recommendation is primarily as follows: (1) the maximum intensity of Wasatch fault earthquakes is expected to be smaller than San Andreas fault earthquakes, and (2) the return interval is much longer for large Wasatch fault events than for large San Andreas fault events.

The SEAU Seismic Committee invited input from the USGS, the UGMS, local building officials, engineers, and others. After studying this issue for approximately nine months, the committee arrived at its conclusion.

The Seismic Committee recommends that SEAU continue to keep abreast of Utah geological research developments. As additional information becomes available which may influence seismic zoning decisions, further adjustments may be appropriate.

Committee Chairman: Newland Malmquist.
Committee Members: Edmund W. Allen, Kelly Calder, Earle Eppich, Kenneth W. Karren, Lawrence Reavely, Kent Rich, Don Wakefield, Kenneth Willmore.

INCREASING WASATCH FRONT SEISMIC DESIGN FORCE LEVELS FROM ZONE 3 TO ZONE 4

PRO ZONE FOUR.

1. Magnitude. When seismic events do occur on segments of the Wasatch fault, they could be as large as 7.0 to 7.5 Richter magnitude (M_L), or events large enough to result in significant damage to many

structures. Furthermore, some geologists, including Walter Hays of the USGS, feel that the Wasatch fault is probably a listric fault underlying the whole Salt Lake Valley.

2. Return Intervals. While return intervals for Wasatch Front faults are longer than for many areas in California, some geologists have come to the conclusion that one or more large intensity earthquakes are overdue. For example, Lloyd Cluff has said that he feels that there is better than a 50% probability of having a M_L 7.0 event in the next 50 years on one of the sements of the Wasatch fault. Walter Arabasz is also concerned about this issue.
3. Site Amplification. USGS studies based on small amplitude motions resulting from underground Nevada nuclear detonations have led some to a preliminary conclusion that accelerations may be amplified as much as 10 times or more in old lake deposits. This fear has been emphasized because of the 1985 Mexico City earthquake. Al Rogers said that although his studies are controversial, they do indicate that there should be carefully considered studies of site-building interaction when major (high-rise) buildings are being designed for the center of the valley.
4. Ductility/Construction Quality. Increasing the force level would increase the ductility or energy absorbing capacity of the resulting structures. Better quality control is still needed to ensure adequate ductility in connections and to insure continuous force paths. At least one local engineer has expressed the conviction that increasing the force level would help structural firms in insuring better building quality.
5. Economic Risk. Losses to buildings in a densely populated Wasatch Front community could be as large as $5,000,000,000, not including loss of life and personal injury, in a major Wasatch Front event.
6. Recent Earthquake Experience. The recent Coalinga earthquake resulted in major damage to and collapse of non-reinforced masonry buildings.

CON ZONE 4.

1. Magnitude. The maximum expected Richter magnitudes predicted for some California zone 4 locations are 8.0 to 8.5, while the

   7.0 to 7.5. Lloyd cluff does not believe that the Wasatch fault is a listric fault.
2. Return Intervals. Return intervals for a specific segment of the Wasatch fault could be as long as 1500 to 2500 years. For a large event somewhere on the Wasatch fault the return interval is predicted at 300-500 years. This is much longer than for the San Andreas fault.
3. Site Amplification. Geotechnical studies taking the non-linear nature of Salt Lake Valley clays into account in soil-building interaction, show that there may even be attenuation rather than amplification. Over 200 years ago Engesser was scorned and eventually apologized for his theory showing how column buckling was influenced by the non-linear nature of the material stress-strain relationship. In 1947, in California, Frank Shanley proved that Engesser was correct all along. The effects of non-linearity are far too often still overlooked. We must adequately take the non-linearity of the soils into account to obtain realistic results.
4. Ductility/Construction Quality. Some engineers feel that it is more important to emphasize the quality of design and construction (with emphasis on connections and force path continuity), rather than to increase the level of force. Chris Polland, speaking on behalf of the Applied Technology Council, stated that buildings designed to lower than current UBC force levels, but with well-designed connections have been found to do well in major California earthquakes. UBC requirements for special inspection should help increase construction quality.
5. Economic Risk. It seems that a much more important issue than increasing force levels is that of upgrading and strengthening the many dangerous unreinforced masonry bearing wall

structures in existence here. This would be a good next objective for an SEAU committee.

6. Recent Earthquake Experience. The town of Mackay, Idaho, was only about 15 km from one end of the active Borah Peak fault zone. However, the damage in Mackay was primarily limited to collapse of masonry parapet walls, or much less than in Coalinga. While most geologists feel that the resulting accelerations from both normal and lateral fault quakes of equal magnitudes would result in similar accelerations, at least one author feels that normal faults would result in smaller lateral accelerations.

THE MAGNITUDE 4.8 BEAR LAKE, UTAH, EARTHQUAKE OF NOVEMBER 19, 1988: A PRELIMINARY SUMMARY

by S.J. Nava, J.C. Pechmann, and W.J. Arabasz
University of Utah Seismograph Stations
Department of Geology and Geophysics

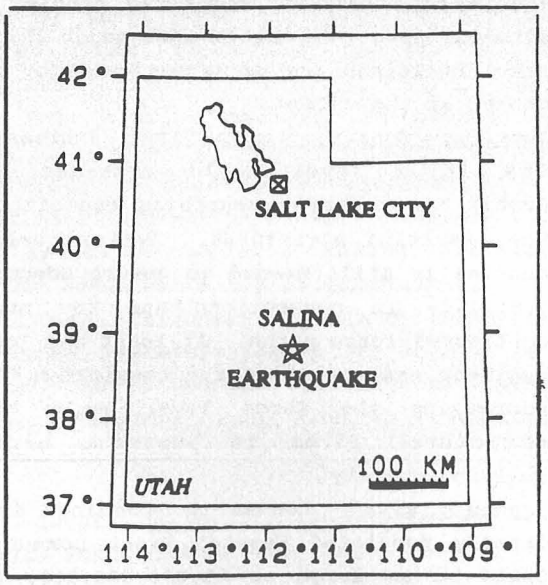
On November 19, 1988 an M_L 4.8 (local magnitude) earthquake occurred near the Utah-Idaho border, approximately 5 km west of Bear Lake, at 12:42 pm (MDT). Historically, this region was the site of an earthquake of estimated magnitude 6, in 1884, believed to have occurred in the Bear Lake Valley. Other documented earthquakes within 25 km of the November 19 main shock, since 1850, include shocks of M_L 3.2 in March 1972, of M_L 3.2 in August 1986, and of M_L 3.5 in October 1986. The 1988 main shock was preceded by two foreshocks: one of M_L 2.5 on November 10 at 9:37 am (MDT), and of M_L 2.6 on November 19 at 12:37 pm (MDT). The University of Utah Seismograph Stations deployed five portable seismographs, within 12 km of the main shock epicenter, from November 20 through November 23 (snow conditions precluded longer monitoring). The instruments succeeded in recording over 100 locatable aftershocks. The depths of the best located aftershocks range from 7 to 11 km. As of early January, seventeen aftershocks of M_L 2.0 and larger have occurred, with the largest (M_L 4.3) occurring 18 minutes after the main shock. A preliminary focal-mechanism indicates normal faulting, possibly with strike-slip component of motion, on one of two possible fault planes: one is nearly vertical, with a north-south strike; the other has a dip of less than 38° and perhaps as small as zero, but has a poorly-constrained strike.

THE SALINA, UTAH, EARTHQUAKE OF 29 JANUARY 1989 Preliminary Earthquake Summary

by S.J. Nava
University of Utah Seismograph Stations
Department of Geology and Geophysics

THE MAIN INFORMATION

- 29 January 1989,
  21:06 Mountain Standard Time
- 38° 49.47' N., 111° 36.84' W.
- 24 km depth (poorly constrained)
- magnitude (M_L) 5.4



ADDITIONAL INFORMATION

- 26 km southeast of Salina, Utah;
  216 km south of Salt Lake City, Utah
- Widely felt:
  Felt strongly throughout central and

northern Utah. Reported felt as far away as Flagstaff, Arizona, Grand Junction, Colorado and Rock Springs, Wyoming. No significant damage report.

- Largest earthquake in the Utah region since 27 March 1975 Pocatello Valley earthquake on Utah-Idaho border, magnitude (M_L) 6.0. (On 14 August 1988 a magnitude (M_L) 5.3 shock had occurred 75 km to the east-northeast and beneath the San Rafael swell of the Colorado Plateau.)

- Largest historical earthquake under the High Plateaus of the Basin & Range-Colorado Plateau Transition Zone.

- Foreshocks: None recorded.

- Aftershocks: Relatively few and small Through 28 February 1989, 48 aftershocks have been recorded. Largest aftershock on 27 February 1989 at 08:13 Mountain Standard Time, magnitude (M_L) 4.2, felt in four counties.

- Strong ground motion records: Main shock recorded at an epicentral distance of 60 km to the north-northeast by the US Bureau of Reclamation at Joe's Valley Dam: maximum horizontal acceleration on the crest of the dam was 0.1g and <0.05g on rock at the base of the dam.

UGMS PREPARES NEW QUATERNARY FAULT MAP OF UTAH

by Suzanne Hecker
Utah Geological and Mineral Survey

A map and database of the Quaternary faults and other tectonic features of Utah are being prepared at UGMS by Suzanne Hecker and will be published as a 1:500,000-scale map and accompanying tables of tectonic activity information. A preliminary draft of the compilation will be completed by July 1989.

The computer database consists of geologic parameters used to characterize earthquake activity on faults: the timing of the most recent and prior surface-faulting events, recurrence intervals, slip rates, single-event displacements, rupture (fault-segment) lengths, and estimated earthquake magnitudes. Methods of age estimation, bibliographic sources of the data, and qualifying comments are included in the records of individual faults, fault segments, or groups of faults. The database will be included in tabular form with the publication.

A digitally compiled map displays the faults according to five age categories and links the faults via "location codes" to entries in the database. Thus, derivative maps of faults with specific characteristics can be readily produced. Quaternary folds, tilted beds, and collapse features (commonly associated with salt diapirism) and Quaternary volcanics are being included in the compilation to complete the picture of recent tectonics in the state and to indicate possible non-seismic origins for some faults.

The compilation builds on a ten-year-old preliminary compilation and age classification of Quaternary faults by Anderson and Miller (1979). Paleoseismic studies and geologic mapping since the earlier compilation have produced much of the available data on tectonic activity and have identified a number of previously unrecognized Quaternary faults.

The new compilation will provide an important tool for neotectonic and seismic-hazard studies in the state. Fault-activity information will aid in evaluating seismic sources and in delineating regional seismic source zones. The map will also be used in the compilation of an earthquake hazards map, also being prepared by the UGMS as one of a series of statewide geologic-hazard maps, to show potential locations for future surface-faulting earthquakes in Utah.

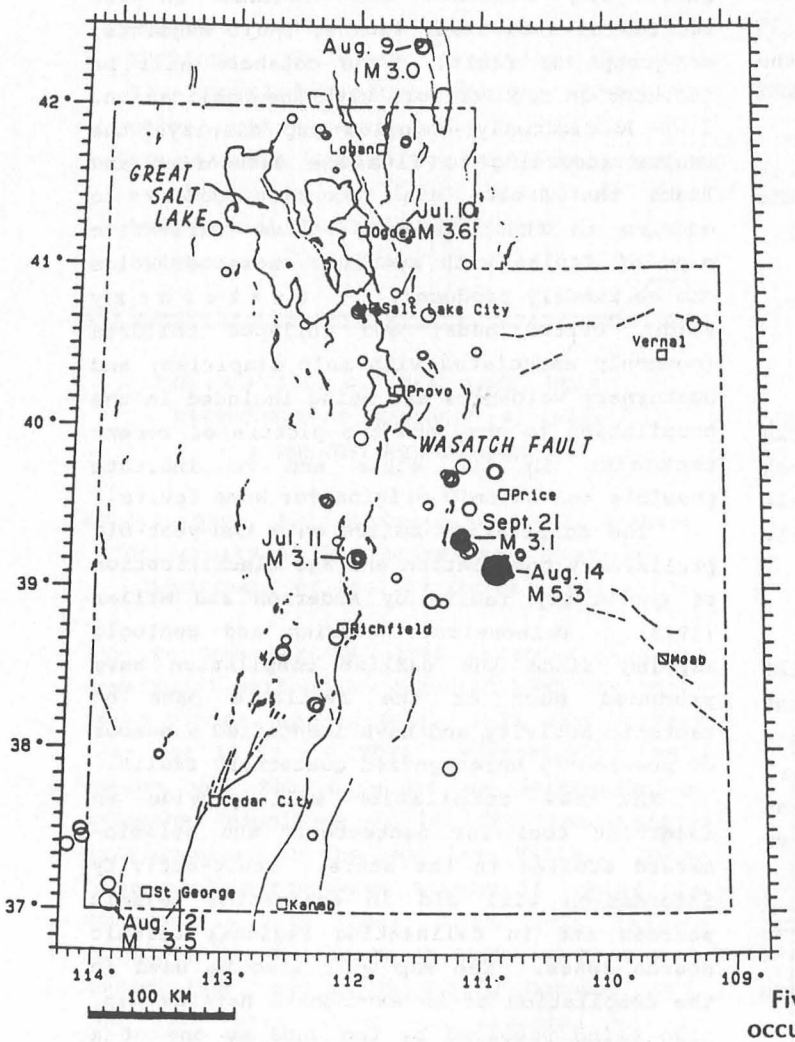
REFERENCES

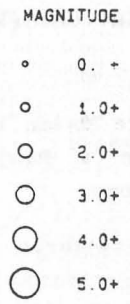
Anderson, L.W., and Miller, D.G., 1979, Quaternary fault map of Utah: Fugro, Inc., Long Beach, California, 30 p.

UTAH EARTHQUAKE ACTIVITY

by Susan J. Nava

UNIVERSITY OF UTAH SEISMOGRAPH STATIONS, DEPARTMENT OF GEOLOGY AND GEOPHYSICS
Utah Earthquakes July through September, 1988





During the three-month period July 1 through September 30, 1988, the University of Utah Seismograph Stations located 260 earthquakes within the Utah region (see accompanying epicenter map). Of these earthquakes, 86 had a local magnitude (M_L) or coda magnitude (M_C) of 2.0 or greater, nine had a magnitude of 3.0 or greater, and eight were reported felt.

The largest earthquake during the report period was a shock of M_L 5.3 on August 14 at 2:03 PM MDT on the northwest edge of the San Rafael Swell in central Emery County, 20 km southeast of Castle Dale, Utah. This was the largest earthquake to occur in the Utah region since the 1975 M_L 6.0 Pocatello Valley earthquake. The Emery County earthquake was felt strongly throughout central Utah (Modified Mercalli Intensity V to VI), where it caused some minor damage, and was reported felt as far away as Golden, Colorado and Albuquerque, New Mexico. Six foreshocks of M_L 1.8 to 3.8 occurred during the 65 minutes prior to the main shock. The two largest foreshocks, of M_L 2.9 at 12:58 PM MDT and of M_L 3.8 at 1:07 PM MDT, and the largest aftershock of M_L 4.4 on August 18 at 6:44 AM MDT, were felt in nearby small towns. The second largest aftershock, of M_L 3.0, occurred on August 15 at 8:50 AM MDT. During the report period, 147 earthquakes associated with the San Rafael Swell sequence have been located. The aftershocks form an epicentral zone, 3 x 4 km adjacent to the main shock epicenter and elongated slightly in a north-northeast direction and a hypo-central zone extending from 8 to 15 km in depth and dipping 60°-70° east-southeast, with a length along strike of 4 km and a downdip extent of 8 km. (A preliminary seismological summary of "The Magnitude 5.3 San Rafael Swell, Utah, earthquake of 14 August 1988" by S.J. Nava, J.C. Pechmann, and W.J. Arabasz appeared in the last issue of Survey Notes.

Five other earthquakes of magnitude 3.0 and greater occurred in the Utah region during the report period: M_L 3.6 on July 10 at 2:45 PM MDT, located 30 km east of Ogden, Utah; M_L 3.1 on July 11 at 5:46 AM MDT, felt at Fayette, Utah; M_C 3.0 on August 9 at 5:07 PM MDT, located 25 km southeast of Soda Springs, Idaho; M_L 3.5 on August 21 at 5:21 PM MDT, located 30 km southwest of St. George, Utah; and M_C 3.1 on September 21 at 11:58 AM MDT, located 20 km west of Huntington, Utah. Additional earthquakes reported felt in Utah during the report period included shocks of: M_L 1.6 on August 23 at 11:13 PM MDT, felt in Salt Lake City; M_L 2.7 on September 8 at 3:42 PM MDT, felt at Goshen; and M_L 2.4 September 23 at 7:40 PM MDT, felt in West Valley City and Magna.

PROJECT TO ASSIST LOCAL GOVERNMENT OFFICIALS IN MITIGATING EARTHQUAKE HAZARD

We look forward to this opportunity to work with local government officials in the Wasatch Front region as they begin to use geologic and seismic information to reduce the risk of earthquake damage. The USGS grant calls for us to conduct workshops for local government officials in Utah and to be available in person and by telephone to assist local officials with specific implementation problems. The hope is that through such efforts, Utah may be able to draw on California's experience with earthquake hazard mitigation and, by avoiding some pitfalls, accomplish loss reduction in much less time than would otherwise be true.

The project is an innovative approach to the transfer of research information and experience because it relies on personal contacts rather than written reports. The success of the project depends on our ability to establish working relationships with staff members of city and county governments in Utah. We have talked with the county geologists and will be working with them during the year. In addition, we are particularly interested in contacting city and county administrators and planners. We know about earthquake mitigation efforts, especially in California; you know the social, political and economic environment in Utah and how things get done in your local government. We think that we may be able to help you with some ideas that you can then apply in your particular context.

We know from experience that there is no such thing as a direct transfer of a program, ordinance or regulation from one jurisdiction to another. We have not been able to do this even between similar communities in California. The basic approach may be transferred, but it takes considerable work to tailor it to the specific needs of a new jurisdiction. What we think we can do is to outline general approaches and how they have worked in some jurisdictions in California and perhaps give suggestions about adapting approaches to your specific circumstances and needs. In order to do this, we need help from city and county administrators and planners. We need your ideas to determine what we can do that would be most helpful.

We are both looking forward to our work in Utah this year and hope that the effort succeeds in passing on some usable ideas, encouraging and supporting the good work that is already underway and, in general, helping to build the local foundation for actions to reduce Utah's vulnerability to damaging earthquakes.

Martha Blair-Tyler, Principal Planner
and George G. Mader, Principal Planner
William Spangle and Associates, Inc.

(Please pull out insert, fill out information, staple, and return to William Spangle and Associates, Inc.)

QUESTIONNAIRE ON USE OF EARTHQUAKE HAZARD INFORMATION

Name _____

Position/Title _____ Jurisdiction/Agency _____

Address _____

Telephone _____

Have you made use of any of the information from the Wasatch Front Study in any of your plans or regulations? _____ If so, please list.

Does you jurisdiction have procedures for requiring and reviewing geologic reports? _____
If so, please describe briefly.

What actions do you think your jurisdiction needs to take to more effectively use geologic and seismic information in plans and regulations?

What do you see as the greatest barriers to using such information?

Can we assist you in any of the following ways? _____ Please comment.

- o Provide information about programs in other cities
- o Identify sources of information
- o Discuss approaches to using earthquake hazard mitigation
  - a) at workshops
  - b) in person
  - c) by telephone

Other suggestions?

(Seal or Staple here)

PLACE
STAMP
HERE

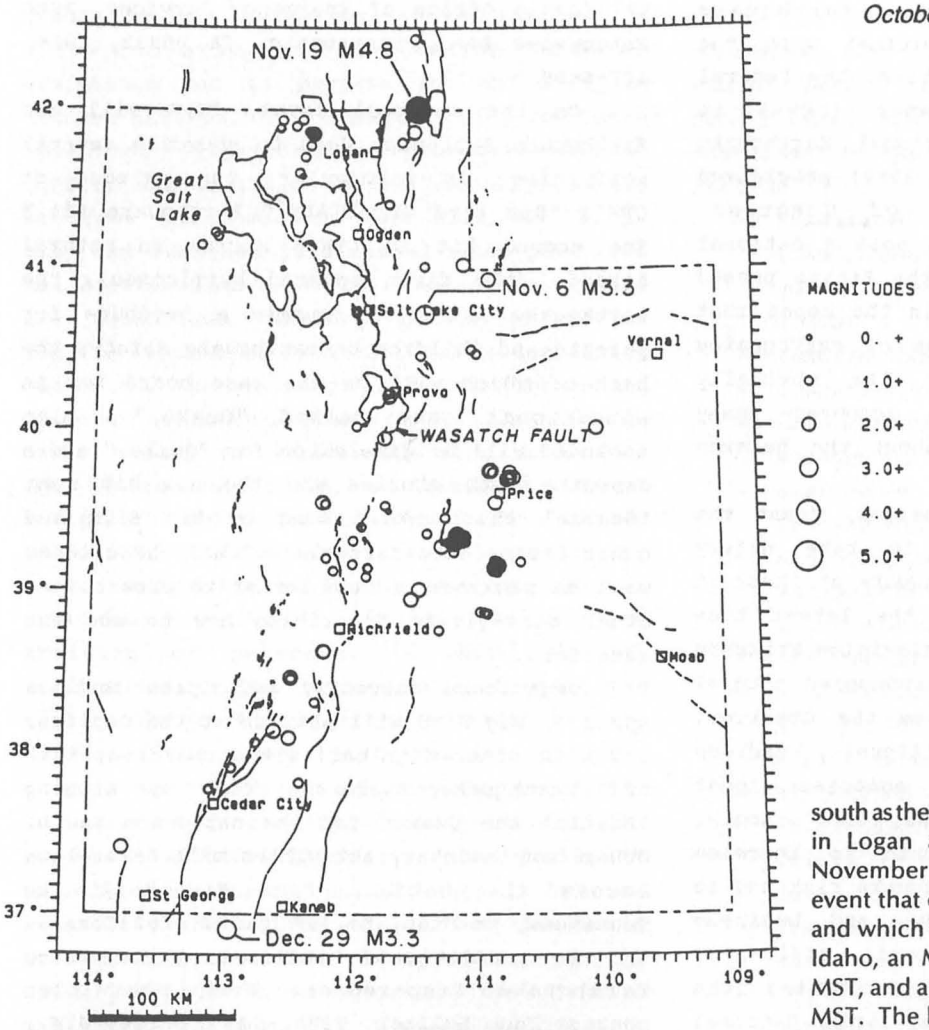
William Spangle and Assoicates, Inc.,
3240 Alpine Road
Portola Valley, CA 94025

ATTN: Martha Blair-Tyler

UTAH EARTHQUAKE ACTIVITY

by Susan J. Nava
University of Utah Seismograph Stations, Department of Geology and Geophysics

October 1 — December 31, 1988



During the three-month period October 1 through December 31, 1988, the University of Utah Seismograph Stations located 245 earthquakes within the Utah region (see accompanying epicenter map). Of these earthquakes, 80 had a magnitude (either local magnitude, M_L, or coda magnitude, M_C) of 2.0 or greater, five had a magnitude of 3.0 or greater, and six were reported felt.

The largest earthquake during the report period was a shock of M_L 4.8 on November 19 at 12:42 PM MST on the Utah-Idaho border, 5 km west of Bear Lake, in northern Rich County. The Bear Lake earthquake was felt widely in northern Utah and southern Idaho (Modified Mercalli Intensity IV to V), and as far south as the Salt Lake Valley. Minor damage was reported in Logan and Ogden, Utah. Aftershocks of the November 19 Bear Lake earthquake include an M_L 4.3 event that occurred 18 minutes after the main shock and which was felt in northern Utah and in southern Idaho, an M_L 3.2 shock on November 28 at 3:46 AM MST, and an M_L 2.8 shock on December 2 at 11:46 AM MST. The latter two were felt by residents in nearby small towns. During the report period, 50 earthquakes associated with the Bear Lake sequence have been located.

Two other earthquakes of magnitude 3.0 and greater occurred in the Utah region during the report period: one of M_L 3.3 on November 6 at 8:30 AM MST, located 9 km NNE of Park City, Utah, and reported felt as far away as the Salt Lake Valley; and another of M_C 3.3 on December 29 at 11:18 AM MST, located 40 km SW of Kanab, Utah. One additional earthquake was reported felt in Utah during the report period: an M_L 1.8 event on October 28 at 4:10 PM MDT, felt in West Valley City.

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

BEAT THE QUAKE: APRIL IS EARTHQUAKE MONTH

From the Natural Hazards Observer

Californians will learn about earthquakes and earthquake safety during the month of April, proclaimed by Governor George Deukmejian as "California Earthquake Preparedness Month." Coinciding with the initial week of these activities, the Federal Emergency Management Agency (FEMA) is coordinating the first "National Earthquake Awareness Week," (April 3-8, 1989) proclaimed in a joint resolution of Congress. Recognizing that earthquakes pose a national threat, both the House and the Senate passed House Joint Resolution 564 in the hopes that it will promote an awareness of earthquakes throughout the country. The specially designated week may also encourage many communities to learn more about the hazards associated with earthquakes.

The theme of both campaigns, "Beat the Quake," prompts citizens to take safety actions before the next earthquake strikes; it also recalls the title of the latest tune prepared by the Children's Television Workshop (CTW) as part of their FEMA-sponsored natural hazard awareness project (see the Observer, Vol XI, No. 2, p. 1). In California, hundreds of events, involving state agencies, local governments, community groups, and schools, are planned during the month to increase public awareness of the earthquake risk and to encourage individual, family, and business preparedness. The California Office of Emergency Services is coordinating the campaign along with the Bay Area Regional Earthquake Preparedness Project (BAREPP) and the Southern California Earthquake Preparedness Project (SCEPP).

Recognizing that there is a 60% probability that a large magnitude quake could happen any time within the next 30 years and could cause up to $60 billion in damage, state leaders have called on communities and individuals to take steps to protect themselves and their property. Each week, California's Earthquake Preparedness Month will target different groups - school administrators, faculty, and students; government agencies; apartment and mobile home dwellers, and homeowners; businesses and industries; and non-English speaking individuals.

For details about Earthquake Preparedness Month activities, contact Tom Mullins, Director, Information and Public Affairs, California Office of Emergency Services, 2800 Meadowview Road, Sacramento, CA 95832, (916) 427-6659.

On the national level, FEMA will use Earthquake Awareness Week to showcase several activities, in particular, the release of CTW's "Big Bird GET READY™ Earthquake Kit." The second kit in CTW's series on natural hazards (the first covered hurricanes), the earthquake kit will contain a brochure for parents and children on earthquake safety, the back of which will be the game board for an educational game called "Quake." Also included will be game cards for "Quake," and a cassette with stories and the new hit song "Beatin' the Quake," sung by Big Bird and other Sesame Street regulars. All these items will be packaged with a letter to parents and other care-givers describing how to use the materials.

Organizers currently anticipate that on April 5, Big Bird will show up at the Capitol, and with other dignitaries and children, kick off Earthquake Awareness Week by singing "Beatin' the Quake" for the nations's media. Other complementary activities will take place across the nation, from New York, to Tennessee, to Utah, to, of course, California.

For additional information regarding Earthquake Preparedness Week activities contact Jane Bullock, FEMA, 500 C Street S.W., Washington, D.C. 20472, (202) 646-2800.

The Big Bird GET READY™ Earthquake Kit will not be ready for general distribution until May 1. At that time, interested persons can receive one free copy, while supplies last by writing FEMA, P.O. Box 70274, Washington, DC 20024.

FEMA ISSUES FINAL RULES FOR DPIGs

From the Natural Hazards Observer

Section 201 of the Disaster Relief Act "establishes a mechanism for providing federal technical assistance to states, and authorizes grants to develop and improve capabilities of state governments to deliver disaster assistance and to prepare for and mitigate natural hazards." Increased funding for these "Disaster Preparedness Improvement Grants" (DPIGs) was included in the recently amended act (see the Observer, Vol. XIII, No. 3, p. 18), and FEMA has just issued rules governing the distribution of these funds. The updated law authorizes matching grants of up to $50,000 (increased from $25,000) to states for improving, maintaining, and updating state disaster assistance plans to "1) identify the tasks needed to deliver disaster assistance and to reduce, avoid, or mitigate natural hazards; 2) make clear assignments to specific offices to execute those tasks; 3) reflect the state authorities for executing disaster assignments; and, 4) provide for adequate training of personnel in their disaster assignments." The revised rules broaden the applicability of the grants so that they can be used to update multihazard, not just natural hazard, plans and they further define "mitigation" to clarify intended usage of the grants. Additionally, the rules spell out exactly how states are to apply for and administer grants, and direct that the grants be "product-oriented." Specifically, the guidelines cite program evaluation; disaster mitigation planning and program development; state disaster assistance plan updating; disaster handbook, standard operating procedure manual, and exercise material development; training; damage assessment plan or procedure development; search and rescue procedure development; and several other endeavors as examples of products eligible under the grants. The revised rules are contained in the Federal Register, Vol. 54, No. 12 (January 19, 1989) pp. 2127-2129. Additional information about DPIGs can be obtained from Greg Jones, Office of Disaster Assistance Programs, FEMA, Room 714, 500 C Street, S.W., Washington, DC 20472, (202) 646-3668.

EMI ANNOUNCES COURSES FOR 1988-1989

The Emergency Management Institute (EMI) at FEMA's National Emergency Training Center (NETC) in Emmitsburg, Maryland has recently announced its program of courses for the coming year. Any person with substantial involvement in emergency operations is eligible to apply for classes. Offerings include:

- Integrated Emergency Management Course (IEMC)/Response (IEMC courses are both generic and specific to particular areas)
- IEMC/Earthquake
- Disaster Preparedness
- Contemporary Issues in Emergency Management
- Executive Development for Emergency Program Managers
- Microcomputer Applications in Emergency Management
- Management of State and Local Information Systems
- Non-Structural Earthquake Hazard Mitigation for Hospitals and Other Health Care Facilities
- Mitigation and Recovery
- Multi-Hazard Planning
- Crisis Counseling
- National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions
- Basic Emergency Public Information
- State Public Assistance Managers Workshop
- Developing Volunteer Resources
- Introduction to Emergency Management

All applications must be approved by the applicant's state emergency management office and regional FEMA office. Further information may be obtained from Jim Tingey, Utah Division of Comprehensive Emergency Management, 1543 Sunnyside Avenue, Salt Lake City, Utah 84108, (801) 533-5271, or the National Emergency Training Center, Office of Admissions, 16825 South Seton Avenue, Emmitsburg, MD 21727, (301) 447-1179.

- From the Natural Hazards Observer

GETTING INSURED FOR THE BIG ONE

From the Natural Hazards Observer

The federal government is currently considering the feasibility of a national earthquake insurance program similar to the National Flood Insurance Program. The insurance industry projects losses of $50-$60 billion in a major California earthquake--losses which insurers feel could strain their financial resources beyond the capacity for recovery. In accordance with the National Earthquake Hazards Reduction Program legislation, several federal agencies are currently working with the insurance industry to evaluate the role of insurance in moderating the damages from earthquakes.

Because such an issue crosscuts the interests of several principle federal agencies, the Interagency Coordinating Committee (ICC) Earthquake Insurance Subcommittee was formed to:

- Facilitate the coordination of earthquake insurance activities that each agency has underway or is planning;
- Provide a mechanism to exchange information with the insurance industry;
- Provide a means to fully utilize the expertise of each agency in evaluating and proposing consensus positions on earthquake insurance issues, including legislation, as they relate to the National Earthquake Hazards Reduction Program.

The first regular quarterly meeting was held on November 22, 1988. Committee members represent the Earthquake Project (an insurance industry coalition which addresses earthquake issues), the U.S. Geological Survey (USGS), the Federal Insurance Administration (FIA), the Federal Emergency Management Agency (FEMA), the Alliance of American Insurers, the National Committee on Property Insurance, the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST).

For further information concerning the ICC Subcommittee on Earthquake Insurance, contact committee chairperson James L. Taylor, Jr., Federal Insurance Administration, Office of Insurance Support Services, Federal Emergency Management Agency, 500 C Street S.W., Washington, D.C. 20472, (202) 646-2771.

In the meantime, insurers have taken a closer look at the costs of a major quake to the insurance industry, and the results are available in "Earthquake Losses Under Workers Compensation and General Liability: Estimates for a "Worst Case" Event in Greater Los Angeles." The All-Industry Research Advisory Council (AIRAC) recently completed the study for the Earthquake Project to estimate insurance industry losses along the Newport-Inglewood fault in the event of an R7.5 earthquake.

Specifically, the study explores potential general liability and property damage losses by estimating the number and degree of damages that may occur to buildings, then calculates the probable number of individuals occupying structures at the time of an event, including those who would make workers compensation claims as a result of injuries suffered during the quake.

In one scenario, the study estimates 17,000 deaths and 68,000 injuries if an earthquake occurred during working hours on a weekday. Insurance payments could total $14.6 billion, with $4.5 billion going toward workers compensation, $6.7 billion to the bodily injury portion of general liability, and $3.4 billion to property damage claims under general liability. These figures do not take into account the loss claims individuals and businesses would collect under their own insurance policies, which the researchers estimate could bring total insured losses to $50 billion. "Earthquake Losses" also provides a range of possible losses and a "most likely" loss figure for each of the three types of loss claims.

Copies of "Earthquake Losses" are available from the All-Industry Research Advisory Council, 1200 Harger Road, Suite 310, Oak Brook, IL 60521, (312) 572-1177. A single copy is free, and each additional copy is $4.00 prepaid.

For those readers interested in pursuing further information on insurance losses from disaster, two related reports are also available from the All-Industry Research Advisory Council: "Catastrophic Losses--How the Insurance System Would Handle Two $7 Billion Hurricanes" (see the Observer, Vol. XII, No. 1, p. 18) and "Fire Following Earthquake--Estimates of the Conflagration Risk to Insured Property in Greater Los Angeles and San Francisco" (Observer, Vol. XI, No. 6, p. 13). Single copies of each report are also available free.

GRANTS

From the Natural Hazards Observer

Earthquake insurance. "Loss-Reduction Provisions of a National Earthquake Insurance Program," FEMA, $339,000, 15 months. Contact: Craig Taylor, Dames and Moore, 911 Wilshire Boulevard, Los Angeles, CA 90017, (213) 683-1560.

The objective of this study is to recommend to FEMA feasible earthquake loss-reduction provisions, including safe land-use and building practices, that can be incorporated into a national insurance or reinsurance program involving the federal government and the private insurance industry. If such a national program is created by the Congress, the recommended provisions and a strategy for their incorporation would be used by FEMA in the formulation of program policies, guidelines, standards, and procedures. It is not a study of the need for a feasibility of a national earthquake insurance program, since it is focused upon only one of the many factors that require consideration. At a minimum, the study will identify property loss reduction measures that can be taken by state and local governments, the private sector, and homeowners for new, existing, and critical buildings.

Earthquake insurance. "Earthquake Insurance in California: The Impacts of a Mandated Offer of Insurance on Residential Earthquake Insurance Purchase," National Science Foundation, $184,668, 18 months. Principal Investigator: Risa Palm, Earthquake Insurance Project, Institute of Behavioral Science, Campus Box 575, University of Colorado, Boulder, CO 80309-0575, (303) 492-2662.

This research is a study of the locations and demographic characteristics of households that have purchased earthquake insurance in California. The locations of sample households in northern and southern California--with and without earthquake insurance--will be compared with geologic characteristics (such as proximity to the San Andreas fault) to determine existence of "adverse selection." This portion of the study will utilize geographic information systems software at the University of Colorado to plot the location of households and compare them to geologic characteristics and census tract information. The second part of the study will involve a sample survey of households to ascertain the economic and demographic characteristics that differentiate households with residential earthquake insurance from those without. The two portions of the research will provide important baseline characteristics that will permit a better understanding of recent shifts in household-level decision making, as well as information upon which policy analysis can be based.

Earthquake risk communication. "Public Earthquake Risk Perception and Response to Risk Communications," National Science Foundation, $145,852, 18 months. Principal Investigators: Dennis Mileti and Barbara Farhar, Hazards Assessment Laboratory, Colorado State University, 204 Aylesworth Hall, Fort Collins, CO 80523, (303) 491-5951.

The communication of earthquake hazard and risk information to increase public hazard awareness, preparedness, and mitigation activities is an integral part of the nation's effort to reduce earthquake losses. A gap exists, unfortunately, between efforts to inform the public about risk and knowledge based on scientific evidence about how this might most effectively be accomplished. Few empirical studies have ever been performed on

the link between risk education/communication and public risk perception and behavior, and the conclusions which can be drawn are, at best, unclear.

The Parkfield earthquake prediction has resulted in risk communications to citizens in some six central California counties. It is the first scientifically credible prediction for a quake in the U.S. with specified time, place, magnitude, and probability that has been approved by national and state prediction councils. The prediction provides an opportunity to study the effects of public risk communication and education comprehensively. Thus, this research will examine public response to risk information in the area affected by the Parkfield earthquake prediction by utilizing mail questionnaires to collect data on 1200 households in three communities. The effect of prior earthquake experience and distance to risk will be assessed, and the impact of various risk communication factors on perceived risk and behavior will also be evaluated through statistical analysis.

Mitigation planning. "Section 409 Hazard Mitigation Planning Handbook," Federal Emergency Management Agency, $773,344, 12 months. Contact: Clancy Philipsborn, Mitigation Assistance Corporation, Box 382, Boulder, CO 80306, (303) 494-4242, or Leo Eisel, Wright Water Engineers, Inc., 2490 West 26th Avenue, Suite 100A, Denver, CO 80211, (303) 480-1700.

Under Section 409 (formerly Section 406) of the Disaster Relief Act, following a presidentially declared disaster, the affected states and local jurisdictions must prepare a plan outlining mitigation steps to be taken to avoid similar destruction in the future. In order to provide guidance in fulfilling these requirements, the principal contractors (Mitigation Assistance Corporation and Wright Water Engineers) are developing a handbook for use by state hazard mitigation officers and other state and local officials involved in the hazard mitigation planning process. The manual will address planning for a variety of natural hazards, provide guidance for development of a long-range multihazard program using the Section 409 planning requirements as a catalyst, and cite successful measures taken in the past. The handbook is being developed through interviews with selected federal, state, and local officials having experience in creating and/or implementing mitigation plans in both disaster and nondisaster situations. Final publication of the handbook is expected this fall.

MEETINGS AND CONFERENCES

May 5-6, 1989, Base isolation systems workshop, sponsored by the Earthquake Engineering Research Center (EERC), held in San Francisco, California. For information contact James Kelly, EERC, 1301 South 46th Street, Richmond, CA 94804, (415) 231-9480.

May 7-10, 1989, Rocky Mountain and Cordilleran Sections, Geological Society of America joint meeting, held in Spokane, Washington. For information, contact Sandra Rush, GSA Communications Department, P.O. Box 9140, 3300 Penrose Place, Boulder, CO 80301, (303) 443-8489.

May 14-17, 1989, Earthquake: an international conference on insuring and managing the inevitable, sponsored by the Society of Chartered Property and Casualty Underwriters (CPCU), held in Honolulu, Hawaii. As more and more leaders in the public and private sector are realizing, a major earthquake will result not only in loss of life and property damage, but also in significant damage to social and economic structures, with repercussions reaching far beyond the area of physical damage. With this conference, the CPCU will open an international dialogue concerning the management of earthquake risks and the possible effects of large earthquakes on the insurance industry. Scientists and engineers will present the latest geophysical information and engineering technology, and financial and

insurance industry experts will address economic issues and present concerns of the world insurance community from both primary and reinsurance perspectives. For a complete program and registration information contact the Society of CPCU, Communications Department, Kahler Hall, 720 Providence Road, CB No. 9, Malvern, PA 19355-0709, (215) 251-2740.

May 25-26, 1989, Emergency management in public works, sponsored by the American Public Works Association, held in Vancouver, British Columbia. this workshop will provide public works and other emergency management officials with a working knowledge of responsibilities and operating procedures they should implement during emergencies. Although the workshop is designed for management-level public works personnel, government and private individuals involved with emergency management could also benefit; the program emphasizes the Integrated Emergency Management System (IEMS). Topics include: emergency management in public works, state agency assistance, developing a plan through teamwork, hazardous materials case study, stress, media relations, mutual aid agreements, mitigation in emergency management planning, legal aspects of emergency management, the federal perspective, and microcomputers in emergency management. For more information, contact the American Public Works Association, 131 E. 60th St., Chicago, IL 60637, (312) 667-2200.

July 9-19, 1989, 28th International Geological Congress, in Washington, DC. For information contact Bruce B. Hanshaw, Box 1001, Herndon, VA 22070-1001, (703) 648-6053.

July 10-11, 1989, Disaster preparedness: the place of earthquake education in our schools, sponsored by FEMA and NCEER, in Buffalo, New York. This conference will review available earthquake education curricula and support materials for students in grades K-12. Participants will discuss ways that earthquake education in the schools can be used to convey disaster preparedness to the public, make recommendations for the further development of education materials, and address ways to help schools prepare students to psychologically and emotionally cope with the aftermath of an earthquake. For further details, contact Katharyn E.K. Ross, Education Specialist, National Center for Earthquake Engineering Research, State University of New York at Buffalo, Red Jacket Quadrangle, Buffalo, NY 14261, (716) 636-3391.

August 7-11, 1989, 5th Chilean conference on seismicity and earthquake engineering held in Santiago, Chile. For information contact 5th CCSEE, Department of Structural Engineering, Catholic University of Chile, Casilla 6177, Correo 22, Santiago, Chile.

August 7-11, 1989, Fifth international conference on structural safety and reliability (ICOSSAR), held at the Ramada Renaissance in San Francisco, California. Held every four years in different countries, each of the ICOSSAR"s is a major international forum for the exchange of information and discussion of recent developments in, and innovative applications of, concepts of structural safety and reliability. Every aspect of structural safety and reliability will be covered. New developments as well as state-of-the-art and novel applications of reliability principles in all types of structural systems will be discussed. ICOSSAR "89 will emphasize the safety and performance requirements of critical engineering systems under the threat of natural and man-made hazards. Issues of risk analysis and risk acceptance pertaining to the safety of major technological systems will also be part of the Conference. For information contact ICOSSAR secretariat, c/o ASCE, 345 East 47th Street, New York, NY 10017, Attention: Elizabeth Yee, (212) 705-7544.

September, 1989, International conference on reinforced and prestressed prefabricated concrete structures in seismic areas, held in Iasi, Romania. For information contact Prof. A. Negoita, Polytechnical Institute, Bd. Karl Marx 38, 6600 Iasi, Romania.

September 4-9, 1989, Fourth international symposium on analysis of seismicity and seismic risk, sponsored by the International Association of Seismology and Physics of the Earth's Interior (IASPEI) held at the Castle of Bechyne, south of Prague. For information contact the Organizing Committee of the Symposium (RNDR. Zdenka Schenkova CSC) Geophysical Institute of the Czechoslovak Academy of Sciences, Bocni II. c.p. 1401, 141 31 Praha 4 - Sporilov, Czechoslovakia.

October 1-6, 1989, Association of Engineering Geologists annual meeting, held in Vail, Colorado. Topics will include: engineering geophysics, earthquake hazards and fault assessment, and earthquake engineering. Abstracts are due by May 1, 1989. For information, contact Michael W. West, Technical Program Chairman, Michael W. West and Associates, Inc., 290 Bank Western Building, 8906 West Bowles Avenue, Littleton, CO 80123, (303) 972-1537.

October 16-20, 1989, Fourth international seminar, earthquake prognostics: hazard assessment, risk evaluation, loss reduction, and earthquake insurance, organized by the Institute of Seismology, State Seismological Bureau of China, and Earthquake Prognostics Research Group, Berlin, Federal Republic of Germany, to be held in Beijing, China. Abstracts are due by April 30, 1989, and should be sent to Prof. Wu Yilin, Secretary; Head, Crustal Deformation Department; Institute of Seismology, State Seismological Bureau of China; Xiao Hong Shan, Wuhan, China. Tel: (86 27) 8144626 and to Prof. Andreas Vogel, Chairman; Head, Department of Mathematical Geophysics; Free University of Berlin; Podbielskiallee 60, D-1000 Berlin 33. Tel: (49 30) 838 63 68.

October 23-26, 1989, Fourth international conference on soil dynamics and earthquake engineering, held in Mexico City, Mexico. The objectives of this meeting are to provide a forum for the presentation and discussion of new and advanced ideas in soil dynamics and earthquake engineering and to encourage and enhance the role of mechanics, geology, and seismology by providing an opportunity for the presentation of the work of applied mathematicians, scientists, and engineers involved in solving problems in the field of earthquake and geotechnical engineering. Abstracts of 300 words or less should be submitted by February 1, 1989. For further information contact either Prof. A.S Cakmak, Department of Civil Engineering, Princeton University, Princeton, NJ 08544, (609) 452-4601; or Prof. I. Herrera, Instituto de Geofisica, Universidad Nacional, Autonomo de Mexico, Apartado Postal 22-582, 14000 Mexico, D.F., (905) 548-5892.

November 8-9, 1989, International symposium on architectural precast concrete claddings - its contribution to lateral resistance of buildings, held at the Holiday Inn Mart Plaza in Chicago, Illinois and organized by Prestressed Concrete Institute in cooperation with ACI, ASCE, CTB, EERI, and NSF. For more information, contact Sidney Freedman, Director, Architectural Precast Concrete Services, PCI, 175 West Jackson Boulevard, Suite 1859, Chicago, Illinois, 60604, or Mark Fintel, Consulting Engineer, Chairman, Program Committee, 20069 Back Nine Drive, Boca RAton, Florida 33434.

May 20-24, 1990, Fourth U.S. national conference on earthquake engineering, sponsored by the Earthquake Engineering Research Institute, California Institute of Technology, University of California at Irvine, University of California at Los Angeles and University of Southern California, held at the Riviera Hotel in Palm Springs, California. The participants at this meeting will discuss both the state-of-the-art in seismic risk reduction

through earthquake engineering as well as the most current approaches to earthquake preparedness. Future trends and needs will also be addressed. Papers are welcome from anyone working in the field of earthquake hazard mitigation; abstracts are due by July 31, 1989. For additional information contact Dee Czaja, 4NCEE Office, Civil Engineering Department, University of California, Irvine, CA 92717, (714) 856-8693.

September, 1990, 9th European conference on earthquake engineering, held in Moscow. For information contact Dr. B.E. Denisov, Secretary-General Organizing Committee of the 9th ECEE, USSR Soviet Committee on Earthquake Engineering, Gosstroy of the USSR 26, Pushkinskaya Street, 103828 Moscow, USSR.

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