# WASATCH FRONT FORUM

VOL. IV
NO. 3-4
SPRING-SUMMER
1988

## EARTHQUAKE HAZARDS PROGRAM

The Wasatch Front Forum is not to be quoted or cited as a publication because much of the material consists of reports of progress and research activities and may contain preliminary or incomplete data and tentative conclusions.

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### DEADLINES FOR FUTURE ISSUES

WINTER 1988 ..... JANUARY 15, 1989
SPRING 1989 ..... APRIL 15, 1989
SUMMER 1989 ..... JULY 15, 1989

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## FROM THE EDITOR . . .

The phase of the NEHRP program along the Wasatch Front stressing implementation is now in its second year. This seems as good a time as any to assess the vitality of the Wasatch Front Forum. The Editors believe that this publication can significantly impact the level of awareness about earthquake hazards and thereby contribute to mitigation efforts. In an attempt to target groups and identify individuals in the area of risk management to whom the Forum could prove of benefit, we have quadrupled our mailing list in the past year but there has been little feedback to indicate whether or not we are meeting the needs and desires of our readership.

In a recent invited comment from the Natural Hazards Observer entitled "Comprehensive Risk Management", John D. Seyffert quotes William Ruckelshaus in a speech to the National Academy of Sciences, "Scientists assess a risk to find out what the problems are. The process of deciding what to do about the problem is risk management. The second procedure involves a much broader array of disciplines, and is aimed toward a decision about control." Seyffert goes on to further emphasize the difference between these two endeavors, " . . . one area, risk assessment, should only involve scientific judgements relative to the severity of a particular problem; the other area, risk management, must consider regulations, economics, and available technology, and then weigh them with the problem." The NEHRP program is at the point of bridging these two endeavors and the Forum's current purpose is to address the professionals working in both of these arenas. We attempt to provide you with timely and useful information from the earth sciences and to foster continuing communication and the transfer of information between professionals of various groups. But we need you to tell us where we are succeeding and where we fall short. The front cover of this issue provides you with the opportunity to do so.

At the very least, you MUST verify our mailing information and return the form to us to continue receiving the Forum. But please take just a few more moments to include your comments, and suggestions so that we can improve the usefulness of this publication to you. We continue to need your contributions. It can't be done without you!

# FIVE COMPONENTS NEEDED FOR REDUCING NATURAL HAZARDS

William J. Kockelman
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Programs having natural hazard reduction as a goal need five components, each a prerequisite for its successor:

Conducting scientific and engineering studies of the physical processes of natural phenomena that may be hazardous--location, size, frequency, severity, triggering mechanism, path, and effect.

Translating the results of such studies into reports and onto maps so that the nature and extent of the hazards or their effects are understood by nonscientific users.

Transferring this translated information to users and assisting them in its use through educational, advisory, and review services.

Selecting and using appropriate hazard reduction techniques -- legislation, regulations, design criteria, and public or corporate policies.

Reviewing the effectiveness of the hazard reduction techniques after they have been in use for a requisite amount of time (review of the other components--studies, translation, and transfer--also may be undertaken).

These five components are often described or divided differently, for example: into 48 resolutions by the United Nations Educational, Scientific, and Cultural Organization (1976), 6 general topics and 37 issues by the U.S. Office of Science and Technology Policy (1978), 171 action items during a state governor's conference on geologic hazards (Utah Geological and Mineral Survey, 1983), or 48 related initiatives recommended by the California Seismic Safety Commission (1986a).

However, each of the various tasks, action items recommendations, findings, objectives, needs, issues, or resolutions found in selected hazard reduction programs published over the past thirteen years (1974-1987) can be easily identified as part of one of the five components.

Table 1 shows 14 selected programs--seven state, six national, and one international -- and the number of their proposed activities as part of a specific component. The authors or contributors to the development of these programs ranged from a state legislature and a state seismic safety commission, through a national working group with contributors from over 60 organizations and over 100 individuals, to an international conference where 50 nations were represented.

The five components can be seen in reduction programs for earthquake hazards (U.S. Office of Science and Technology Policy, 1978), for landslide hazards (U.S. Geological Survey, 1982), for flood hazards (National Science Foundation, 1980), for coastal area hazards (White and others, 1976), and for other geologic hazards (Utah Geological and Mineral Survey, 1983). Even when the assignment was to identify research needs, all five components were identified (or may be inferred) in a report by Changnon (1983) on flood hazard mitigation and in a report by the California Seismic Safety Commission (1986b). See Table 1.

Sometimes one or more of the components are emphasized depending upon the originating agency's assignment, for example geologic or seismologic research (Wallace, 1974), or the topics and disciplines of the advisory groups, for example reduction techniques (California Joint Committee on Seismic Safety, 1974) or the review of a program in effect for many years (Changnon, 1983).

In actual practice the components emphasized are dependent upon each agency's authorization, funding, interests, and staff capabilities. For example, several Federal

Table 1. FIVE COMPONENTS NEEDED FOR REDUCING NATURAL HAZARDS[1/]

| SELECTED HAZARD REDUCTION PROGRAMS | STUDIES 2/ | TRANSLATION 3/ | TRANSFER 4/ | REDUCTION 5/ | REVIEW 6/ |
|---|---|---|---|---|---|
| Tasks in the Wasatch Front, Utah, regional earthquake hazards assessments element (Hays and Gori, 1984, p. 22-44) | 7/ XX | X | X | X | X |
| Working group action items from a governor's conference on geologic hazards (Utah Geological and Mineral Survey, 1983) | XXX | X XXX | X XXX | X XXX XXX | X |
| Abbreviated recommendations for earthquake risk reduction by the Utah Seismic Safety Advisory Council (1981) | X | X | X | XX | 8/ |
| Findings and objectives of the California Earthquake Hazards Act of 1986 (California State Legislature, 1985, Gov't Code, secs. 8870(b) and 8872(b)) | X | 8/ | X | XX | X |
| Detailed initiatives recommended by the California Seismic Safety Commission (1986a, p. 45-92) | X | X | X | X XXX | X |
| Examples of research needs in the California Seismic Safety Commission (1986b, app. A) report on their role in seismic research | XX | 8/ | X | XX | X |
| Recommendations of the five advisory groups of the California Joint Committee on Seismic Safety (1974) reduction program (USGS, 1982) | XX XXX | X XXX | XXX XX | XX XXX XXX XXX X | X X |
| Issues in an earthquake hazards reduction implementation plan (U.S. Office of Science & Technology Policy, 1978, app. II) | X | X | X | XXX | X |
| Tasks in a national earthquake hazard reduction program (Wallace, 1974) | XX XXX XXX | XX | X | X | X |
| Resolutions of an intergovernmental conference on earthquake risks (United Nations Educational, Scientific, & Cultural Org., 1976) | XXX | XX | XXX | XXX | X |
| Recommendations of the External Working Group in their flood hazard mitigation study (National Science Foundation, 1980, p. 213-227) | X | X | XX | XXX | XX |
| Recommendation for high priority research for flood mitigation by Changnon and others (1983, Table 1, P. 187-198) | XXX | X | X | XXX | XXX XXX |
| Recommendations for natural hazard management in coastal areas by White and others (1976, p. III-1 to 31) | X | X | XX | XX | X |

1/ Natural hazards include earthquakes, hurricanes, coastal erosion, tsunamis, wildfires, windstorms, volcanoes, floods, high ground water, snow avalanches, landslides, and other ground failures.

2/ Studies primarily include scientific and engineering studies.

3/ Translation refers to hazard information understandable by nonscientific users.

4/ Transfer includes education, training, public awareness, and technical assistance.

5/ Reduction refers to the five phases of hazard reduction--long-term mitigation techniques, preparedness measures, response during an event, recovery operations, and reconstruction activities.

6/ Review refers primarily to a systematic appraisal of the effectiveness of individual reduction techniques but can also refer to a review of the other components--studies, translation, and transfer.

7/ Each "X" indicates a range from 1 to 10 specific references to tasks, action items, recommendations, findings, objectives, needs, issues, or resolutions that relate to one of the components, e.g., "XX" equals 11 to 20; "XXX" equals 21 to 30.

8/ The component may be inferred from a reading of the selected program.

agencies under the ongoing National Earthquake Hazard Reduction Program (NEHRP) completed numerous tasks relating to the components. The status of the scientific component is discussed by Hanks (1985) and the type, location, and number of tasks completed under the NEHRP can be seen in fiscal year reports to Congress by Schnell and Herd (1984) and by the Federal Emergency Management Agency (1983, 1985, 1987).

Many of the components can be seen in other hazard reduction programs not shown on Table 1, for example: selecting earthquake prediction and hazard mitigation options (National Science Foundation and U.S. Geological Survey, 1976); preparing for and responding to a damaging earthquake in the Eastern United States (Hays, 1982); reducing losses from landsliding in the United States (National Research Council, 1985); and confronting natural hazards by the Advisory Committee on the International Decade for Natural Hazard Reduction (1987).

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## STEPS TO EARTHQUAKE SAFETY FOR LOCAL GOVERNMENTS

"Steps to Earthquake Safety for Local Governments", a new publication of the California Seismic Safety Commission, points out that while state governments can do much to reduce earthquake hazards, it is local governments that are on the real front lines and must take the responsibility for preparing their communities. Local officials, response personnel and volunteers who will be first on the scene after an earthquake must be prepared to handle the worst effects of the disaster, often without outside help. Regardless of their size and resources, cities and counties are finding many ways to increase seismic safety that are within their budgets and in tune with political realities. They are also finding that preparing for earthquakes enhances their readiness for other natural and manmade disasters. This report provides an action plan that local officials, city and county managers, and administrators can follow in initiating and carrying out preparedness efforts. It begins with the earthquake self-evaluation checklist reproduced below, presenting approaches for assigning priorities to necessary needed actions based on 1) lives saved, 2) damage reduction, 3) socioeconomic continuity, 4) social responsiveness, 5) opportunity, and 6) cost. The report also suggests how to select actions and combine them into an integrated, multiyear earthquake safety program for a jurisdiction.

The critical element of putting the program into effect is emphasized. Single copies of the report #SSC 88-01 are available free from the California Seismic Safety Commission, 1900 K Street, Suite 100, Sacramento, California 95814, (916) 322-4917.

### EARTHQUAKE SAFETY SELF-EVALUATION CHECKLIST

| ACTIONS | HOW IS YOUR CITY OR COUNTY DOING? NO ACTION | ACTION STARTED | ACTION COMPLETED | DOES NOT APPLY | YOUR PRIORITY |
|---|---|---|---|---|---|
| **EXISTING DEVELOPMENT** | ✔ Check the appropriate box | | | | |
| Inventory Hazardous Buildings | | | | | |
| Strengthen Critical Facilities | | | | | |
| Reinforce Hazardous Buildings | | | | | |
| Reduce Nonstructural Hazards | | | | | |
| Regulate Hazardous Materials | | | | | |
| **EMERGENCY PLANNING AND RESPONSE** | | | | | |
| Determine Earthquake Hazards and Risks | | | | | |
| Plan for Earthquake Response | | | | | |
| Identify Resources for Response | | | | | |
| Establish Survivable Communications System | | | | | |
| Develop Search and Rescue Capability | | | | | |
| Plan for Multijurisdictional Response | | | | | |
| Establish and Train a Response Organization | | | | | |
| **FUTURE DEVELOPMENT** | | | | | |
| Require Soil and Geologic Information | | | | | |
| Update and Improve Safety Element | | | | | |
| Implement Special Studies Zones Act | | | | | |
| Restrict Building in Hazardous Areas | | | | | |
| Strengthen Design Review and Inspection | | | | | |
| **RECOVERY** | | | | | |
| Plan to Restore Services | | | | | |
| Establish Procedures to Assess Damage | | | | | |
| Plan to Inspect and Post Unsafe Buildings | | | | | |
| Plan for Debris Removal | | | | | |
| Establish Program for Short-Term Recovery | | | | | |
| Prepare Plans for Long-Term Recovery | | | | | |
| **PUBLIC INFORMATION, EDUCATION AND RESEARCH** | | | | | |
| Work with Local Media | | | | | |
| Encourage School Preparation | | | | | |
| Encourage Business Preparation | | | | | |
| Help Prepare Families and Neighborhoods | | | | | |
| Help Prepare Elderly and Disabled | | | | | |
| Encourage Volunteer Efforts | | | | | |
| Keep Staff and Programs Up-To-Date | | | | | |

## EARTHQUAKE DISASTER PLAN PAYS OFF

When fire broke out on the 12th floor of the 62-story headquarters building of the First Interstate Bank in Los Angeles on May 4, 1988, it destroyed four stories which housed critical operations of bank business. As reported in the Los Angeles Times newspaper, 18 months before, the bank had spent $1.5 million establishing a sophisticated plan for responding to a natural disaster. On April 14 the bank went through a practice drill.

What everyone had been anticipating was an earthquake. What they got was a fire that gutted several floors of the bank's downtown headquarters including the sites of such critical operations as the 12th floor securities trading room and the fireproof vault on the 11th floor where as much as $100 million in bonds and securities are kept. Less than a mile from the headquarters building the bank maintains a permanent emergency center to cope with precisely this type of disaster. Top bank executives said on May 5 that the disaster plan functioned almost flawlessly, allowing the bank to keep vital operations functioning with little or no interruption and minimizing the effect of the fire on business and customers.

"That was the best $1.5 million we have ever spent," said William Siart, chairman and chief executive of First Interstate Bank of California.

- From EERI Newsletter

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## EARTHQUAKE INSURANCE

Reprinted from NCEER Bulletin, July 1988

Recent California earthquakes highlighted the vulnerability of urban areas to even moderate earthquakes. For example, the 5.9 magnitude Whittier-Narrows earthquake of October 1, 1987, resulted in a loss of $358 million,[1] $72 million of which were compensated by the private insurance companies.[2] Federal and State disaster assistance programs offered grant and loan packages worth tens of millions of dollars to uninsured homeowners and businesses. Yet, many of the victims did not qualify for assistance.

In view of the high seismic risk faced by a number of U.S. communities, disproportionately high dollar losses caused by this moderate earthquake have brought public attention to issues of earthquake insurance and state/federal disaster assistance. Insurance industry officials, decision-makers and members of the earthquake research community are involved in a debate on the appropriate roles of public disaster assistance and earthquake insurance: Will the insurance industry be able to absorb the losses in billions of dollars caused by a major earthquake? How will federal/state disaster assistance programs handle large numbers of uninsured earthquake-affected businesses and homeowners? Should current insurance and disaster assistance programs be restructured?

Current arguments range from claims that the current disaster assistance tends to subsidize seismic losses without reducing future vulnerability of communities, to increasing the supportive role of the federal government in the wake of earthquake disasters. In both extremes, earthquake insurance figures as an option which should be seriously examined. The following discussion describes the current state of affairs in earthquake insurance in this country.

Very few people in the United States purchase earthquake insurance. Even in the seismically high risk state of California, only about 15% of home-owners, and 20% of small businesses are covered by earthquake insurance policies. Very high premiums and deductibles are credited as principal reasons for this. It is argued that the premiums and deductibles could be reduced, thus offering protection to a wider audience, if the risk were spread over a larger market.

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[1] *FEMA, 1987, The Whittier-Narrows Earthquake of October 1, 1987: Federal/State Hazard Mitigation Survey Team Report. Los Angeles: FEMA, OES, SCEPP, CSSC.*

[2] *Roth, Richard, 1988, Memorandum of Feb. 9, to Respondents of the Special Earthquake Call. Los Angeles: California Department of Insurance.*

However, the insurance industry is reluctant to market earthquake insurance more aggressively, for fear that after a catastrophic earthquake their obligations might exceed their financial solvency. An estimate of potential insured earthquake losses in the state of California has been regularly published for the last eight years by the California Department of Insurance. In their 1987 report[3] a table was published for the aggregate probable maximum loss (PML):

Aggregate PML by Residential/ Commercial Classes[4]
($ millions)

| Earthquake Zone | 1985 | 1986 | Change 1986/85 |
|---|---|---|---|
| A. San Francisco | | | |
| -residential | 510 | 846 | 65.9% |
| -commercial | 3,758 | 2,848 | -24.2% |
| Total | 4,268 | 3,694 | -13.4% |
| B. Los Angeles | | | |
| -residential | 508 | 839 | 65.2% |
| -commercial | 5,427 | 4,093 | -24.6% |
| Total | 5,935 | 4,932 | -16.9% |

This table shows that the PML figures were reduced in the 1985/86 period. One reason for this may be the new California law,[5] which by offering earthquake insurance for residential owners, also eliminated the concurrent causation doctrine. This doctrine was formerly responsible for insurers' duty to cover the loss, in the cases when any factor, not specifically excluded from an all-risk policy, was found to have contributed to damage.

Some members of the industry, however, feel that even though earthquake insurance is principally offered on the named-peril and all-risk basis, after major earthquakes, insurance companies may expect increased losses because of the provisions of fire, health or general liability coverage. For example, since most properties are insured for fire (and possibility for fire and conflagration in U.S. cities after earthquakes has been documented).[6] it is likely that the insurers may expect increased claims in this area. Furthermore, property owners who have uninsured losses in an earthquake might seek compensations from negligent third parties. There is a widespread feeling that in such cases, insurance companies would almost always have to compensate.[7]

Elimination of the concurrent causation doctrine protects insurance companies in the state of California to a certain extent. However, the new law also tends to reduce the number of insured home-and business-owners, because of increased premiums and deductibles in 1985. This contradiction between the small number of insured and industry's inability to spread the risk and reduce premium rates, is further complicated by the federal regulation which precludes the insurers from establishing reserve funds for meeting obligations related to future disasters.[8] That is why the insurance industry ultimately seeks support in the domestic and international reinsurance market. In the past, reinsurers have borne the brunt of insured losses in major earthquakes. However, there is a growing concern in regard to the capacity of even international reinsurers to absorb huge losses estimated to occur after a major earthquake (e.g. magnitude 8.3) affecting San Francisco or Los Angeles in California, or other large cities such as Memphis, Tennessee, or St. Louis, Missouri.

It is because of these problems that several recent initiatives propose a more active federal role in earthquake insurance. The Earthquake Project, which is a management planning group established by several large insurance companies and industry associations, is involved[9] in exploring the industry's options. Proposals of other groups and individuals oscillate from suggesting that Federal Government become a reinsurer of private insurance companies, to Washington's relaxing regulation on reserve disaster funds. Vocal proponents of earthquake hazard

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[3]*California Department of Insurance, 1987, California Earthquake Zoning and Probable Maximum Loss Evaluation Program. Los Angeles: California Department of Insurance.*

[4]*ibid., p. 1.*

[5]*AB 2865 went into effect on January 1, 1985.*

[6]*Scawthorn, Charles, 1987, Fire Following Earthquake. Oakbrook IL: All Industry Research Advisory Council.*

[7]*Committee on Commerce, Science and Transportation, 1987 Earthquake Insurance: Problems and Options. Washington, D.C.: U.S. Government Printing Office.*

mitigation contend that successful lessons of the National Flood Insurance Program should be analyzed and used for establishing a similar system for earthquakes: the Federal Government would guarantee earthquake insurance, offering the property owners enough incentives to rehabilitate their seismically hazardous buildings.

Although the industry is still unsure as to how to sell affordable and effective insurance for major seismic events, earthquake insurance is an area which offers great possibilities, and should be vigorously explored. Building earthquake hazard mitigation incentives into property insurance policies in the zones of identified seismic risk appears to be a viable policy, supported by a large constituency.

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[8]*Committee on Commerce, Science and Tranportation, 1987, Op. Cit (p. 28).*

[9]*For example, An Earthquake Project sponsored symposium was held on Wednesday, October 21, 1987, in San Francisco. Mr. Wayne E. Hedien, President of Allstate Insurance Company, outlined the industry sponsored proposal for the Federal Catastrophe Insurance and Reinsurance Corporation Act.*

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## LESSONS IN JOURNALISM AND SCIENCE

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Reprinted from the Natural Hazards Observer, July 1988

Looking through the library's shelf of books about the Three Mile Island accident, I am struck by the emphasis on the press. It seems that both news media and emergency planners have tried hard to learn as much as possible from the March 1979 events. At the time, Walter Cronkite told his television audience; "Good evening. The world has never known a day quite like today." He spoke of "the ultimate risk of a meltdown" and "the massive release of radioactivity." People called radio and television stations in panic. Understandably, the Report of the President's Commission said the major health effects of Three Mile island were "severe mental stress."

We're still learning how to cover such events, but I believe progress has been made toward improved media relations in emergencies. A review of coverage of the Henderson, Nevada, rocket fuel plant explosion supports that view. I think news coverage of any nuclear accident today would be much better than it was in 1979, but there is much important work left to be done.

The shelf of books on Three Mile Island, Bhopal, and Chernobyl offers more lessons about communication, helpful journalism, and public reactions to information. These lessons for journalists and those who work with the mass media are equally important to the problems of engineering and science.

News coverage remains a major concern for emergency managers. The relationship of news organizations and emergency management agencies is getting expert attention at all levels. In Arizona, the state Division of Emergency Services and county groups are working out programs to cope with the media-emergency problems, and the state newspaper organization is involved.

As a rule, disaster events cause reporters to go in search of scientists and people who speak the language of science. Under these conditions, we are not surprised to find the relationships strained by the conflicting styles of these two groups of professionals. In disasters, journalists operate under different sets of pressures than do scientists. No one suggests that journalists should become like scientists, but they need to acquire the means to cope with scientists and engineers, and with the complex information that comes from scientists and others with scientific background in the emergency community.

In the context of emergency planning, it seems to me that the burden will rest more heavily on the people of science to tell their story in words that will be meaningful to mass media audiences. While there are already courses intended to help journalists work with science, the attitudes of scientists may suggest a need for seminars to enable scientists to work with the press.

Recently, we did a survey of scientists at the University of Arizona to see just what their attitudes were toward journalists in a disaster setting. We found that the science community had a remarkably low opinion of the press's performance. There were a few compliments, but generally, the results showed

a relationship in need of some attention, on both sides. Scientists said that as "watchdogs," journalists lack the technical background to understand what they are watching when a disaster occurs.

The survey asked the scientists to comment on "disaster journalism" and to offer advice to journalists who cover what they read and watch on television. I have tried to distill their anger into these pieces of advice for journalists covering disasters:

1) Deal in facts. Don't sensationalize.
2) Spare the victims unnecessary media exposure.
3) Stay neutral about the controversies.
4) Slow down. Be a little more like scientists; give the facts time to emerge.
5) Ensure that each fact is correct, a suggestion that might surprise journalists who think of themselves as accurate.
6) Attribute everything to named sources. Don't use unnamed ones.
7) Run your draft by your sources.
8) Avoid the pseudo-expert, the scientist speaking outside his or her area of expertise who knows how to generate a good quote.
9) When experts disagree, say so. Science is often inconclusive, and the news treatment should be so too.
10) Admit your limitations. A reporter is only a reporter, and shouldn't have all the answers.

The responses indicated that the scientists understand the constraints under which the press operates and value its contributions to public knowledge. However, respondents drew a line between mainstream media and the prestige media, giving higher marks to national sheets like the New York Times.

The scientists described "disaster journalism" with such salty phrases as sensational, superficial, biased, lacking facts, shocking, awful, and a form of news that offers "a lot of hype and no useful information." Reporters, they said, are brainwashed, shallow, irresponsible.

Coverage of the Three Mile Island nuclear plant accident was recalled by one scientist as "slightly short of criminal. With radiation doses less than that received by a transcontinental flight, the public was thrown into a state of panic by the press (mainly TV). The overwhelming economic disaster was barely mentioned." Scientists faulted the press for failing to report costs of protective measures compared to risks that remain.

The project confirms what others have said: the split between journalists and scientists is a real one, and is substantial. The contrasting ways of thinking on both sides of the science-journalism gap have been explored by Dorothy Nelkin in Selling Science, and by Sharon Dunwoody and Carol Rogers in Scientists and Journalists, two books that have been well-received in a course on scientific thinking and methods for journalism graduate students at the University of Arizona. A next step may involve designing better courses for scientists, emergency managers, and others on how to work with the press.

Journalists need to acquire the means to communicate more effectively with the kinds of critics who spoke in this survey, but the burden rests equally heavily on the people of science to tell their stories in words that will be meaningful to audiences of the mass media. The two cultures do share some goals after all--to enable people to make better decisions and to help them avoid injury or death.

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## ATC-21

Three new publications will be available from FEMA sometime this fall. They are:

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| ATC 21 | Rapid Visual Screening of Buildings for Potential Seismic Hazards: a handbook |
| ATC 21-1 | Supporting Documents: detailed computations and formulas used in the handbook |
| ATC 21-2 | Earthquake Damaged Buildings: an overview of heavy debris and victim extrication, a state of the art summary, detailing |

which sorts of buildings are likely to "pancake" in the event of an earthquake (as many buildings did in Mexico City) and what tools are readily available to response personnel for extricating people caught in the debris.

Larry Reaveley of Reaveley Engineers and Associates, Inc., who helped develop the ATC-21 handbook, provided the following summary:

This handbook provides a methodology and supporting background information for organizations and persons who wish to perform a Rapid Visual Screening of Buildings for Potential Seismic Hazards. The screening utilizes a methodology based on a "sidewalk survey" of a building, and consists of a Data Collection Form which an inspector completes based on visual observation of the building. The Data Collection form includes space for sketches and a photograph of the building, as well as for noting pertinent earthquake safety-related data. This Handbook provides the inspector with background information and data required to complete the form.

The methodology is built around identifying the primary structural lateral load resisting system and materials of the building, for which a Basic Structural Hazard Score is provided on the form and which the inspector circles. The inspector then modifies this Basic Structural Hazard score by adding or subtracting Performance Modification Factors, which relate to significant seismic-related defects the inspector may observe, in order to arrive at a final Structural Score S. The Basic Structural Hazard, Performance Modification Factors and final Structural Score S all relate to the probability of the building sustaining major life-threatening structural damage. Final S scores typically range from 0 to about 6, with higher S scores corresponding to better seismic performance.

The result is a ranking of inspected buildings, which may be divided into two categories: acceptable as seismically adequate, and those requiring detailed investigation by experienced structural engineers. A criteria of buildings whose S scores are less than about 2 is suggested as a "cut-off", based on present building code and design practice criteria. That is, if a building has an S score less than 2, it should be investigated by an experienced professional engineer.

All three reports are currently in the printing process. Ugo Morelli of FEMA in Washington, D.C., can provide a limited number of advance xerox copies of these reports to individuals with an urgent need for them before this fall. Contact him at (202) 646-2810.

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## ESTIMATING BUILDING STOCKS FOR EARTHQUAKE MITIGATION

Reprinted from the Natural Hazards Observer, May 1988

Risk assessment requires determining the incidence of damage to the elements at risk in order to establish vulnerability. Buildings and non-building structures, besides representing a considerable financial investment, determine the spatial organization of social and economic systems. Unfortunately, the United States has neither a complete nor an accurate enumeration of structures, even though the built environment is perhaps the main social and economic element at risk due to natural disasters.

Because previous research had indicated that indirect methods - principally those based on population studies - seemed to produce effective techniques for estimating building stocks, the National Science Foundation and the National Center for Earthquake Engineering Research funded the Cornell Institute for Social and Economic Research, Program in Urban and Regional Studies to undertake a series of research projects in order to develop a reliable method for estimating building stocks. So far, studies carried out in such diverse locations as New York City; Ithaca, New York; and Wichita, Kansas have shown remarkably stable relationships for a number of critical variables.

The Wichita study (still being carried out) has involved the complete enumeration-through the local tax assessor's files - of both primary and auxiliary buildings by detailed use category. Since the study covers the entire Wichita metropolitan area, it permits comparisons of the central core, the built-up area, and the periphery. Indeed, if the regularities in building stock distribution found in the various studies conducted so far are determined to be generalizable across the nation, the task of estimating the attributes of building stocks in other areas will be greatly facilitated.

The research has resulted in a series of working papers collectively entitled Estimating Building Stocks for Earthquake Mitigation and Recovery Planning. Of the various papers, listed below, the first, by Jones et al., provides the best overview and summary of the work.

Estimating Building Stocks and Their Characteristics. Barclay G. Jones et al., 1987, 20 pp., $2.00.

A Large-Scale Urban Simulation Model Applied to Building Stocks. Charles M. Hotchkiss and Barclay G. Jones. 1987, 19 pp., $2.00.

An Investigation into Estimation of Building Stocks Through Sampling Aerial Photography. Kimberley A. Johnson, 1987, 137 pp. $10.00.

Determination of Building Stocks for Urban Vulnerability Analysis and Earthquake Loss Estimation. Barclay G. Jones et al., 1987, 23 pp. $2.00.

The Residential Building Stock: Characteristics and Trends in Wichita-Sedgwick County, Kansas. Michael J. Savonis., 1987, 168 pp., $10.00.

All the publications can be ordered from the Cornell Institute for Social and Economic Research, Program in Urban and Regional Studies, 106 West Sibley Hall, Cornell University, Ithaca, NY 14853.

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## BUILDING SEISMIC SAFETY COUNCIL INTRODUCES NEW HANDBOOKS ON SEISMIC SAFETY

The Building Seismic Safety Council (BSSC) has just announced the release of a new series of Seismic Considerations handbooks. The series was developed for owners, developers, financiers, designers, public officials and others involved in the decision-making process for the design and construction of elementary and secondary schools, health care facilities, and hotels and motels.

More than 40 states are prone to earthquakes, says James R. Smith, executive director of the BSSC. "Buildings are still being constructed without regard to their safety during an earthquake, even though most earthquake deaths and injuries are caused by falling debris and building collapse," states Mr. Smith.

The purpose of the Seismic Considerations handbooks is to encourage consideration of earthquake-resistant design and construction in seismic risk areas throughout the United States. Each handbook provides an accessible source of expert information including the benefits and costs of designing and constructing specific facilities to resist earthquake damage. "Schools, hospitals, and other special occupancy buildings like hotels and motels, and office and apartment buildings are important elements in our communities, due to the nature of their occupancies, functions, and, in the case of schools and hospitals, their importance in disaster response and recovery efforts," declares Mr. Smith. "Each of these building types should be built to resist earthquakes regardless of current practices for non-essential, smaller, or less densely populated buildings."

Currently available are three handbooks: elementary and secondary schools, health care facilities, and hotels and motels. Handbooks for office buildings and apartment buildings will be published later this year to complete the series, funded by the Federal Emergency Management Agency (FEMA).

In addition to addressing the life safety considerations that are the major concern of seismic codes and standards, the handbooks present information on the damage that can result in a loss of building function. Using conventional real estate analyses, each

illustrates the long-term rate of return on a seismic design investment. Further, each handbook illustrates how sound seismic design makes good sense--quite apart from life and public welfare protection--by demonstrating how, if a shake occurs, the benefits associated with not having a break in continuity of operations far outweigh the costs of seismic design and construction.

The Seismic Considerations handbooks draw upon lessons learned in past earthquakes and the results of an earlier trial designs program to show that the additional costs of earthquake-resistant design most often are not cost prohibitive. "The fact is, seismic resistant design need not be expensive," emphasizes Smith. "When undertaken as part of the original design effort by a team familiar with seismic design, incorporating seismic provisions such as the NEHRP Recommended Provisions is generally less than 1.5 percent of construction costs, which is, of course, only part of the total project costs."

NEHRP refers to the National Earthquake Hazards Reduction Program, a nationwide earthquake hazard mitigation effort first authorized by Congress in 1977. With funding from FEMA the BSSC developed and approved by consensus the NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings, a comprehensive, state-of-the-art set of building design provisions that are national in scope. The Provisions will soon be reissued as an updated 1988 edition.

Each Seismic Considerations handbook is divided into two parts. Part one is intended for those involved in the decision-making process--including building owners and developers, insurers, investors and financiers, elected officials and members of school and hospital boards. The earthquake hazard situation in the United States is described and the specific risk to each type of facility is outlined. Part one of the handbook also discusses means for mitigating the hazard and the cost-benefits of seismic design.

The second part is aimed at building designers and highlights particular earthquake design problems related to each building type. Part two also discusses how the NEHRP Recommended Provisions treat those problems. Each handbook also contains a list of sources, a glossary, and a case study.

The Building Seismic Safety Council is an independent voluntary body under the auspices of the National Institute of Building Sciences. The BSSC has a membership of nearly 60 organizations representing all major segments of the building community.

Copies of Seismic Considerations: Elementary and Secondary Schools; Seismic Considerations: Health Care Facilities; and Seismic Considerations: Hotels and Motels, are available in limited quantities free of charge. Write: Building Seismic Safety Council, 1015 Fifteenth Street NW, Suite 700, Washington, D.C. 2005 or call (202) 347-5710.

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## UPDATE ON USGS PROFESSIONAL PAPER ON ASSESSING REGIONAL EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH

### PARTS A and B

Part A of the Professional Paper is undergoing text review in Reston. Twenty-six chapters comprise the far-reaching report, which is divided into three sections: 1) the tectonic framework and earthquake potential of the Wasatch Front area, 2) the ground-shaking hazards and aspects of loss estimation in the Wasatch Front area, and 3) the use of earthquake hazards information for implementation of loss reduction measures in the Wasatch Front area.

Authors will begin receiving "marked up" copies of their manuscripts for revision within the next month to four months. The Professional Paper should be ready for printing within a year depending on the speed of the text review and revision process.

A call for Part B of the Professional Paper was announced in December 1987. The sequel will include the results of recent research and implementation activities which were unavailable at the time Part A was being compiled. Part B will be divided into sections similar to Part A, i.e., Tectonic framework, ground shaking, loss estimation, and implementation. In addition, there will be a section on ground-failure hazards.

Manuscripts for Part B will be accepted until January 1, 1989. Persons interested in submitting papers should contact Paula Gori or

Walt Hays, editors, 905 National Center, Reston, Virginia 22092 (701-648-6707) for information regarding style and peer review requirements.

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USGS REDBOOKS

The published proceedings of 3 U.S. Geological Survey Workshops described in the Autumn-Winter 1987 issue of the Forum are available free of charge, while supplies last, from Paula L. Gori, U.S. Geological Survey, 905 National Center, Reston, VA 22092, (703) 648-6707:

Proceedings of a workshop on "Earthquake Hazards Along the Wasatch Front, Utah," Open-File Report 87-154, 155 p.

Proceedings of a workshop on the "U.S. Geological Survey's Role in Hazards Warnings," Open-File Report 87-269, 133 p.

Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah, Open-File Report 87-585, 2 volumes, 1340 p.

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TRANSFER OF EARTHQUAKE HAZARDS AND RISK INFORMATION TO KEY GOVERNMENT OFFICIALS AND PROFESSIONALS IN UTAH

Gary E. Christenson
William F. Case
Utah Geological and Mineral Survey

A June 1, 1988, meeting was held between Wasatch Front earthquake hazards researchers and information users at the State Capital. The objective of the meeting was for researchers to present explicit factual information on earthquake hazards and risk, particularly related to ground shaking, in Utah and to advise on issues concerning seismic safety policy. The meeting was co-organized by W.W. Hays (USGS) and L.D. Reavely (Reavely Engineers and Associates, Inc.) and consisted of a panel of experts, each giving a summary of their findings, work in progress, and recommendations, followed by an open discussion of issues. Researchers included W.W. Hays, Ted Algermissen, Al Rogers, Carl Steinbrugge, and E.V. Leyendecker of the USGS and Lloyd Cluff of Pacific Gas and Electric. The audience consisted of geotechnical and structural engineers and building officials representing private industry, universities, local governments, professional organizations, and state government.

Below is a list of questions the panelists attempted to answer in their presentations. Those wishing further information are urged to contact panel members.

Walter Hays - Overview of the Problems

Lloyd Cluff - The Wasatch Fault

- Has the Wasatch fault produced earthquakes in the past? Will it produce earthquakes in the future (i.e., next 30-50 years)?
- On the basis of trenching studies in Utah and comparison with other listric and other active faults throughout the world, what are reasonable seismic safety policies for Utahns to adopt with regard to siting, design, construction, and land use in order to coexist with the Wasatch fault?

Ted Algermissen - The Ground Shaking Hazard

- What could happen in the near field of the listric Wasatch fault?
- Do probabilistic ground-shaking hazard maps represent a reasonable picture of the levels of ground shaking that could happen in the near field in the next 50 years?
- How does the Wasatch Front compare with California in terms of near-field ground shaking?

Walter Hays and Albert Rogers - Soil Response

- How do soil amplification phenomena enter into the overall assessment of the ground shaking hazard in Utah?
- On the basis of damaging earthquakes in Caracas, Venezuela, Mexico City, Mexico, and other locations, what are reasonable seismic safety policies for Utah to adopt with regard to soil response?

Ted Algermissen and Carl Steinbrugge - Losses

- What kinds of losses can be expected on the basis of various ground shaking hazard scenarios?
- What are the biggest problems? Why?
- What are the implications of various levels of ground shaking and soil response on the losses (i.e., what are the rules of thumb for scaling from low to high levels of ground motions)?
- What are the implications of ground failure on the losses?

E.V. Leyendecker - Structural Design Considerations

- In view of current ground-shaking hazard maps, what are the most important considerations for the structural engineer in Utah?
- How do the detailing standards for zone 3 and zone 4 (i.e., the Uniform Building Code) differ in terms of ductility? redundancy?
- Will ductility inherent in a zone 3 design accommodate the potential near-field effects of a Wasatch Front earthquake exceeding the design level of zone 3?
- Will redundancy inherent in a zone 3 design accommodate the potential near-field effects of a Wasatch Front earthquake exceeding the design level of zone 3?
- When is it acceptable to ignore the infrequent but plausible earthquake that has the potential for causing collapse of buildings and facilities?

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## EARTHQUAKE ENGINEERING AND SOIL DYNAMICS II CONFERENCE

### "RECENT ADVANCES IN GROUND-MOTION EVALUATION"

The ASCE Geotechnical Division Specialty Conference was held in Park City, Utah, June 27-30, 1988. It focused on all aspects of earthquake ground-motion specification for design and analysis of engineering structures. Topics spanned from regional geologic consideration, through transmission of motions from bedrock to the ground surface, to idealization of ground motions for design. One of the primary goals of the conference was to bring together the various considerations of seismologists, geophysicists, and engineers in portraying ground motions. In this way engineers will be able to improve their understanding of earthquake source and ground-motion transmission processes, and seismologists and geophysicists will be able to better understand the engineers' methods and needs in developing representative ground motions for design and analysis.

In his welcoming address, Utah Governor Norman H. Bangerter urged all participants to work quickly toward providing Government leaders with specific information that can be used to develop sound prevention and response policies. "When there are predictions of a 90% chance of a major earthquake on the Wasatch Front in the next 50 years, it is an unnerving thought for a Governor. As Governor, my decisions are only as good as the information I receive when I make those decisions... This is what I would ask from you today. I need you to compile more area specific information that is useful for state agencies as well as planners, builders, and architects - so that they can use this information in their planning to avoid the most sensitive areas; and in construction designs to make structures earthquake resistent. It is critical that you as a scientific community work together to agree on ground response information. When you don't agree, it is difficult for those involved in planning and construction to justify the extra expense. I need to be able to convince others of the hazards. Estimates of life loss, scenarios of how extreme the damage will be, dollar figures of what it will cost state government, and a vision of what impact this will have on insurance companies and banks are important because they personalize the risks for decision makers. Hazards information needs to be translated in ways that are applicable and understandable, so that individuals know where the hazards are, what the effects will be, and when such events may occur....And as a Governor building the future of this state, I need information that can be used as ammunition to develop codes and standards. I know the cost savings of doing

something right the first time - instead of having to redo it. I'd hate to think that the state's new construction would need retrofitting for earthquakes in the next decade or so. That would be as much of a waste of taxpayer's money as spending extra dollars unnecessarily. If we can all work together to minimize the impact of earthquake hazards, we will be going a long way in building a bright future for Utah."

A conference proceedings is published and available as ASCE Geotechnical Special Publication No. 20, for $34.50 post paid from the American Society of Civil Engineers, 345 East 47th Street, New York, NY 10017-2398, (212) 705-7518. From its abstract:

> Ground-motion determination for analysis and design of engineering structures is a shared, interdisciplinary task involving geologists, seismologists, geophysicists, geotechnical engineers, and earthquake engineers. Considerations in developing ground motions representing all of these disciplines are presented beginning with a current assessment of geologic and seismic hazard on an overall or regional scale and continuing with discussions on: local site effects measurement of strong ground motion, seismologic characterization of ground motion; determination of laboratory and in-situ properties to enhance analysis of ground-motion transmission; practical development of ground motion for structural analysis; and ending with an analysis of the effects of strong ground motion and large deformation.

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## GOVERNOR'S CONFERENCE ON COMPREHENSIVE HAZARDS REDUCTION

Fred May
Utah Division of Comprehensive Emergency Management

The Governor's Conference on Comprehensive Hazards Reduction sponsored by the Utah Division of Comprehensive Emergency Management (CEM), was held May 5-6 at the Olympic Hotel in Park City, Utah. During the two day event, some 30 speakers addressed the needs and accomplishments of comprehensive hazards reduction in Utah. The conference was deemed a success by the 400 plus attendees, representing federal, state, and local governments, and the private sector. Beyond the scope of Utah's activities, national and international perspectives on disaster reduction were presented by the conference's keynote speaker, Dr. Riley Chung of the National Research Council, and by Jerome Oakley of FEMA Region VIII.

Dr. Chung's keynote address described the development of the International Decade for Natural Disaster Reduction (IDNDR). He noted that a National Decade is also being developed. He praised Utah for being the first State nationwide to declare a State Decade for Natural Disaster Reduction, and for participating with the National Academy of Sciences, and others, in both the National and International Decades; both are in various stages of endorsement. Dr. Chung then discussed natural disasters worldwide where over 3 million people have died and 820 million have been injured during the past 20 years. Direct property damage during that period of time is estimated conservatively at $25-100 billion. The spectrum of natural disasters ranged from mudslides in Rio de Janeiro, Brazil to the Mexico City earthquake. Directing his remarks nationally, Dr. Chung presented information on the impact from hurricanes, tornadoes, wildfires, volcanoes, and other types of disaster. The Federal Emergency Management Agency (FEMA) has spent an average of $400 million annually for disaster relief over the past 20 years.

One highlight of the conference was Governor Norman H. Bangerter's declaration making the 1990s the Utah Decade for Natural

Disaster Reduction. Governor Bangerter called on state and local governments to develop appropriate planning and action programs to reduce impact and expense from natural disasters. Such programs are of interest to FEMA and the National Academies of Sciences, Engineering, and Medicine, which are promoting and planning the International and National Decade programs. Utah CEM and other agencies will be promoting the Utah Decade and assisting other agencies and offices in their planning efforts.

Prior to introducing the Governor, John T. Nielsen, Commissioner of Public Safety, described the type of comprehensive emergency management programs that exist today, both nationally and within Utah. These are high-tech fields generally requiring college preparation and training courses such as those provided by the National Emergency Training Center at Emmetsburg, Maryland. The field of comprehensive emergency management requires expertise in disciplines including geology, geophysics, economics, urban planning, political science, behavioral science, communications, chemistry, and public administration. Many workers in the field have advanced degrees and are well qualified. Commissioner Nielsen addressed the need for increased mitigation, preparedness, and response planning in all areas of disaster reduction, but he emphasized hazardous materials. It is simply a matter of time until a major hazardous materials incident occurs somewhere in Utah - it could be a real tragedy. These incidents occur too regularly nationwide, and Utah's turn will probably come. Hopefully, planning will prevent such incidents and that is our intent. Public safety has the awesome responsibility of addressing the entire array of comprehensive hazards and it is difficult to predict what may happen next. To do this, the Department works through Utah CEM as both a coordinating and a development agency. CEM works with numerous mitigatory and advisory agencies in reducing the risk from natural and technological hazards.

To "bring home" the reality of impact on families during and after a disaster, Morgan and Sarah Haroldsen of Mackay, Idaho, described to the 400 conference attendees what it is like to live at an earthquake epicenter. Not only were lives disrupted by the major Borah Peak Earthquake (7.3 Richter Magnitude), but people have lived through 4 1/2 years of ongoing aftershocks, still in the high "4" range. The Haroldsen's realistic account had the audience laughing one moment and crying the next. Their point was well taken. No-one could avoid the reality of the fact that a major earthquake does have a profound effect on families, both emotionally and economically. The experience would quickly become very real to unsuspecting people, even here in Utah.

Besides the several speakers who addressed statewide hazard mitigation, local flood control successes, earthquake risk reduction, hazardous materials programs, slope stability, dam safety, and other topics, specially-selected presentations were also made on satellite monitoring of global weather, liability issues in hazard mitigation, disaster impact on financial institutions, and Utah's involvement in international hazards reduction programs. CEM's staff is involved in the international programs, especially Partners of the Americas, assisting those countries in comprehensive emergency management programs. Four concurrent work sessions were conducted on Thursday afternoon. These addressed hazards reduction for a broad array of hazards, with speakers from federal, state, and local governments and academia. At the conclusion of each work session, hazards reduction recommendations were obtained from the attendees. These recommendations will be incorporated in upcoming CEM reports and publications.

The well-attended conference was determined a success by all present, and the Park City springtime provided an added bonus. The spectrum of natural hazards was addressed and attendees were given the challenge to return to their work places and promote comprehensive hazards risk reduction and to plan for the Utah Decade of Natural Disaster Reduction.

## INTERNATIONAL SEISMIC ISOLATION/HISTORIC PRESERVATION SYMPOSIUM "EARTHQUAKE RISKS AND THE ARCHITECTURAL LANDMARK"

Held in Salt Lake City May 11-15, 1988 and sponsored by the Salt Lake City Corporation and the Office of the Mayor, this convocation brought together a multidisciplinary group of local, national and international professionals involved in all aspects of historic preservation in seismically active areas. The base isolation seismic retrofit of the historic Salt Lake City and County Building (SLCCB) served as a focus for the Symposium. Topics addressed during the four day meeting included: the history and theory of seismic isolation; research and developments in seismic isolation; a retrospective of public issues; seismic isolation as a governmental decision; seismic isolation retrofit issues; seismic design for architects; conservation code changes; seismic hazards and historic structures; public funding for restoration; risk management issues; improving public awareness; historic preservation education; historic cultural property in seismic zones; the city's concerns; project management and restoration; general contractor's viewpoint; landscape research and restoration; traditional conservation and modern technology; seismic isolation within new construction. Speaking to these topics was an equally diverse group of individuals including:

Architects: Sir Bernard Feilden, Chief Architect, York Minster Restoration, Great Britain
- Burtch W. Beall, Jr., SLCCB Restoration Architect
- Chris Arnold, Building Systems Development, Inc., San Mateo
- James R. McElwain, Ezra Ehrenkrantz, and Dr. Theodore Prudon, The Ehrenkrantz Group, San Francisco
- Tim Craig and Sandy Turnbull

Engineers: James Bailey and Edmund W. Allen, E.W. Allen and Associates, SLCCB Project Structural Engineers
- Ronald Mayes, President and Dr. Ian Buckle, Dynamic Isolation Systems, Inc., Berkeley
- Larry Reaveley, Reaveley Engineers and Associates, Inc.
- Roland Sharpe, Engineering Decision Analysis, Inc.
- Larry Migliaccio, Eacon P.C.
- Dr. Mehmet Celebi and Dr. Nasar Mostaghel, University of Utah
- Dr. James Kelly, Director, Earthquake Engineering Research Center
- David Boyer, Vice President, ProSoCo, Inc.
- Max Peterson, Sam McAllister and Jerry Lyon, Salt Lake City Engineers

Geologists: Ken W. King and S. Ted Algermissen, U.S. Geological Survey, Denver
- Bruce N. Kaliser, Sergent, Hauskins and Beckwith Engineers

Government Officials: Utah State Senator Jake Garn
- Salt Lake City Mayor Palmer DePaulis and Phil Erickson, Executive Assistant to the Mayor
- Leigh von der Esch, former Director, Thomas Godfrey, Chairperson, and Sydney Fonnesbeck, Salt Lake City Council
- Bart Barker, Chairman and Larry Meyer, Administrative Assistant, Salt Lake County Commission
- Judge David Lee
- Norma Matheson, wife of former Utah Governor Scott Matheson

Public Opinion Pollster: Dan Jones, Dan Jones and Associates

Financiers: Prudential-Bache Securities, Public Finance Task Group
- Alice Steiner, Wallace and Associates
- Kent Michie, Vice President, Smith Capital Markets
- Richard Fox, Ballard, Spahr, Andrews and Ingersoll
- Lance Bateman, Director, Salt Lake City Finance Department,

and Cheryl Cook, former Salt Lake City Treasurer

Preservationists: Dr. Derek Linstrum, Director of Conservation Studies, University of York, Great Britain
- Dr. Barclay Jones, Cornell University, Ithaca
- Dr. John McCormick
- Melvyn Green, Melvyn Green and Associates

Risk Managers: Richard Lane, Senior Vice President, Rolins, Burdick, Hunter, Seattle
- Jane Erickson, Salt Lake City Risk Manager
- Susan Michelson, Vice President, Evans and Sutherland

Contractors: Ted Jacobsen, Jacobsen Construction Co., Inc., SLCCB Project Contractor
- J. Scott Howell, Robinson Ornamental Iron, Inc.
- Jan Striefel, Land Mark, Inc.

A paper presented to symposium participants, "An overview and chronology of the policy issues concerning the restoration of the Salt Lake City and County Building" is available free of charge from Dee Halverson, Heritage Associates, 8288 Supernal Way, Salt Lake City, Utah, 84121, (801) 943-6495 or from Phil Erickson, Salt Lake City Corporation, Office of the Mayor, 324 South State Street, Salt Lake City, Utah, 84111, (801) 535-6042. Funded by The Getty Conservation Institute, the Symposium proceedings will be published by the National Trust for Historic Preservation sometime in the fall of 1988. Watch the Forum for further details.

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## SEISMIC ISOLATION UPDATE

A newsletter published by Dynamic Isolation Systems, Inc. of Berkeley, California, featured a new Salt Lake City building in its lead article of the Spring 1988 issue (v. 2, no. 1), reprinted below. Anyone having a personal or professional interest in seismic isolation matters and wishing to subscribe to the quarterly newsletter can direct inquiries to Donald K. Hansen, Vice President, Dynamic Isolation Systems, Inc., 2855 Telegraph Avenue, Suite 410, Berkeley, CA 94705, (415) 843-7233.

## EVANS & SUTHERLAND BUILDING 600: A NEW SEISMICALLY ISOLATED HIGH-TECH FACILITY NEARING COMPLETION

An advanced high-tech facility that uses an equally advanced earthquake protection system is nearing completion in Salt Lake City. The facility is Evans & Sutherland's Building 600 located at the University of Utah Research Park. Its seismic protection system consists of 98 shock absorbing isolators that decouple the 116,000 square foot, four-level building from earthquake ground motion - thus protecting it from damage.

Why Seismic Isolation?

Dr. David C. Evans, President of Evans & Sutherland, stated that "with our continued growth and need for new facilities, we wanted the best earthquake protection currently available since Salt Lake City, like California, is a vulnerable earthquake area."

Evans & Sutherland's Building 600 will serve as corporate headquarters and as their center for the research, assembly and testing of their computerized flight simulator systems. "At any one time," Dr. Evans, continued, "there could be at least $100 million in equipment and work in process in the building. The value of the contents is many times the cost of the structure. Protection of the people and the contents in the event of an earthquake was the major motivating factor in the decision to use seismic isolation."

In reviewing conventional design approaches, Larry Reaveley of Reaveley & Associates, the project structural engineers, pointed out that, "as we've learned more about the nature of earthquakes and the magnitude of force they impose on structures, we've been making buildings stronger to increase safety. Conventional buildings are made earthquake resistant to avoid collapse, but they're not made earthquake proof. In moderate earthquakes, that means we can expect some

internal damage, while in major earthquakes we can expect significant structural as well as content damage, endangering lives and costing millions."

As readers of SEISMIC ISOLATION UPDATE are aware, seismic isolation is a viable option to conventional "brute-force" building design. DIS President Ronald L. Mayes said that "seismic isolation works by decoupling or isolating the structure from its foundation, greatly reducing earthquake ground motion transmitted to the building." He added that, "an appropriate analogy would be the relationship between automobiles and their suspension system-springs and shock absorbers-which cushion the occupants from a bumpy ride."

Cost Issues

In reviewing project cost, Alpheus Jessup, project architect for Ehrlich Rominger of Los Altos, said that "in the early phases of design development, cost estimates were developed for both conventional and isolated structures. The cost of the isolated structure was more than the conventional building." But, Alpheus added, "we determined that the cost required to incorporate seismic isolation as the primary earthquake protection mechanism was preferable to...achieving a similar level of protection through substantial bracing of equipment. We saw this to be impractical."

Design and Construction Issues

"The seismic resisting system is a four-story steel moment frame," Larry Reaveley stated. "The building is approximately 165 feet by 285 feet in plan and 53 feet high. The moment frame was designed to satisfy the Uniform Building Code Seismic Zone 3 design criteria with drift being the governing design factor. The DIS earthquake protection system we used consists of 98 specially-designed seismic 'shock absorbers,' formally known as isolators. Each is made up of many thin layers of rubber and steel that are bonded together into a single unit. The center of each unit is filled with a lead core. These isolators are stiff vertically enabling them to carry the weight of the building and its contents safely. In the horizontal direction, where earthquake protection is required, the isolators are relatively soft, permitting the building to experience only gentle, slow, sideways movement while the ground shakes violently beneath it."

The building is, in effect, separated from the ground for the isolation system to function. "We had to provide special detailing for architectural and mechanical elements so that the maximum anticipated horizontal movement could occur without causing damage," Alpheus Jessup noted. "We used different detailing techniques in parts of the building than we usually employ." he continued, "but since we considered seismic isolation from the outset of the project, this wasn't particularly difficult."

Frank Stringham, Vice President of the Bettilyon Corporation, construction managers, said that "the building went up without any problems. From a constructor's point of view, the isolators are like column base plates and didn't require any special installation techniques."

Business Objectives Met

According to Evans & Sutherland's Risk Manager, Gary Jones, "The decision to incorporate seismic isolation has important business implications. It will significantly increase our ability to continue manufacturing operations following an earthquake. If we were to suffer serious damage to our manufacturing capabilities, not only would we lose substantial work in process but we'd become vulnerable to loss of market share. This could affect the long-term viability of our business."

Dr. Evans underscored Gary's remarks, stating, "We believe that we've achieved our objective. We've provided our own form of earthquake self-insurance and have minimized the risk to our people and the building contents, especially the high-value work in process. Most importantly, we've enhanced our ability to continue our business operations immediately after an earthquake."

THE PARTICIPANTS

Owner: Evans & Sutherland, Dr. David C. Evans, President, P.O. Box 8700, Salt Lake City, UT, 84108.

Architect: Erlich Rominger, Alpheus Jessup, Project Architect, 4800 El Camino Road, Los Altos, CA, 94022.

Structural Engineer: Reaveley & Associates, Dr. Larry Reaveley, Vice President, 1515

South 1100 East, Salt Lake City, UT, 84105.

Seismic Isolation Consultant/Isolator Supplier: Dynamic Isolation Systems, Inc., Dr. Ronald L. Mayes, President, 2855 Telegraph Ave. - Suite 410, Berkeley, CA, 94705.

Construction Manager: The Bettilyon Corporation, Frank F. Stringham, Vice President - Construction Services, 333 West 2100 South, Salt Lake City, UT 84115.

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UTAH PRESERVATION CONSORTIUM
DISASTER PLANNING AND RECOVERY WORKSHOP

September 15-16, 1988 / BYU Convention Center

The Utah Preservation Consortium is dedicated to cooperatively improving the preservation and conservation of culturally significant library, archive and museum collections within the state. The goals of the organization are met by disseminating information among the membership of preservation issues and techniques. The purpose of the Disaster Planning and Recovery Workshop was to bring together a select group of North American Disaster Planners who are familiar with collections of high intrinsic value to Utah. The Workshop detailed the importance of creating a disaster contingency plan and step-by-step instructions for designing a plan that is institutionally specific. The panel of speakers assembled to conduct this one-time Workshop were selected from the United States and Canada because of their professional expertise and their commitment to educating collecting institutions on the importance of pre-disaster planning. The aim of this Workshop was to motivate each collecting institution in the region to create a disaster contingency plan to minimize the loss of collection of intrinsic value in the event of a natural or man-made disaster. It is hoped that improved response to regional disasters will result as a consequence of this planning. Speakers included:

John P. Barton, Head Conservator, Archives of Ontario, Canada.

Sandra Wright, Planning and Coordination Officer, Conservation Branch, National Archives of Canada.

Randall Butler, Archivist & Conservation Officer, Loma Linda University, California.

Durell Barney, Fire Marshall, Brigham Young University, Provo, Utah.

Eric Lundquist, Document Reprocessors, San Francisco, California.

Jim Tingey, Utah Division of Comprehensive Emergency Management, Salt Lake City, Utah.

Don Hartsell, Airdex Corporation, Houston, Texas.

Barbara Roberts, Head Conservator, Decorative Arts and Sculpture Conservation, J.Paul Getty Museum, Santa Monica, California.

Richard Trela, Paintings Conservator, Brigham Young University, Provo, Utah.

Ted F. Powell, Micrographics Division, Genealogical Society of Utah, Salt Lake City, Utah.

For more information or to register, contact

U.P.C. Workshop Registration
C/O Billie Jones
Salt Lake City Public Library
209 East Fifth South
Salt Lake City, Utah, 84111.

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NCEER INFORMATION SERVICE DATABASE

In Spring 1987, the National Center for Earthquake Engineering Research contracted with BRS Information Technologies, Inc., of Latham, New York for the development of a bibliographic database of literature pertaining to earthquakes, earthquake engineering and hazard mitigation, natural

hazards, disaster preparedness and response, and related areas so that researchers and investigators could quickly and easily identify potentially useful materials. The database--now called QUAKELINE--currently holds about 3,000 records, and it is anticipated that an additional 3,000 will be added in the next year. Abstracts are provided for each item, along with location and availability information. The documents listed include books and book chapters, proceedings, journal articles, technical reports, audio-visual materials, standards and codes, and other materials, and all items have been acquired for the NCEER collection and are available through the Information Service.

NCEER is strongly promoting the use of its database by researchers everywhere, and has consequently developed a users manual, QUAKELINE: A GUIDE TO SEARCHING, to familiarize potential users with use of the system. For persons not having access to computer telecommunications or not wishing to conduct a search themselves, the Information Service will conduct a search and mail the results.

Persons interested in using the database should first contact Patricia Coty at the NCEER Information Service, National Center for Earthquake Engineering Research, State University of New York at Buffalo, Red Jacket Quadrangle, Buffalo, NY 14261, (716) 636-3377 in order to obtain a password, as well as access and cost information. Copies of QUAKELINE: A GUIDE TO SEARCHING, can be obtained from the same address.

- From NCEER Newsletter and Natural Hazards Observer

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## EARTHQUAKE HAZARDS REDUCTION

The Earthquake Hazards Reduction Act of 1977 was reauthorized by Congress and became Public Law 100-252 on February 29, 1988. The law authorizes nearly $238 million in appropriations for fiscal years 1988-1990 to the four federal agencies charged with carrying out provisions of the Act: the Federal Emergency Management Agency, the U.S. Geological Survey, the National Science Foundation, and the National Bureau of Standards. The funds are apportioned as follows: $73,078,000 for FY 88; $79,766,000 for FY 89; and $85,080,000 for FY 90.

The House Science, Space, and Technology Committee pushed for a three-year (rather than two-year) renewal in order to provide more long-term stability to the programs funded under the Act. The Science Committee has been interested in providing a comprehensive, multi-year 50-state approach to mitigating earthquakes in the United States. It views the next three years as a test for incorporating earthquake monitoring systems located east of the Rocky Mountains into permanent USGS data-gathering facilities; further, it is hoped that the expansion of earthquake research activities into universities across the country--to study earthquake dynamics and structural behavior in both known and potentially active seismic areas--will broaden knowledge and training for earth scientists and seismic engineers, and improve disaster preparedness in areas beyond the West Coast.

The three-year reauthorization will also allow FEMA, state legislatures, and state agencies adequate time to work out cost-sharing arrangements for state and local emergency planning. Currently, FEMA's State add Local Assistance Program provides planning grants with no requirements that states match funds; however, beginning in 1989, 50-50 cost-sharing will be required of all states that receive federal monies for earthquake mitigation planning. The State of California voluntarily elected to cost-share in the 1988 fiscal year.

Obtain further details from the Congressional Record-House, February 16, 1988, pp. H 305-308, or by contacting Jane Bullock, FEMA, Natural and Technological Hazards, 500 C Street, S.W., Washington, D.C. 20472, (202) 646-2000.

- From Natural Hazards Observer

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## STANFORD AND USGS JOIN FORCES

A new research center has been established at Stanford University. This center, named the STANFORD/USGS CENTER FOR RESEARCH IN EARTHQUAKE ENGINEERING AND SEISMOLOGY, will function in cooperation with the John A. Blume Earthquake Engineering Center and will be a focal point for interdisciplinary research that takes advantage of the combined expertise existing at the USGS and Stanford University. The center will provide an interface opportunity for earthquake scientists and earthquake engineers to effectively approach the earthquake hazards mitigation problem together.

The center was inaugurated on June 21, 1988. It is located at Stanford University, in the same building as the Blume Center. For information on the goals and objectives of this center, contact Helmut Krawinkler, Professor of Civil Engineering at Stanford, or Thomas Hands, Chief of the Branch of Engineering Seismology and Geology at USGS Menlo Park.

- From EERI Newsletter

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## INVESTIGATORS FOR LIFELINE EARTHQUAKE DAMAGE SOUGHT

Reprinted from EERI Newsletter

Individuals who would be interested in evaluating the performance of lifelines after a damaging earthquake are sought. A training course will be given to qualify investigators in early November 1988. The need for and history of earthquake investigations is described below. The objectives of the workshop are then described followed by a description of the tasks that might be involved in conducting an earthquake investigation.

Investigation of damage and system response after earthquakes has been one of the primary methods of improving building codes, seismic design of equipment, and system response to damaging earthquakes. Lifeline systems include power, communication, water, sewage, transportation and liquid and gaseous fuels systems. The investigation of lifeline systems poses special problems. Lifeline equipment and structures are often highly specialized and lifelines are highly interdependent. The effect of damage has to be evaluated in terms of how it impacts system response.

After the Alaskan earthquake of 1964 the National Research Council (NCR), National Academy of Sciences began investigating earthquakes and other natural disasters. Since 1971, the Earthquake Engineering Research Institute (EERI) has also sent reconnaissance teams to evaluate the impact of significant earthquakes throughout the world. In recent years, the Earthquake Investigations Committee, Technical Council of Lifeline Earthquake Engineering, ASCE, has provided an investigator to EERI and NRC reconnaissance teams to investigate lifeline damage. Over the years, teams have investigated earthquakes in Japan, Mexico, Chile, Italy and many other countries as well as numerous U.S. earthquakes.

Early investigations emphasized the documentation of damage. Recently, increased emphasis has been placed on determining the causes of damage and its impact. This expanded scope has put an impossible burden on the lifeline investigator. The individual would have to investigate each of the lifelines mentioned above. For each lifeline he would have to be familiar with the equipment, facilities, and the operation of the system.

To improve post-earthquake investigations of lifelines, more investigators are needed to gather information and each investigator must have broader knowledge on each of the lifelines. In addition, investigators must be familiar with past earthquake damage in order to identify and evaluate types of damage not previously observed.

To meet the need for more and better trained investigators, the Earthquake Investigations Committee will conduct a

workshop to train investigators. The committee is seeking individuals who have some experience in one of the lifelines listed above. A one-day workshop will be held on the West Coast in early November. There will be a registration fee of about $135 to cover the cost of the workshop. It is anticipated that participants will become members of the Earthquake Investigations Committee. Additional training will be provided at annual meetings of the committee. Workshop participants and investigators need not be members of ASCE.

The demands on an investigator are highly dependent on the earthquake and its location. Investigations within the U.S. may take two or three days, while those in foreign countries typically require about a week in the field. Individuals would have to be able to travel on short notice. Upon returning, a detailed report and a paper for a publication would have to be prepared describing observations. In addition, some individuals may be requested to make a presentation at a briefing session. The costs associated with the investigation such as transportation, food and lodging will have to be borne primarily by the individual or his employer. It should be noted that while no previous investigator has ever been seriously injured, there are risks, and sometimes some inconvenience in going to an area that has just had a damaging earthquake.

All investigators with whom the author has spoken have said that the earthquake investigation experience was professionally valuable to them and their employers, as well as personally rewarding.

If you are interested in participating in the workshop and becoming an investigator, please contact Anshel J. Schiff, Dept. of Civil Engineering, Stanford University, Stanford, CA 94305, (415) 941-9233.

## HOT NEWS FLASH!!

## EARTHQUAKE IN CENTRAL UTAH

On August 14, 1988, a magnitude 5.4 earthquake rocked central Utah. Seismologists at the University of Utah reported that the main shock occurred at 2:03 pm and was centered in Castle Valley about eight miles southeast of Castledale in Emery County at 39° 07.22' N lat., 110° 49.55' W long. (Chalk Hills area (NW corner) of Sids Mountain Quadrangle, NW 1/4 SE 1/4 SW 1/4 sec. 32, T. 19 S., R. 10 E.), at a depth of 18.7 km. The slip was oblique, predominatly strike-slip with nodal planes as follows:

I. N. 43° E., dip 72° SE, 31° rake, plunging NE, left-lateral movement.
II. N 36° W, dip 61° SW, -160° rake, plunging NW, right-lateral movement.

Two foreshocks preceded the main shock, one of $M_L$ 3.5 at 12:59 pm and another of $M_L$ 4.3 at 1:08 pm.

Initial reports indicated little damage, although material was knocked off shelves and some damage to chimneys occurred in Huntington and Castledale. The principal effect of the earthquake was to generate hundreds of rockfalls along the many cliffs in the area, kicking up clouds of dust but luckily doing little damage. A more complete discussion of the earthquake will be included in the next issue of the Wasatch Front Forum.

# UTAH EARTHQUAKE ACTIVITY

James C. Pechmann

UNIVERSITY OF UTAH SEISMOGRAPH STATIONS, DEPARTMENT OF GEOLOGY AND GEOPHYSICS

## *January through March 1988*

Figure 1 shows the epicenters of 157 earthquakes located by the University of Utah Seismograph Stations within the Utah region during the three-month period January through March 31, 1988. The seismicity sample includes 51 earthquakes of magnitude 2.0 and greater and two earthquakes of magnitude 3.0 and greater.

The largest earthquake during the report period, and the only one reported felt, had a local magnitude ($M_L$) of 3.5 and occurred on January 2 on the southern border of Utah, 30 km west of Kanab. This earthquake was felt at Rockville, Springdale, and Virgin, Utah, and at Fredonia, Arizona.

Clusters of earthquakes occurred at five localities labeled on the map:

(1) a cluster of 10 aftershocks (coda magnitude ($M_C$) $\leq$ 1.6) of an $M_L$ 2.7 earthquake that occurred near the Utah-Idaho border on December 11, 1987;

(2) 72 aftershocks ($M_L \leq$ 3.1) of the 1987 Lakeside earthquake sequence west of the Great Salt Lake, which included 8 shocks of $M_l$ 3.8 to 4.8 during September and October of 1987;

(3) 26 seismic events of $M_C \leq 2.5$ located 40 km southwest of Price in an area of active underground coal mining;

(4) a swarm of 7 earthquakes of $M_L \leq 2.5$ that occurred 50 km south of Price between Janauary 14 and 20; and

(5) seven earthquakes ($M_C \leq$ 1.7) 40 km west of Richfield, representing a continuation of small magnitude activity that began in this area in December 1987.

## *April through June 1988*

During the three-month period April 1 through June 30, 1988, the University of Utah Seismograph Stations located 87 earthquakes within the Utah region (see figure 2). Of these earthquakes, 32 had a local magnitude ($M_L$) or coda magnitude ($M_C$) of 2.0 or greater, four had a magnitude of 3.0 or greater, and one was reported felt.

Aftershock activity from the 1987 Lakeside sequence west of the Great Salt Lake ($M_L$ 4.8; location L on map) has now decreased to a very low level. Only two aftershocks—one of $M_C$ 1.5 on May 6 and one of $M_C$ 2.0 on June 14—were located in the Lakeside area during the report period. For comparison, 72 aftershocks, including 10 of magnitude 2.0 or greater, were located in the Lakeside area during the first three months of 1988. Only the comparison of the numbers of magnitude 2.0 or greater aftershocks can be considered reliable because the earthquake detection and location capability of the network in the Lakeside area deteriorated after late March. This deterioration was due to intermittent failures of the four temporary stations installed in this area in October 1987 to supplement the coverage of the permanent network stations. Aftershocks of magnitude 2.0 and greater in the Lakeside area can be readily detected and located using only the permanent network stations, although the locations are much less accurate without the local station coverage.

The two largest earthquakes during the report period occurred twelve minutes apart on May 22, but 350 km away from each other. The first was an $M_L$ 3.6 event that occurred 10 km west of the Utah-Nevada border at 1:10 PM MDT. The second was an $M_C$ 3.8 earthquake at 1:22 PM MDT, located 10 km south of the Utah-Arizona border and 45 km WSW of Kanab. The other two earthquakes of magnitude 3.0 or greater were an $M_L$ 3.3 event north of the Great Salt Lake on May 11 and an $M_C$ 3.0 earthquake 45 km SW of Price on May 4. The earthquake southwest of Price was the largest of 11 earthquakes that occurred in this area during the report period. An earthquake of $M_C$ on June 13, located 10 km SE of Richfield, was reported felt in Richfield.

Additional information on earthquakes within Utah is available from the University of Utah Seismograph Stations, Salt Lake City, Utah 84112; telephone (801) 581-6274.

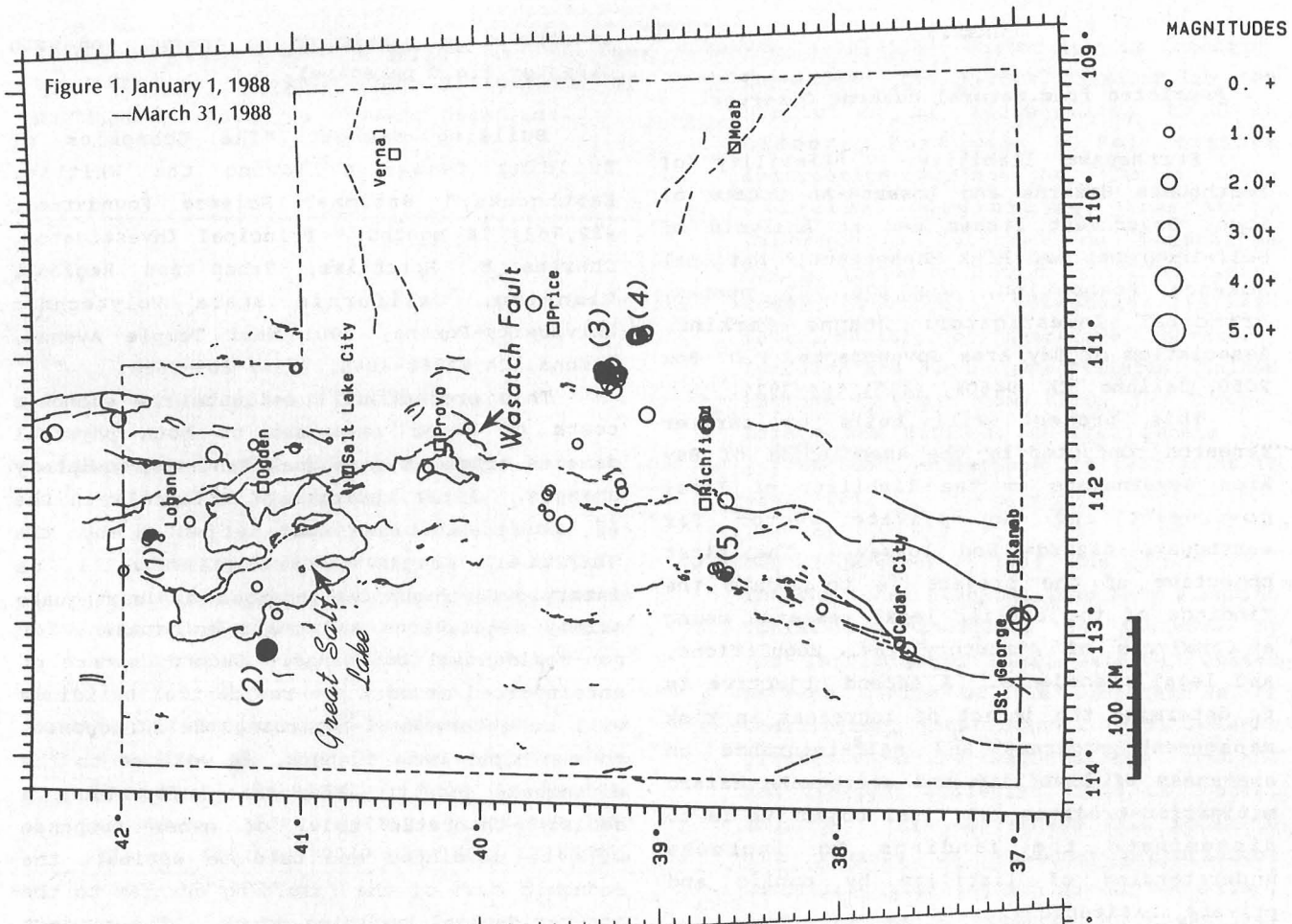


Figure 1. January 1, 1988 —March 31, 1988

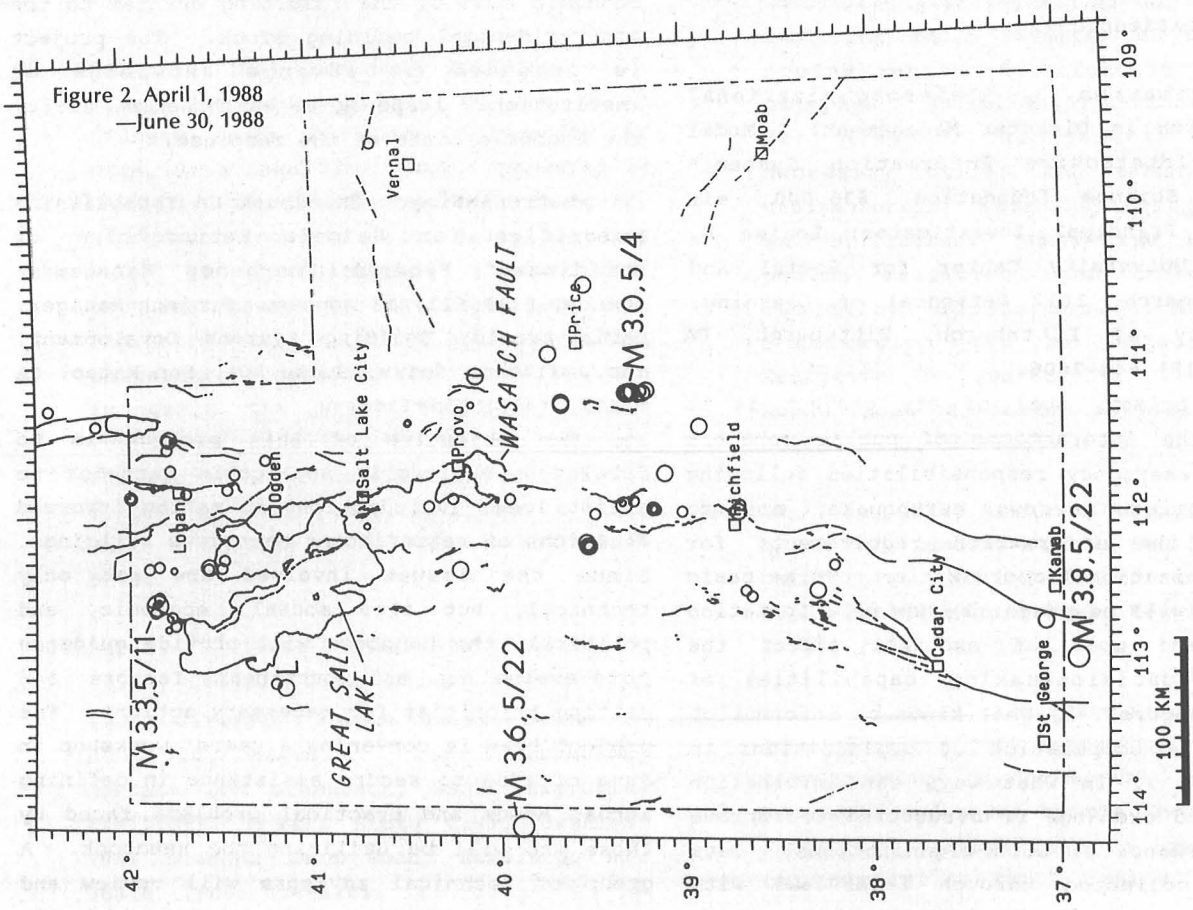


Figure 2. April 1, 1988 —June 30, 1988

## GRANTS

Reprinted from Natural Hazards Observer

Earthquake liability. "Liability of Earthquake Hazards and Losses--An Update of Local Government Issues and an Analysis of Self-insurance and Risk Management," National Science Foundation, $111,070, 15 months. Principal Investigator: Jeanne Perkins, Association of Bay Area Governments, P.O. Box 2050, Oakland, CA 94604, (415) 464-7934.

This project will build on earlier research conducted by the Association of Bay Area Governments on the liability of local government and the private sector for earthquake hazards and losses. The first objective of the project is to update the findings of the earlier legal research using an analysis of statutory law, regulations, and legal precedents. A second objective is to determine the impact of increases in risk management programs and self-insurance on awareness of liability and earthquake hazard mitigation programs. A final objective is to disseminate the findings to increase understanding of liability by public and private institutions.

Information. "Interorganizational Coordination in Disaster Management: A Model for an Interactive Information System," National Science Foundation, $30,000, six months. Principal Investigator: Louise K. Comfort, University Center for Social and Urban Research, 1617 Cathedral of Learning, University of Pittsburgh, Pittsburgh, PA 15260, (412) 648-7606.

The primary goal of the project is to analyze the interactions of public managers that had emergency responsibilities following the Whittier Narrows earthquake, and to identify the information requirements for interorganizational coordination. Three basic questions will be posed: 1) How do information content and mode of exchange affect the disaster decision-making capabilities of public managers? 2) What kinds of information improve the cooperation of organizations in disaster? 3) In what ways can information content and exchange be structured to improve the performance of such organizations? Data will be collected through interviews with managers in various jurisdictions, with executives of participating groups, and with disaster field personnel.

Building damage. "The Economics of Building Damage Following the Whittier Earthquake," National Science Foundation, #22,762, 18 months. Principal Investigator: Charles M. Hotchkiss, Urban and Regional Planning, California State Polytechnic University-Pomona, 3801 West Temple Avenue, Pomona, CA 91768-4048, (714) 869-2688.

This project will estimate the economic costs of owner responses to both physical damages after an earthquake and to regulatory changes. First, government officials in the 17 municipalities most affected by the Whittier Narrows earthquake will be interviewed regarding changes in earthquake safety regulations and their enforcement for non-residential buildings. Second, owners of unreinforced masonry non-residential buildings will be interviewed regarding their responses to municipal code changes, as well as to the earthquake itself. From that information, a decision-theoretic model of owner response will be developed and used to estimate the economic cost of the resulting changes to the non-residential building stock. The project is intended to advance knowledge of institutional response to earthquakes, and of the economic costs of the response.

Retrofitting. "Handbook on Establishing Priorities for Seismic Retrofitting of Buildings," Federal Emergency Management Agency, $119,621, 18 months. Project Manager: Chris Arnold, Building Systems Development, Inc., 3130 La Selva, Suite 308, San Mateo, CA 94403, (415) 574-4146.

The objective of this project is to develop a nationally applicable handbook to assist local jurisdictions in making informed decisions on retrofitting hazardous buildings. Since the issues involved are not only technical, but also social, economic, and political, the handbook will provide guidance for evaluating all pertinent factors and setting priorities for necessary actions. The project team is convening a users' workshop in June of 1988 to secure assistance in defining actual needs and practical problems faced by those who will be utilizing the handbook. A group of technical advisors will review and revise the handbook before it is published.

This project is one of a series underwritten by FEMA to improve the mitigation of earthquake hazards in existing buildings.

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MEETINGS AND CONFERENCES

October 16-21, 1988, Association of Engineering Geologists Annual Meeting, held in Kansas City, Missouri. For information contact Thomas J. McClain, Technical Program Chairman, Kansas Geological Survey, 1930 Constant Avenue, Lawrence, KS 66046, (913) 864-3965.

October 31-November 3, 1988, Geological Society of America Annual Meeting, Centennial Celebration held in Denver, Colorado. For information contact Jean Kinney, GSA, Box 9140, Boulder, CO 80301, (303) 447-2020.

November 9-10, 1988, The NEHRP Building Provisions Course, held at the Olpin Student Union Building, University of Utah, Salt Lake City, Utah, sponsored by Utah Division of Comprehensive Emergency Management and FEMA. Dr. Larry Reaveley will be coordinating this (free) technical course for structural and civil engineers and building and permitting inspectors, designed to show how to integrate the NEHRP Building Seismic Provisions into Utah's UBC3 Guidelines. For registration information contact Jim Tingey at CEM, 1543 Sunnyside Avenue, Salt Lake City, UT, 84108, (801) 533-5271.

November 14-18, 1988, Western States Seismic Policy Council 1988 Annual Conference at the Outrigger Prince Kuhio Hotel in Honolulu, Hawaii. For information, contact Don Gransback, WSSPC Executive Assistant, Hawaii State Civil Defense, 3949 Diamond Head Road, Honolulu, HI, 96816, (808) 734-2161.

November 14-18, 1988, United Nations Economic Commission for Europe, Seminar on the Prediction of Earthquakes, held in Lisbon, Portugal. For further information contact Dr. Carlos Sousa Oliveira, Organizing Committee, Laboratorio National de Engenharia Civil, Avenue do Brasil 101, 1799 Lisboa Codex, Portugal, telephone (351)-1-882131/888161, or Executive Secretary, Industry and Technology Division, United Nations Economic Commission for Europe, Palais des Nations, CH-1211 Geneva 10, Switzerland, telephone (41)-22-34.60.11 ext. 3174.

November 28-December 2, 1988, The Fourth International Biennial Emergency Planning Conference, "Emergency '88" sponsored by the Institute of Civil Defense, United Nations Office of the Disaster Relief Coordinator, International Civil Defense Organization, and League of Red Cross and Red Crescent Societies, held in London, England. This confernece will focus on all aspects of disaster preparedness education, training and public education, including media coverage of disasters, professional education in disaster management, establishing national centers for disaster management training, necessary skills and techniques for professionals, educating the public in self-sufficiency, using the media for public education, and other public education approaches. Additional information can be obtained from Emergency '88 Secretariat, 72 Fielding Road, Chiswick, London W4 1DB, England, telephone 01-995-8356.

December 7-11, 1988, American Geophysical Union fall meeting held in San Francisco, California. For information contact AGU, 2000 Florida Avenue, N.W., Washington, DC 20009, (202) 462-6903.

December 15-17, 1988, Annenberg School of Communications 1988 Symposium on Science Communication: Environmental and Health Research, sponsored by the Environmental Protection Agency, held in Los Angeles, California. Four topics will be

emphasized: communicating scientific information within the scientific community; communicating scientific information to engineers, technologists, and practitioners; communicating scientific information within and across governmental units, including federal, state, and local agencies; and communicating scientific information to the mass media and thus to the public. Prospective papers should be submitted by October 15, 1988 to Everett M. Rogers, Annenberg School of Communication, University of Southern California, 3502 South Hoover Street, University Park, Los Angeles, CA 90089-0281, (213) 743-7416.

January 31 - February 1, 1989 (tentative), Annual Wasatch Front Earthquake Hazards Reduction Program Meeting sponsored by USGS, FEMA, Utah Geological and Mineral Survey, and the Utah Division of Comprehensive Emergency Management, held at the University Park Hotel in Salt Lake City, Utah. Watch upcoming issues of the Forum for details but reserve the dates now.

March 13-17, 1989, Third short course on soil dynamics and foundation engineering, conducted by the Department of Civil Engineering, University of Missouri-Rolla, in San Francisco, California. Dynamic loads due to earthquakes and other sources pose a serious hazard for structures and foundations. Understanding dynamic behavior of foundations and soils is of great importance in developing earthquake-resistant design of foundation systems. In this course, dynamic soil-structure interaction, retaining structures, mat and pile foundations, liquefaction of soils, earth dam stability, and selection of design soil parameters will be covered. Emphasis will be placed on behavior and design of structures. Workshop sessions will be devoted to problem solving both with computers and by manual methods. For more information contact Shamsher Prakash, Course Director, Third Short Course on Soil Dynamics and Foundations Engineering, 308 Civil Engineering, Rolla, MO 65401.

April 19-21, 1989, Seismological Society of America Annual Meeting at the Victoria Conference Center in Victoria, British Columbia, Canada. For more information, contact SSA Office, 201 Plaza Professional Building, El Cerrito, CA, 94530, (415) 525-5474 OR Dr. Garry C. Rogers, Geological Survey of Canada, Pacific Geoscience Center, P.O. Box 6000, Sidney, B.C., Canada, V8L 4B2, (604) 356-6500.

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.

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.

October 21-24, 1989, Soil Dynamics and Earthquake Engineering IV, held in Mexico City, Mexico.

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. Further details available later in 1988.

## RECENT PUBLICATIONS

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Arya, A.S., 1987, Protection of educational buildings against earthquakes, UNESCO Educational Building Report 13, $5.00 plus $2.50 postage and handling. Order stock no. UB246 from UNIPUB, 4611 F Assembly Drive, Lanham, MD, 20706-4391, 800-233-0506.

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Charles C. Thomas, Publisher, 2600 South First Street,
Springfield, IL, 62794-9265, (217) 789-8980.

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