# APPENDIX A

## SUMMARIES OF THE BSSC MEETINGS IN CHARLESTON, MEMPHIS, ST. LOUIS, AND SEATTLE

It was noted that many persons in Charleston believe there will eventually be another serious seismic event but do not have any understanding of what it would do. It also was noted that when adopting improved seismic requirements, one must make sure that the average person does not assume that the use of a building code incorporating seismic considerations will eliminate all damage. It must be emphasized that codes only provide for "minimums" and that their purpose is life safety; seismic code requirements generally are aimed at saving occupants by preventing major structural collapse but are not intended to eliminate property damage.

It was stated that often new construction and even renovation work is done by speculative developers who have no lasting association with the buildings and that buyers therefore must be taught what questions to ask about building seismic safety. Further, many building officials need to be made aware of the seismic hazard, especially since many of them do not have engineering training.

It was explained that prior to 1981, even though the county had adopted the Standard Building Code, which includes seismic provisions for new buildings, enforcement was spotty. Since that time, an ordinance ordering their enforcement has been passed. It was noted, however, that because of the historical nature of much of Charleston, replacement of the existing building stock with new and, hence, seismic-resistant structures will occur quite slowly--that is, while a complete turnover of buildings could be expected to occur in about 100 years in most cities, it will probably take about 300 years in Charleston. It was also noted that some contractors prefer not to work in Charleston or in the county but that is simply because it is cheaper to work in nearby areas where there are no codes at all, not because of the seismic requirements of the city and county. Costs were also discussed to some extent and the need for cost-benefit analyses was mentioned.

Considerable discussion focused on the South Carolina Seismic Safety Consortium headquartered at The Citadel. This organization involves 120 representatives from a variety of professions and interest groups; members come from Virginia, North Carolina, and Georgia as well as South Carolina. It was described as a grass roots but coordinated approach to action. The major activities of the consortium involve digesting available information, data and technology and repackaging it in different forms for various audiences (e.g., building community professionals and homeowners). It was noted that the consortium's work has highlighted the need for technical information, vulnerability analyses, and technology transfer. The consortium believes it has three main audiences

Currently in force in the city of Charleston is the 1982 Standard Building Code (SBC). Although the SBC incorporate ANSI A58.1-1972 for seismic design if required by local building authorities, at the time of the BSSC trial design effort, the city of Charleston building authority recommended that the more recent ANSI A58.1-1982 be used for its seismic requirements.

to consider when preparing educational information: the general public, the building official, and the architects and engineers. It was further noted that the professional community shares in the responsibility to make the public aware.

With respect to the impact of new or improved seismic provisions on regulatory practices, it was stated that the critical stage is design review. Since inspectors only determine if things are being constructed in accordance with plans and specifications, they would require little if any specialized training. If that is not the case, it is up to the building official to take action. In fact, it was suggested that the building officials ought to take someone found to be in violation of the code to court every now and then just to keep everyone on their toes.

Many questions arose about costs, some focusing on those related to actions providing for more than structural integrity. The tentative nature and form of the cost data presented at this meeting led the participants to conclude that the projections of cost derived from the trial designs probably represented minimums. The participants also indicated that they would like to have cost-benefit data as well as comparative data concerning what seismic protection would cost in comparison with protection from other hazards. Some wondered just how much a building owner would be willing to invest in seismic protection when there do not appear to be any financial incentives like those provided by the insurance industry for fire protection. The subject of whether it is a lessening of property damage or life safety that the insurance industry is trying to stimulate was discussed.

Some believed that the NEHRP Recommended Provisions are designed to address the worst case and frequent problem areas like those in California. It was suggested that in areas like those in the East where earthquakes are possible but not probable, use of the NEHRP Recommended Provisions would tend to overprotect low-density areas and underprotect high-density ones.

A discussion of the model codes led one participant to maintain that the best way to implement the NEHRP Recommended Provisions would be to get them incorporated in the model codes. It was noted that local government probably will not act without strong pressure from somewhere and that consensus by the building community is a necessary first step.

The lack of public awareness of the earthquake threat in Memphis was discussed at length. It was stated that even most Memphis building professionals believe the likelihood of life loss due to earthquake is remote. Since the community has limited resources and wants to attract new industry to provide more jobs and a bigger tax base, it is feared that any increase in building costs would prompt businesses to go somewhere cheaper. It also is feared that many economically marginal buildings simply would not be built at all if higher rents would have to be charged.

It was noted that some Memphis buildings are being designed with seismic protection that not required by the local code and that this shows that at least some people recognize the risk and are willing to pay for protection. It also was stated that lenders sometimes require seismic resistant design and that the expanding use of computers and other sensitive electronic equipment may attract tenants to protected buildings and permit premium rents to be charged. (Such determinations, however, are difficult to make in that one does not know whether it is the seismic protection or just the prestige of a new building that is attracting tenants.)

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Currently in force in the city of Memphis and in Shelby County is the Standard Building Code (SBC), 1982, with adopted revisions (which include no seismic requirements) and with seismic design requirements excluded.

There was considerable discussion of the negligence/liability issue. It was explained that since a body of scientific knowledge regarding the earthquake threat is available, earthquakes can no longer be considered "acts of God." When the technical literature shows that there is a risk, a building owner or developer or even a regulatory or other community agency might well be considered negligent if an earthquake occurs and fatalities result, even if there is no building code requirement for seismic protection. The issue might be further complicated if some buildings in a community are designed to be seismic resistant. It was noted that this precedent has not yet been tested in court specifically concerning earthquakes but that it has for other natural phenomena.

Great concern was expressed that enactment of seismic provisions for new buildings would necessitate something being done for some existing buildings, particularly schools and other critical or high-occupancy buildings, and that the cost of such retrofit would be extremely high. It also was noted that problems could arise if the general public became overly sensitive to the earthquake hazard. Information about experiences in other places with similar risks was requested.

Some maintained that the life safety issue is of paramount importance and that studies show that many more people would be injured or killed if an earthquake occurred during the day rather than at night. It was noted, however, that few lives have been lost due to earthquakes in the United States during the past 100 years and that people therefore are unaware of or ignore the potential risk, deeming it to be of little significance to them. In addition, although one can speculate about what the damage would be from specific seismic events, no one knows for sure what will happen and this uncertainty contributes to apathy.

With respect to enforcement of seismic code provisions, it was noted that considerable training of building inspectors and probably additional inspectors would be required. One alternative might be to have the designer provide for the inspection.

Questions arose concerning the existing degree of seismic risk actually present and the probabilities of a major seismic event over time. Questions also focused on the sorts of effects to be expected from various degrees of shaking since the geology of the eastern United States is different from that of the West.

Considerable attention was paid to the architectural or nonstructural damage that might occur and whether the NEHRP Recommended Provisions would eliminate such damage in the future. Similarly, concern was expressed about the possibility of fire damage and whether it might not cause far more damage and deaths than structural collapse. Further, many were concerned about the "interface" area and whether necessary critical facilities would be operational after a seismic event even if they did not collapse.

Another major concern was that providing seismic-resistant structures would increase the average building cost and, therefore, a jurisdiction enforcing seismic provisions would be at a disadvantage relative to neighboring jurisdictions that did not enforce seismic provisions. Any resulting increase in rents was deemed to be of special importance since it might well reduce the market and result in a loss of rental income to the owner, tax revenue, and jobs.

Much discussion was focused on public awareness of seismic risk. It was generally believed that awareness is developing among St. Louis building community professionals and, to a limited extent, among the general public. All seemed to believe that what is needed is awareness without alarm and that the public must be made aware that it is not now protected. Many seemed to think that public officials were not convinced that there is a risk. It also was noted that the adoption of seismic provisions for new construction would raise questions concerning retrofit of existing structures; the retrofit issue poses special problems because of the relatively high costs and great number of buildings thought to be involved. Some maintained that clear cost-benefit data are of major importance, but others felt that the economics are somewhat irrelevant since public safety must be guaranteed whatever the cost.

The question of liability also arose. The discussion reflected the fact that it is difficult to reach agreement on how much one is obligated to do. It was pointed out that most large industrial organizations concern themselves with seismic design because they do not want to experience either a shutdown or life loss but that the speculative developer is concerned only about his market and, hence, would resist anything that would increase costs. Many seemed to believe that public officials need to be made aware that the courts most likely would hold them just as liable as a building designer or owner if an earthquake occurred and lives were lost.

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Currently in force in St. Louis is the Building Officials and Code Administrator's (BOCA) Basic Building Code with no enforcement of seismic requirements.

Economic incentives to promote seismic design were deemed to be needed. Many thought that the insurance industry should encourage seismic safety the way it does fire safety. Concern by mortgage bankers also was considered important.

The discussion revealed that because Seattle already has seismic provisions in its code, there probably would be little enthusiasm for changing to incorporate the NEHRP Recommended Provisions. In addition, it was noted that any current concern about seismic regulations in Seattle is related to existing construction and enforcement.

With respect to costs, the participants warned those in communities without seismic provisions about several points: (1) incredibly erroneous statements are made about how much seismic protection increases costs, (2) the speculative developer will resist any increase in costs and will be as shortsighted as the buyer will permit him to be, and (3) sometimes a small design change can cost a lot. One participant asked if there were any data available on life-cycle costs for buildings with seismic protection that might reveal secondary benefits and another wondered whether the structure's useful life would be extended.

The fact that some financial institutions are requiring seismic design and insurance was mentioned. Questions arose about whether the insurance industry really recognizes the benefits of seismic protection and whether seismic protection is acknowledged in company rate structures. If so, it was thought that this would be an economic incentive for owners.

Much of the discussion focused on the importance of awareness and education. It was noted that even government officials, scientists, and building community professionals lack a clear awareness of the problem. It was mentioned that the general knowledge many have of the California earthquake situation presents a problem because people assume there is no risk in their area because there is no obvious active fault zone like the San Andreas.

It was stated that public officials and community decision-makers must understand the problem if they are to be able to respond effectively to their constituents once awareness develops. With respect to the general public, they must be made aware of the seismic hazard, but in ways that suggest that there is something they can do about the it.

In a community with no seismic-resistant building requirements, no one group can hope to stimulate action; all sectors of the community must be involved. It also was maintained that the building professionals in such communities must have the tools they need to provide appropriate seismic designs and that there must be a close relationship with the code enforcement agency. In addition, it was noted that the regulatory agency must have enough trained people to provide for review of designs and to ensure enforcement of any seismic provisions adopted.

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Currently in force in Seattle is the Uniform Building Code, 1979, including seismic requirements.

# APPENDIX B

# GLOSSARY

## INTRODUCTION

An important aspect of dealing with community seismic safety involves making sure that everyone "speaks the same language." If the community at large is to gain any real understanding of complex seismic issues, all of the persons involved in seismic safety activities need to understand and use the commonly accepted definitions for important terms.

## GENERAL TERMS

The following definitions are from a 1984 U. S. Geological Survey Open-File Report (84-762), A Workshop on "Earthquake Hazards in the Virgin Islands Region", (Reston, Virginia: USGS):

> Acceptable Risk - a probability of social or economic consequences due to earthquakes that is low enough (for example in comparison with other natural or manmade risks) to be judged by appropriate authorities to represent a realistic basis for determining design requirements for engineered structures, or for taking certain social or economic actions.
>
> Damage - any economic loss or destruction caused by earthquakes.
>
> Design Earthquake - a specification of the seismic ground motion at a site; used for the earthquake-resistant design of a structure.
>
> Design Event, Design Seismic Event - a specification of one or more earthquake source parameters, and of the location of energy release with respect to the site of interest; used for the earthquake-resistant design of a structure.
>
> Earthquake - a sudden motion or vibration in the earth caused by the abrupt release of energy in the earth's lithosphere. The wave motion may range from violent at some locations to imperceptible at others.
>
> Elements at Risk - population, properties, economic activities, including public services etc., at risk in a given area.
>
> Exceedence Probability - the probability that a specified level of ground motion or specified social or economic consequences of earthquakes, will be exceeded at the site or in a region during a specified exposure time.
>
> Exposure - the potential economic loss to all or certain subset of structures as a result of one or more earthquakes in an area. This term usually refers to the insured value of structures carried by one or more insurers. See "Value at Risk."

Intensity - a qualitative or quantitative measure of the severity of seismic ground motion at a specific site (e.g., Modified Mercalli intensity, Rossi-Forel intensity, Housner Spectral intensity, Arias intensity, peak acceleration, etc.).

Loss - any adverse economic or social consequence caused by one or more earthquakes.

Seismic Event - the abrupt release of energy in the earth's lithosphere, causing an earthquake.

Seismic Hazard - any physical phenomenon (e.g., ground shaking, ground failure) associated with an earthquake that may produce adverse effects on human activities.

Seismic Risk - the probability that social or economic consequences of earthquakes will equal or exceed specified values at a site, at several sites, or in an area, during a specified exposure time.

Seismic Zone - a generally large area within which seismic-design requirements for structures are constant.

Value at Risk - the potential economic loss (whether insured or not) to all or certain subset of structures as a result of one or more earthquakes in an area. See "Exposure."

Vulnerability - the degree of loss to a given element at risk, or set of such elements, resulting from an earthquake of a given magnitude or intensity, which is usually expressed on a scale from 0 (no damage) to 10 (total loss).

The following excerpt from the 1983 National Research Council report, Multiple Hazard Mitigation (Washington, D.C.: National Academy Press), defines several other terms that sometimes cause confusion in discussions of seismic safety:

> ... The level of intensity or severity that is capable of causing damage depends upon the vulnerability of the exposed community; vulnerability is generally a function of the way in which structures are designed, built, and protected, and the vulnerability of a structure or community to a particular natural event is a measure of the damage likely to be sustained should the event occur. The degree to which a community is prone to a particular natural hazard depends on risk, exposure, and vulnerability. When a natural hazard occurrence significantly exceeds the community's capacity to cope with it, or causes a large number of deaths and injuries or significant economic loss, it is called a disaster.
>
> Hazard management includes the full range of organized actions undertaken by public and private organizations in anticipation of and in response to hazards. Hazard management has two primary (but not completely distinct) components: emergency

management, typified by the police, fire, rescue, and welfare work carried on during a disaster; the advance planning and training that are necessary if emergency operations are to be carried out successfully; and the post-disaster recovery period in which damage is repaired; and mitigation, which focuses on planning, engineering design, economic measures, education, and information dissemination, all carried out for the purpose of reducing the long-term losses associated with a particular hazard or set of hazards in a particular location.

## MEASURES OF EARTHQUAKE MAGNITUDE AND INTENSITY

The following excerpt from the 1976 thesis, Seismic Design of a High-Rise Building, prepared by Jonathan Barnett and John Canatsoulis in partial fulfillment of the requirements for the degree of Master of Science at the Worcester Polytechnic Institute explains the Richter magnitude scale and the modified Mercalli intensity scale:

> There are two important earthquake parameters of interest to the structural engineer. They are an earthquake's magnitude and its intensity. The intensity is the apparent effect of an earthquake as experienced at a specific location. The magnitude is the amount of energy released by the earthquake.
>
> The magnitude is the easiest of these two parameters to measure, as, unlike the intensity which can vary with location, the magnitude of a particular earthquake is a constant. The most widely used scale to measure magnitude is the Richter magnitude scale. Using this scale, the magnitude, measured in ergs, can be found from the equation $\text{Log } E = 11.4 + 1.5\ M$, where M is the Richter magnitude. This relationship was arrived at by an analysis of the amplitude of the traces of a standard seismograph located 100 kilometers from the epicenter of an earthquake and correlating this information with the radiated energy as determined through measurements of the waves released by the earthquake. The epicenter of an earthquake is the point on the surface of the earth directly over the focus. The focus (or hypocenter) is the point in the earth's crust at which the initial rupture (slippage of masses of rock over a fault) occurs. In use, the Richter scale represents an increase by a factor of 31.6 for each unit increase in the Richter magnitude. Thus, a Richter magnitude of 6 is 31.6 times larger than Richter magnitude 5....
>
> [A] problem with using the Richter magnitude is that it gives little indication of an earthquake's intensity. Two earthquakes of identical Richter magnitude may have widely different maximum intensities. Thus, even though an earthquake may have only one magnitude, it will have many different intensities.
>
> In the United States, intensity is measured according to the modified Mercalli index (MMI). In Europe, the most common

intensity scale is the Rossi-Forel scale while in Russia a modification of the Mercalli scale is used.

The following excerpt from Bruce A. Bolt's 1978 book, Earthquake: A Primer (San Francisco, California: W.H. Freeman and Company), describes the modified Mercalli intensity values (1956 version); masonry definitions from C. F. Richter's 1958 book, Elementary Seismology (San Francisco, California: W. H. Freeman Company), are inserted in brackets:

I. Not felt. Marginal and long-period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frames creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knicknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D [weak materials such as adobe, poor mortar, low standards of workmanship; weak horizontally] cracked. Small bells ring (church and school). Trees, bushes shaken visibly, or heard to rustle.

VII. Difficult to stand. Noticed by drivers. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices also unbraced parapets and architectural ornaments. Some cracks in masonry C [ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners but not reinforced or designed against horizontal forces]. Waves on ponds, water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of cars affected. Damage to masonry C; partial collapse. Some damage to masonry B [good workmanship and mortar; reinforced but not designed in detail to resist lateral forces]; none to masonry A [good workmanship, mortar, and design; reinforced, especially laterally; bound together by using steel, concrete, etc.; designed to resist lateral forces]. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. General damage to foundations. Frame structures, if not bolted down, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in the ground. In alluviated areas, sand and mud ejected, earthquake fountains and sand craters.

X. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown in the air.

## EARTHQUAKE OCCURRENCES

The following maps are included to give the reader some idea of where damaging earthquakes have occurred in the United States.

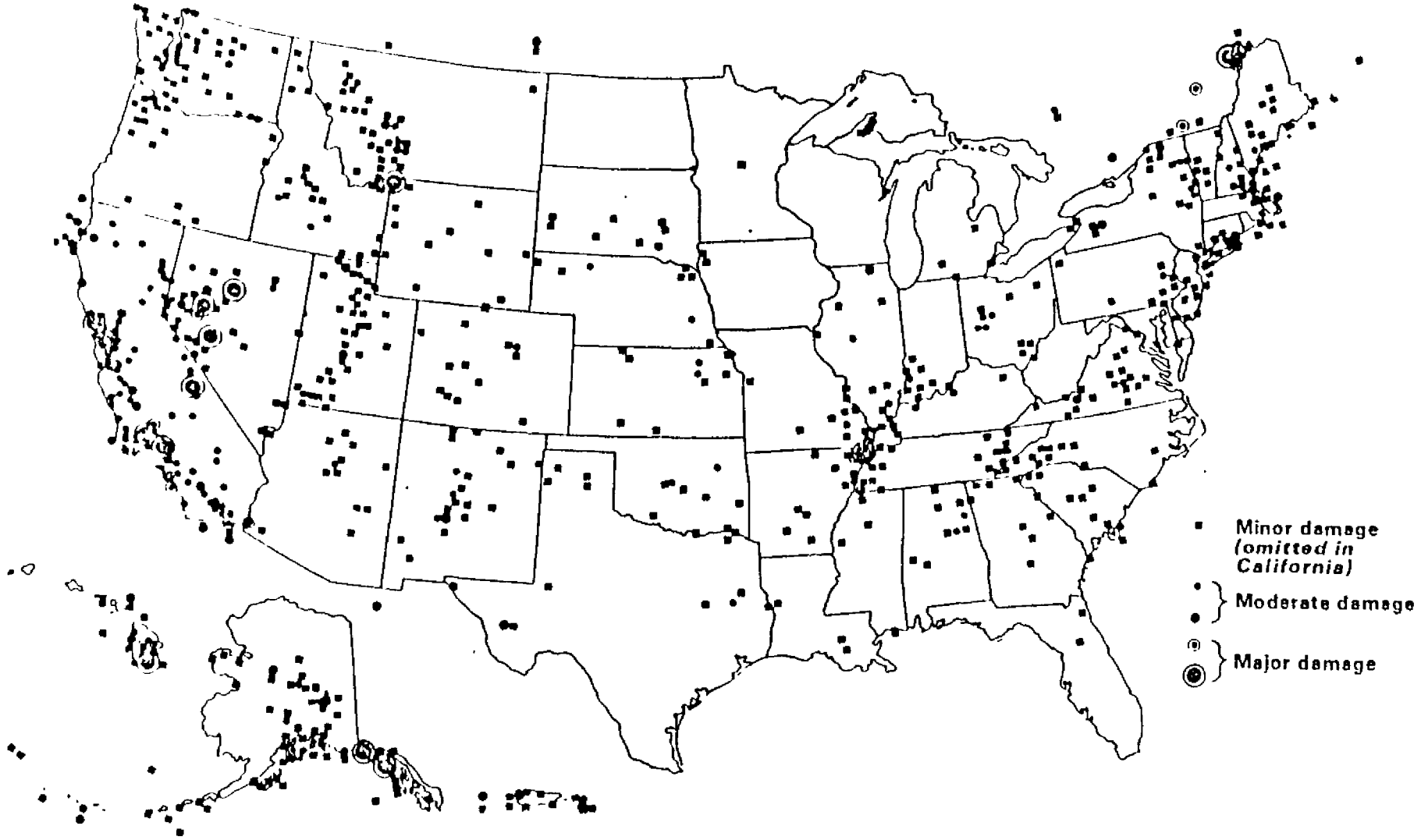


FIGURE 1 Location of damaging earthquakes in the United States. (Reproduced from Christopher Arnold's article "Quake Codes" in the spring 1984 issue of Architectural Technology.)

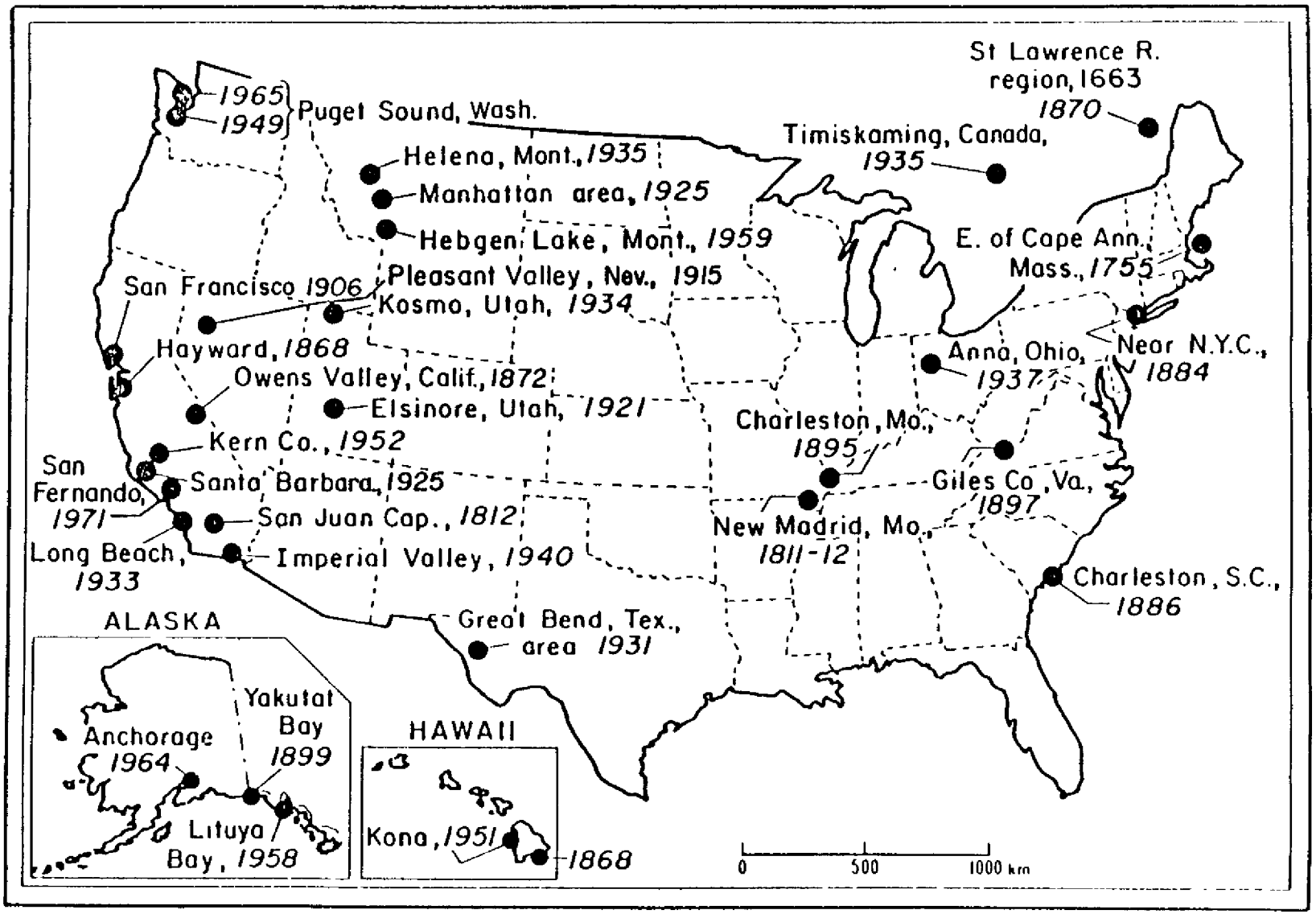


FIGURE 2 Notable damaging historic earthquakes in the United States. (Reproduced from Mary L. Schnell and Darrell G. Herd's 1984 report, National Earthquake Hazards Reduction Program: Overview (FY 1983), Report to Congress, USGS Circular 918, U.S. Geological Survey, Reston, Virginia.)

# APPENDIX C

# SEISMIC SAFETY INFORMATION SOURCES

## INTRODUCTION

This list is designed to identify potential sources of seismic safety information useful at the local level. Although the list is far from exhaustive, it does include many of the associations, organizations, and centers that provide various types of data ranging from relatively general information to specific technical guidance.

Since much information is best obtained at the local level, the reader is urged to contact local academic institutions and the local chapters of the various professional organizations.

## ORGANIZATIONS

**American Concrete Institute**
P.O. Box 19150
Detroit, Michigan 48219
(313)532-2600

**American Consulting Engineers Council**
1015 15th Street, N.W., Suite 802
Washington, D.C. 20005
(202)347-7474

**American Institute of Architects**
1735 New York Avenue, N.W.
Washington, D.C. 20006
(202)626-7300

**American Institute of Architects Foundation**
1735 New York Avenue, N.W.
Washington, D.C. 20006
(202)626-7421

**American Institute of Steel Construction**
400 North Michigan Avenue
Chicago, Illinois 60611
(312)670-2400

**American Insurance Association**
85 John Street
New York, New York 10038
(212)669-0400

**American Planning Association**
1313 East 60th Street
Chicago, Illinois 60637
(312)947-2082

**American Plywood Association**
7011 South 19th Street
Box 11700
Tacoma, Washington 98411-0700
(206)565-6600

**American Society of Civil Engineers**
345 East 47th Street
New York, New York 10017-2398
(212)705-7496

**American Red Cross, National Office of Disaster Assistance**
18th and E Streets, N.W.
Washington, D.C.
(202)857-3718

**Applied Technology Council**
2471 East Bayshore Road, Suite 512
Palo Alto, California 94303
(415)856-8925

**Arizona State University, Office of Hazard Studies**
Center for Public Affairs
Tempe, Arizona 85287
(602)965-4518

**Arkansas Earthquake Advisory Council**
Arkansas Geological Commission
3815 West Roosevelt
Little Rock, Arkansas 72204
(501)663-9714

**Associated General Contractors of America**
1957 E Street, N.W.
Washington, D.C. 20006
(202)393-2040

**Association of Bay Area Governments**
Metro Center
P.O. Box 2050
Oakland, California 94606
(415)464-7900

**Association of Engineering Geologists**
Box 506
Short Hills, New Jersey 07078
(201)379-7470

**Association of Major City Building Officials**
200 North Spring Street
Los Angeles, California 90012
(213)485-2021

**Association of the Wall and Ceiling Industries International**
25 K Street, N.E.
Washington, D.C. 20001
(202)783-2924

**Bay Area Regional Earthquake Preparedness Project**
Metro Center
1018th Street, Suite 152
Oakland, California 94607
(415)540-2713

**Bay Area Regional Earthquake Preparedness Project Policy Advisory Board**
Assistant Director, Institute of Governmental Studies
University of California
109 Moses Hall
Berkeley, California 94720
(415)642-6722

**Battelle Human Affairs Research Centers**
4000 N.E. 41st Street
Seattle, Washington 98105
(206)525-3130

**Brick Institute of America**
11490 Commerce Park Drive, Suite 300
Reston, Virginia 22091
(703)620-0010

**Building Officials and Code Administrators, International**
4051 West Flossmoor Road
Country Club Hills, Illinois 60477
(312)799-2300

**Building Owners and Managers Association, International**
1221 Massachusetts Avenue, N.W.
Washington, D.C. 20005
(202)638-2929

**Building Seismic Safety Council**
1015 15th Street, N.W., Suite 700
Washington, D.C. 20005
(202)347-5710

**Business and Industry Council for Earthquake Preparedness**
Director of Emergency Planning and Office Administration
Atlantic Richfield Company
515 South Flower Street
Los Angeles, California 90071
(213)486-2535

**California Seismic Safety Commission**
1900 K Street
Sacrament, California 95814
(916)322-4917

**Canadian National Committee on Earthquake Engineering**
National Research Council of Canada
Division of Building Research
Ottawa, Ontario K1A 0R6

**Central United States Earthquake Consortium**
2001 Industrial Park Drive
Box 367
Marion, Illinois 62959
(618)997-5659

**Concrete Masonry Association of California and Nevada**
83 Scripps Drive, Suite 303
Sacramento, California 95825
(916)920-4414

**Concrete Reinforcing Steel Institute**
933 North Plum Grove Road
Shaumburg, Illinois 60195
(312)490-1700

**Council of American Building Officials**
5205 Leesburg Pike, Suite 1201
Falls Church, Virginia 22041
(703)931-4533

**Earthquake Education Center**
Baptist College
P.O. Box 10087
Charleston, South Carolina 92411
(803)797-4208

**Earthquake Engineering Research Institute**
2620 Telegraph Avenue
Berkeley, California 94704
(415)848-0972

**Federal Emergency Management Agency, Division of Earthquakes and Natural Hazards Programs**
500 C Street, S.W.
Washington, D.C. 20472
(202)646-2797

**Governor's Earthquake and Safety Technical Advisory Panel**
Kentucky Division of Disaster and Emergency
EOC Building, Boone Center
Frankfort, Kentucky 40601
(502)564-8600

**Governor's Earthquake Emergency Task Force**
California Office of Emergency Services
2800 Meadowview Road
Sacramento, California 95832
(916)427-4285

**Illinois Earthquake Advisory Board**
Illinois Emergency Services and Disaster Agency
110 East Adams Street
Springfield, Illinois 62706
(217)782-4448

**Indiana Earthquake Advisory Panel**
Indiana Department of Civil Defense
B-90 State Office Building
100 North Senate
Indianapolis, Indiana 46204
(317)232-3834

**Insurance Information Institute**
110 Williams Street
New York, New York 10038
(212)669-9200

**Interagency Committee on Seismic Safety in Construction**
c/o Center for Building Technology
National Bureau of Standards
Gaithersburg, MD 20899
(301)921-3377

**International City Management Association**
1120 G Street, N.W.
Washington, D.C. 20005
(202)626-4600

**International Conference of Building Officials**
5360 South Workman Mill Road
Whittier, California 90601
(213)699-0541

**Masonry Institute of America**
2550 Beverly Boulevard
Los Angeles, California 90057
(213)388-0472

**Masonry Institute of Washington**
925 116th Street, Suite 209
Bellevue, Washington 98004
(206)453-8820

**Metal Building Manufacturers Association**
1230 Keith Building
Cleveland, Ohio 44115
(216)241-7333

**Mississippi Seismic Advisory Panel**
Mississippi Emergency Management Agency
P.O. Box 4501, Fondren Station
Jackson, Mississippi 39216
(601)352-9100

**Missouri State Earthquake Safety Advisory Council**
P.O. Box 116
Jefferson City, Missouri 65101
(314)751-2321

**National Academy of Sciences, Committee on Natural Disasters**
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
(202)334-3312

**National Association of Home Builders of the U.S.**
15th and M Streets, N.W.
Washington, D.C. 20005
(202)822-0200

**National Bureau of Standards, Center for Building Technology**
Room B168, Building 226
Gaithersburg, Maryland 20899
(301)921-3471

**National Concrete Masonry Association**
2302 Horse Pen Road
Herndon, Virginia 20072
(703)435-4900

**National Conference of States on Buildings Codes and Standards**
481 Carlisle Road
Herndon, Virginia 22070
(703)437-0100

**National Coordinating Council on Emergency Management**
3126 Beltline Boulevard
Columbia, South Carolina 29204
(803)765-9286

**National Elevator Industry, Inc.**
1 Farm Spring
Farmington, Connecticut 06032
(212)986-1545

**National Emergency Managers Association**
c/o Director
Colorado Division of Disaster Emergency Services, EOC
Camp George West, Golden, Colorado 80401
(303)273-1624

**National Fire Sprinkler Association**
5715 West 76th Street
Los Angeles, California 90045
(914)878-4200

National Forest Products Association
1619 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202)797-5800

National Institute of Building Sciences
1015 15th Street, N.W., Suite 700
Washington, D.C. 20005
(202)347-5710

National Science Foundation, Directorate for Engineering, Fundamental Research for Emerging and Critical Engineering Systems Division
1800 G Street, N.W.
Washington, D.C. 20550
(202)357-7710

Natural Disaster Resource Referral Service
P.O. Box 2208
Arlington, Virginia 22202
(703)920-7176

Natural Hazards Planning Council
Director, Planning Office
P.O. Box 3088
Christiansted, St. Croix, Virgin Islands 00820
(809)773-1082

Natural Hazards Research and Applications Information Center
University of Colorado, IBS 6
Campus Box 482
Boulder, Colorado 80309
(303)492-6818

New England Seismic Advisory Council (proposed)
P.O. Box 1496
400 Worcester Road
Framingham, Massachusetts 01701
(617)875-1318

Oklahoma Masonry Institute
3601 Classen Boulevard, Suite 108
Oklahoma City, Oklahoma 73118
(405)524-8795

Portland Cement Association
5420 Old Orchard Road
Skokie, Illinois 60077
(312)966-6200

Prestressed Concrete Institute
201 North Wells Street
Chicago, Illinois 60606
(312)346-4071

**Rack Manufacturers Institute**
1326 Freeport Road
Pittsburgh, Pennsylvania 15238
(412)782-1624

**School Education Safety and Education Project**
State Seismologist
Geophysics Department, AD-50
University of Washington
Seattle, Washington 98195
(206)545-7563

**Soil and Foundation Engineers Association**
P.O. Box 92630
El Taro, California 92630
(714)859-0294

**South Carolina Seismic Safety Consortium**
Department of Civil Engineering
The Citadel, The Military College of South Carolina
Charleston, South Carolina 29401
(803)792-7677
or
Baptist College
P.O. Box 10087
Charleston, South Carolina 29411
(803)797-4208

**Southeastern United States Seismic Safety Consortium**
Department of Civil Engineering
The Citadel, The Military College of South Carolina
Charleston, South Carolina 29401
(803)792-7677

**Southern Building Code Congress International**
900 Montclair Road
Birmingham, Alabama 35213
(205)591-1853

**Southern California Earthquake Preparedness Project**
6850 Van Nuys Boulevard
Van Nuys, California 91405
(213)787-5103

**Southern California Earthquake Preparedness Project Policy Advisory Board**
Director of Emergency Planning and Office Administration
Atlantic Richfield Company
515 South Flower Street
Los Angeles, California 90071
(213)486-2535

**Steel Plate Fabricators Association, Inc.**
2901 Finley Road, Suite 103
Downers Grove, Illinois 60515
(312)232-8750

**Structural Engineers Association of Arizona**
2415 West Colter
Phoenix, Arizona 85015
(602)249-0963

**Structural Engineers Association of California**
217 2nd Street
San Francisco, California 94105
(415)974-5147

**Structural Engineers Association of Utah**
2126 South 1000 South
Salt Lake City, Utah 84106

**Structural Engineers Association of Washington**
1411 4th Avenue, Suite 1420
Seattle, Washington 98101
(206)624-7045

**Technical Advisory Council**
Deputy Director, State Emergency Management Office
Public Security Building 22
State Office Building Campus
Albany, New York 12226
(518)454-2156

**Tennessee Earthquake Information Center**
Memphis State University
Memphis, Tennessee 38152
(901)454-2007

**Tennessee Seismic Advisory Panel**
Tennessee Emergency Management Agency
Tennessee EOC, 3041 Sidco Drive
Nashville, Tennessee 37204-1502
(615)252-3311

**U.S. Geological Survey, Office of Earthquakes, Volcanoes, and Engineering**
905 National Center
Reston, Virginia 22092
(703)860-6471

CSM Campus
1711 Illinois Avenue, Mail Stop 966
Golden, Colorado 80401
(303)236-1611

345 Middlefield Road, Building 1, Mail Stop 22
Menlo Park, California
(415)323-8111, Ext. 2312

**U.S. Public Health Service, National Institute of Mental Health, Center for Mental Health--Studies of Emergencies**
5600 Fishers Lane
Rockville, Maryland 20857
(301)443-1910

**U.S. Small Business Administration Disaster Assistance Division**
Area 1 (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Puerto Rico, Rhode Island, Vermont, Virgin Islands)
15-01 Broadway
Fair Lawn, New Jersey 07410
(201)794-8195

Area 2 (Alabama, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Kentucky, Maryland, Michigan, Minnesota, Mississippi, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia, Wisconsin)
75 Spring Street, S.W., Suite 822
Atlanta, Georgia 30303
(404)221-5822

Area 3 (Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, New Mexico, Oklahoma, Texas)
2306 Oak Lane, Suite 110
Grand Prairie, Texas 75051
(214)767-7571

Area 4 (Alaska, Arizona, California, Colorado, Guam, Hawaii, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming)
P.O. Box 13795
Sacramento, California 95825
(916)484-4461

**University of Delaware, Disaster Research Center**
Newark, Delaware 19711
(302)451-2581

**Western States Structural Engineers Association**
304 Great Western Building
Spokane, Washington 99201

**Western States Clay Products Association**
9780 South, 5200 West
West Jordan, Utah
(801)561-1471

**Western Seismic Safety Council**
c/o Hugh Fowler
Washington State Department of Emergency Services
4220 East Martin Way
Olympia, Washington 98504
(206)459-9191

## DATA BASES

**American Geological Institute**
Indexes approximately 5,000 serials on the world's geological literature.
GeoRef
4220 King Street
Alexandria, Virginia 22302
(703)379-2480

**Department of Agriculture**
Data bases or computerized records maintained by agencies within the department include material on emergency disaster assistance, emergency loan distribution, insurance paid out for crop losses. avalanches, hail, and drought. AGRICOLA is a computerized bibliographic reference service dealing primarily with agriculture.
(301)344-3755

**Earthquake Engineering Research Center Library**
Extensive library on all aspects of the earthquake problem. Publications available by mail.
University of California
47th and Hoffman Boulevard
Richmond, California 94804
(415)231-9403

**Federal Emergency Management Agency, Disaster Management Information System**
More than 65 elements of information on presidentially declared disasters are available on magnetic tape.
FEMA/SL-DA
500 C Street, S.W.
Washington, D.C. 20472
(202)382-6423

**National Geophysical Data Center**
Maintains an earthquake data file, photo files, and a set of data bases of direct interest to Pacific tsunami research and operations
NOAA/EDIS/NGDC
D62
Boulder, Colorado 80303
(303)497-6337

**National Technical Information Service**
The source for the public sale of government-sponsored research, development, and engineering reports and other analyses prepared

by federal agencies and their contractors and grantees. For general information call (703)487-4604. For information on research in progress call (703)487-4808. For information on the transfer of federal technology having potential commercial or practical applications, call (703)487-4808.

NTIS
5285 Port Royal Road
Springfield, Virginia 22161

**Smithsonian Institution**

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SEAN NHB
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Mail Stop 129
Washington, D.C. 20560
(202)357-1511

**U.S. Geological Survey**

For information on the books, maps, and photographs of the USGS call the Reference Librarian at the:

National Center
(703)860-6671
or
Western Regional Library
(415)323-8111
or
Central Regional Library
(303)234-4133

USGS Circular 777, A Guide to Obtaining Information from the USGS, assists in obtaining USGS products and unpublished information and USGS Circular 817, Scientific and Technical, Spatial, and Bibliographic Data Bases of the U.S. Geological Survey, lists 223 USGS systems. Copies are available free from the:

USGS Branch of Distribution
604 Pickett Street
Alexandria, Virginia 22304.

USGS Earth Resources Observation Systems (EROS) offers a computerized reference service for searches for remote sensing data. Contact:

EROS Data Center
Sioux Falls, South Dakota 57198
(605)594-6151

Geographic Information Systems, Methods, and Equipment for Land Use Planning lists many manual and computer-aided systems, systems design, and data sources for land use planners and managers. It is available as PB 286-643 from:

NTIS
5285 Port Royal Road
Springfield, Virginia 22161