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from the
CONFERENCE ON DISASTER PREPAREDNESS - THE PLACE OF EARTHQUAKE EDUCATION IN OUR SCHOOLS

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on
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Technical Report NCEER-89-0017

Edited By: Katharyn E.K. Ross[1]
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1 Education Specialist, National Center for Earthquake Engineering Research, State University of New York at Buffalo

NATIONAL CENTER FOR EARTHQUAKE ENGINEERING RESEARCH
State University of New York at Buffalo
Red Jacket Quadrangle, Buffalo, NY 14261

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This conference report contains papers dealing with earthquake education of students, teachers, school administrators, public officials and the general public. The topic includes safety standards of several state school systems, earthquake curricula, seismic risk assessment, a state by state overview and evaluation of earthquake and natural hazard curricula, school safety suggestions, and student drills.

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Introduction for the Conference:

"DISASTER PREPAREDNESS--THE PLACE OF EARTHQUAKE EDUCATION IN OUR SCHOOLS"

Center for Tomorrow, UB Amherst Campus, July 9, 1989.

Katharyn E. K. Ross
Education Specialist
National Center for Earthquake Engineering Research

Welcome to the inaugural earthquake education conference sponsored by the National Center for Earthquake Engineering Research and co-sponsored by the Federal Emergency Management Agency and Emergency Preparedness Canada. The National Center for Earthquake Engineering Research was established at the State University of New York at Buffalo in September of 1986 by the National Science Foundation. The Center's focus is to minimize damage caused by earthquakes through directed research, implementation of findings, public education and transfer of technology. The National Center for Earthquake Engineering Research also examines socio-economic issues of earthquakes such as emergency preparedness, response and recovery.

Even at this early stage, one can point to a number of successes:

- Setting up a working and well functioning administrative structure,
- Developing a method of funding that relies on organized group efforts,
- Generating substantial amounts of matching funds, and thereby greatly increasing the research support of earthquake engineering,
- Defining critical areas of research,
- Developing cooperation among groups of researchers from different institutions, and from different disciplines,
- Establishing connections with practicing engineers and industry,
- Gaining (rather quickly) a positive reputation among the public and the technical community,
- Achieving great visibility, particularly in the eastern and central parts of the United States, thereby increasing awareness of the seismic risk,
- Engaging many young researchers in earthquake engineering research,
- Publishing a large number of technical reports and journal articles,
- Financing major upgrades at core experimental facilities,
- Organizing workshops, conferences, and forums, and holding of numerous television, radio and other media conferences,
- Creating an on-line earthquake engineering information system, and
- Establishing working relationships, and formal cooperative agreements with peer organizations and institutions in a number of different foreign countries.

Over the first two years, the $5 million per year provided by the National Science Foundation has been leveraged at a rate of approximately 1.7; that is, for the $10 million, there has been raised an additional $16,956,000 in non-federal matching support.

A particularly significant development has been the establishment of NCEER Information Service, which is available via computer link to all researchers, professionals, libraries, government offices, etc. throughout the world. As part of that service is an Information Service data base, Quakeline. It contains a large number of indices and abstracts of published information which are generally not indexed through any other source.

NCEER has published, during the past two-years, more than seventy Technical Reports resulting from its various research projects. Additional reports are currently in review or being prepared.

To date, 114 principal investigators throughout the United States have been involved in the research program (see Figure 1). Thirty U.S. institutions have been involved. There have been 24 industrial "participants."

The Center has entered into formal Agreements or Memoranda of Understanding with a number of foreign countries and/or research institutes: five in Japan, three in China, one in Taiwan, one in Spain, one in Austria, one in Mexico, and one in Greece. A number of other requests for cooperative and collaborative research are currently being considered. These involve researchers in Chile, Great Britain, France, Yugoslavia, Turkey, and India.

NCEER is a collaborative team effort of academics, practicing professionals, government officials and other experts. Their mutual objective is to enhance basic knowledge of earthquakes, perfect engineering practices and implement earthquake hazards mitigation procedures. Studies include investigation of earthquake ground motion, soil behavior, structural performance and design principles, education, response and recovery programs. NCEER is equally interested in the broad-based dissemination of information and technology, sponsoring national and international conferences, meetings with private and public sector leaders, public seminars on earthquakes and offering a computer-based information service as a reference resource on engineering, geological, political and socioeconomic aspects of earthquakes.

Only a concentrated and continued flow of information about earthquakes will raise the consciousness of people throughout this country and the world to the level required to bring about changes; changes in building codes to ensure safer more earthquake-resistant built environments, changes in emergency response training to include earthquake preparedness drills, and changes in earthquake preparedness levels in schools as well as homes and businesses.

History and research have proven that earthquakes are not just a California problem. Unless and until serious steps are taken to counter an earthquake's destructive powers, we are vulnerable to devastation similar to that felt in Armenia. It is hoped that this conference will provide the information that's needed to insure the place of earthquake education in our schools.

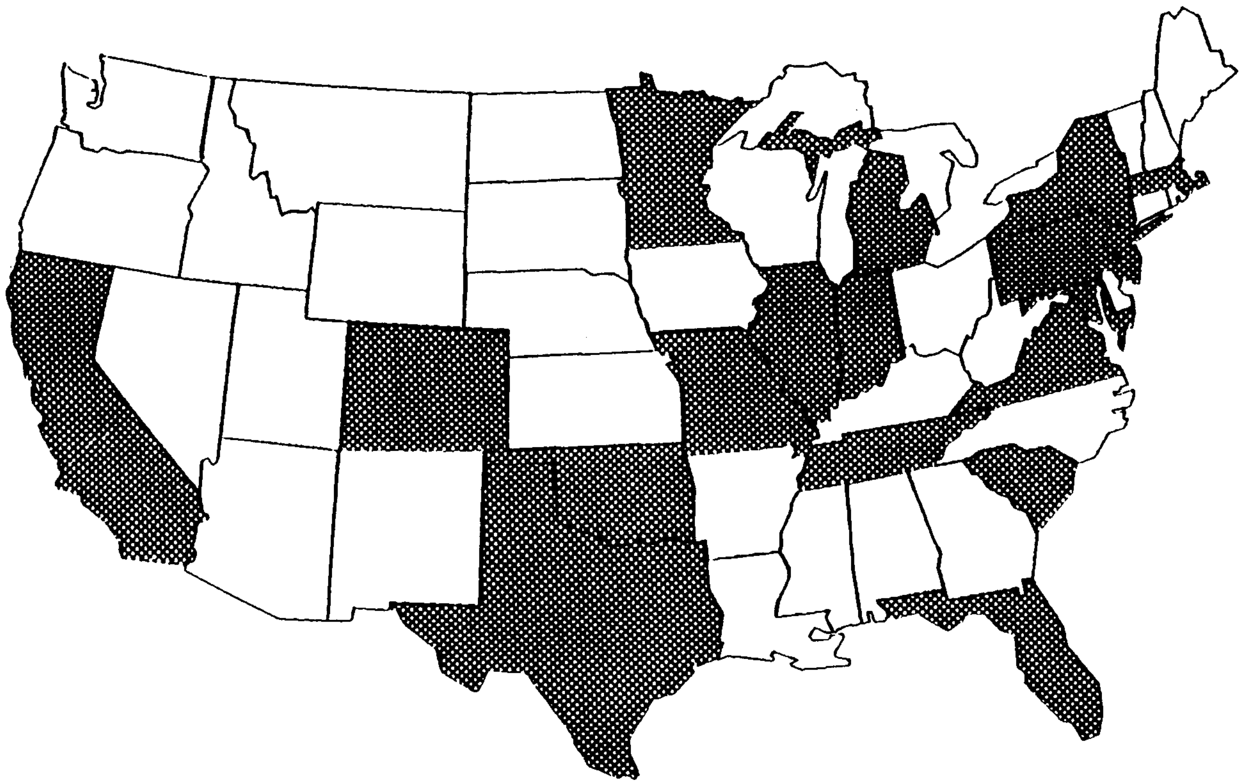

FIGURE 1 States in Which NCEER Research Projects Are Carried Out (September 1986 - August 1989)

CE PAPERS

EARTHQUAKE HAZARDS IN BRITISH COLUMBIA AND WASHINGTON

Linda Lawrance Noson

Natural Hazard Specialist
Federal Emergency Management Agency

ABSTRACT

British Columbia and Washington are both in earthquake country. Thousands of earthquakes are recorded each year by seismograph networks in the United States and Canada. A number of historic earthquakes have shaken the region hard enough to cause widespread damage and alarm. Many Indian legends attempt to explain this terrifying shaking. One such legend involves the spread of a disease called "Earthquake Foot." People infected with Earthquake Foot cause an earthquake whenever they stumble. Geological and geophysical information collected with modern instruments and analyzed by scientists in Canada and the United States provides more data from which to develop an explanation of why the earth shakes in this region. Recent studies conclude that a "Great" earthquake (similar in size to the largest earthquakes recorded) must be considered a possibility in the Pacific Northwest.

Investigation of the causes and the impact of earthquakes on the physical and built environment have led to efforts to find ways to reduce that impact. Both the United States and British Columbia have developed school earthquake safety and education programs to provide greater protection for a particularly vulnerable population and to disseminate general earthquake preparedness information to the larger community through the schools.

LINDA NOSON

Ms. Linda Lawrance Noson, Natural Hazards Specialist with the Federal Emergency Management Agency, Region X, has served as a seismologist at the University of Washington, Director of the School of Earthquake Safety and Education Project, and co-chair of the Washington State Seismic Safety Council. She is currently program manager for federally funded earthquake hazard programs in Washington, Oregon, Idaho, and Alaska.

INTRODUCTION

The Pacific Northwest is well-known for snowclad mountains, white-water rivers, and thick rain forests. Some of the hazards of such an environment - avalanches, drowning, and fires - are obvious and the precautions necessary to deal with them well understood. The hazard from earthquakes is less well recognized, yet damage and loss of life during a large earthquake are certain. A 1975 study by the U.S. Geological Survey of six counties in the Puget Sound area (U.S. Geological Survey, 1975) projects as many as 2,200 deaths and 8,700 injuries in the next magnitude 7.5 earthquake. An earthquake much larger than the one used to make the 1975 estimates is now considered a possibility in the Pacific Northwest (Atwater, 1987).

By understanding the causes and effects of earthquakes in Washington and British Columbia, appropriate actions can be taken to reduce loss of life and property. Earthquakes, like the rain, will always be a part of the region's environment. However, these forces need not level our cities or generate mass confusion and economic disaster. Our homes, schools, and businesses can be made safer places to be during future earthquakes. Earthquake resistant design can improve the ability of buildings to survive strong ground shaking. Individuals can be trained to immediately seek protection and provide emergency care and assistance when the shaking stops. And communities can plan for recovery to accelerate a return to social and economic stability. These efforts require an informed and prepared population.

WHAT CAUSES EARTHQUAKES?

An earthquake is the shaking of the ground produced by an abrupt shift of rock along a fracture in the earth, called a fault. Within seconds, an earthquake may release energy that has taken hundreds or even thousands of years to accumulate. Plate tectonics is a starting point for understanding the forces in the earth that cause earthquakes.

Plates are thick slabs of rock that make up the outermost 100 kilometers or so of the earth. Earthquakes occur only in the outer, brittle portions of these plates, where temperatures in the rock are relatively low. Temperature differences deep within the earth cause very slow movements of interior rock, called convection. Convection results in the movement of the overlying plates. This movement can deform the brittle portions of the plates. If the deformation exceeds the strength of the rocks comprising these brittle zones, the rocks can either break suddenly, releasing the stored elastic energy as an earthquake or change shape slowly and gradually release the energy without an earthquake.

Ninety percent of the world's earthquakes occur along the boundaries between plates. These boundaries are called spreading, convergent, or transform, depending on whether the plates move, respectively, away from, toward, or horizontally past one another. Subduction occurs where one plate converges toward another plate, moves beneath it, and plunges as much as several hundred kilometers into the earth's interior. Each of these boundaries are present in the Pacific Northwest (Fig. 1): 1) the Juan de Fuca Ridge and the Gorda Ridge are spreading boundaries that separate the northwestward moving Pacific Plate from the northeastward moving

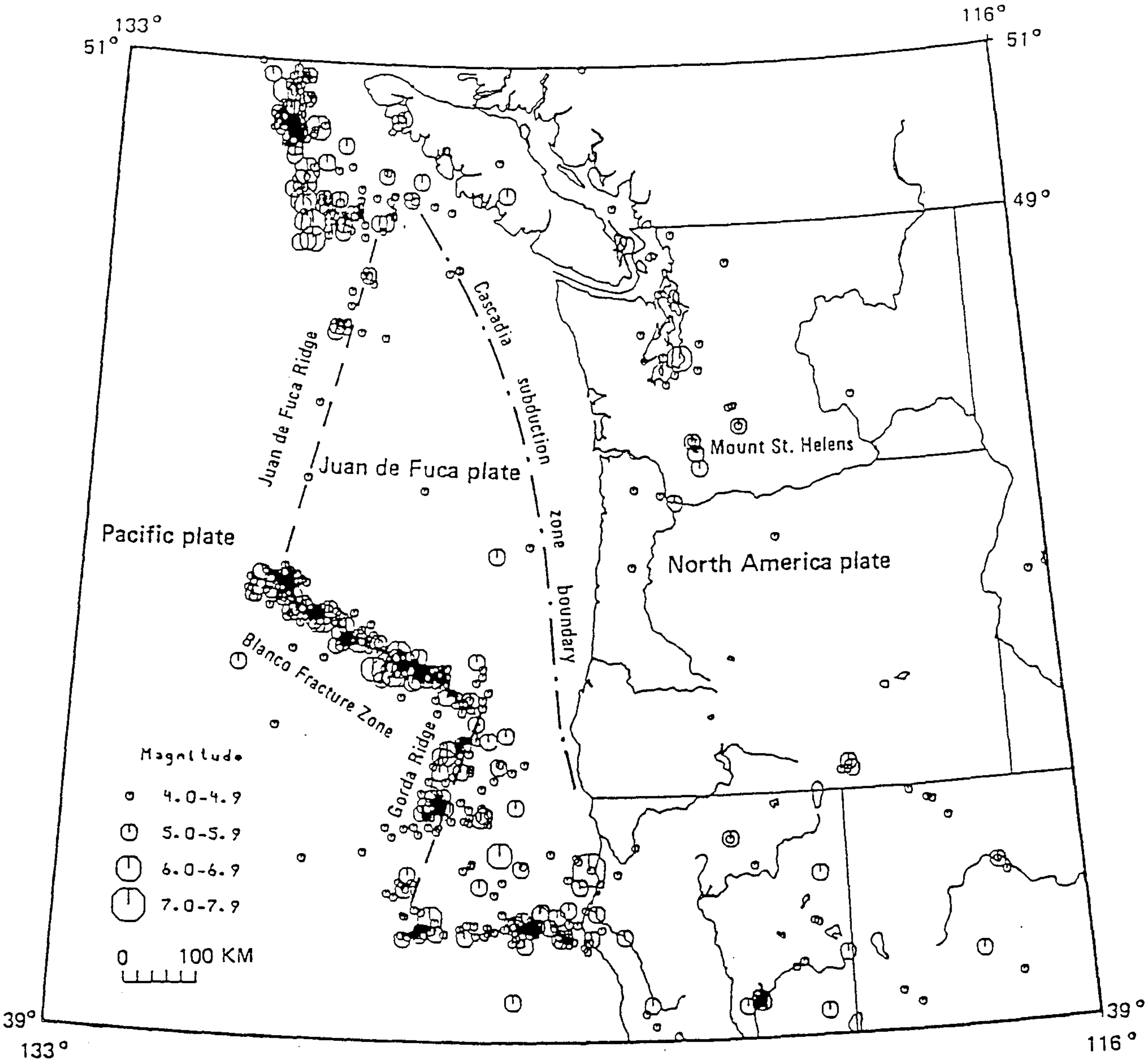

Figure 1. Epicenters of earthquakes in the Pacific Northwest since 1960. Only the largest earthquakes near Mount St. Helens are indicated. Note the position of the Cascadia subduction zone relative to Washington's coast and that epicentral locations mark plate boundaries. (Data from the National Oceanic and Atomospheric Administration and the University of Washington. Figure from Noson and others, 1988).

Juan de Fuca Plate; 2) coastal British Columbia, Washington, and Oregon are in the Cascadia Subduction Zone where the Juan de Fuca Plate converges with the North America Plate; and 3) transform boundaries exist along the Blanco Fracture Zone where the Pacific Plate moves laterally past the Juan de Fuca Plate and along the Queen Charlotte Fault where the Pacific Plate moves laterally past the North America Plate.

Earthquake activity varies according to the type of plate boundary:

The Juan de Fuca Ridge is an area of high temperature and weak rocks that yield readily to the pushes and pulls from inside the earth. This is an area with relatively few earthquakes of small size where the rocks break before large amounts of energy can accumulate.

The Queen Charlotte Transform boundary, like the San Andreas Fault in California builds up tremendous energy in the rocks as the massive North America and Pacific Plates grind by each other. The rate of earthquake activity and the size of earthquakes are greater along transform boundaries than at spreading boundaries. The 1906 San Francisco earthquake (magnitude 8.3) and the 1949 Queen Charlotte earthquake (magnitude 8.1) are examples of notable earthquakes along transform boundaries. Since a transform fault juxtaposes two plates, movement shifts features like streams, fences, and buildings built across the boundary. Earthquakes are concentrated in a narrow zone in width and depth along the boundary.

The convergent boundary between the Juan de Fuca Plate and the North America Plate shows more complicated geologic and geophysical features than the ridge or transform boundaries (Noson et al., 1988). Three source zones have been identified for earthquakes in this area: within the upper part of the North America Plate, inside the descending Juan de Fuca plate, and between the North America and Juan de Fuca Plates. Source Zone 1: The upper North America Plate earthquakes occur most densely within the Puget Sound - Georgia Strait region. However, historically, the largest shallow earthquakes have occurred in the Washington Cascades and on Vancouver Island. Source Zone 2: The best documented and most damaging historic earthquakes have occurred deep beneath Puget Sound and Georgia Strait inside the descending Juan de Fuca Plate. Source Zone 3: No earthquakes have been recorded between the Juan de Fuca Plate and the overlying North America Plate. However, subduction zones in other parts of the world with similar characteristics have had large, historic subduction zone or "Great" earthquakes with magnitudes of 8 and larger.

Geologic evidence from along the British Columbia, Washington, and Oregon coast is compatible with the occurrence of eight "Great" earthquakes during the past 5,000 years. The largest and most devastating earthquakes in the world, called subduction earthquakes, occur between converging plates.

Although the movement of plates can explain most earthquake activity, local rock movements may be caused by other forces. Readjustments of the earth following the melting of massive glaciers, the movement of magma in volcanic areas, and filling reservoirs with water have been known to generate earthquakes.

EARTHQUAKE HAZARDS IN THE PACIFIC NORTHWEST

Geological and geophysical studies carried out by scientists in Canada and the United States have provided the general framework within which to understand where, how often and how big earthquakes will be in the Pacific Northwest. More studies will be needed to better define the spatial and temporal distribution of earthquakes in this region. Will large, deep earthquakes within the descending Juan de Fuca Plate continue to be concentrated within the Puget Sound - Georgia Strait region or will they occur beneath Oregon as well? What is the largest shallow earthquake that is likely to occur? Answers to these questions require continued scientific attention.

Earthquakes produce two major types of hazards: primary and secondary. The primary hazards are ground shaking, surface faulting, and sudden elevation changes. Ground shaking is the most damaging primary hazard even in areas with many active surface faults like California. Surface faulting causes extreme damage, but that damage is very localized where as ground shaking causes damage over a very large area.

Major active surface faults have not been identified in the Pacific Northwest. Sudden elevation changes occur during very large subduction earthquakes. Following the 1964 Alaska earthquake with a moment magnitude[1] of 9.2 (Davies, 1986) and surface wave magnitude 8.4, the land was raised up to 33 feet and subsided about 6 feet over a broad area. Geologists have studied evidence of sudden elevation changes in Canada and the United States that may have been caused by subduction earthquakes in the Pacific Northwest.

Secondary hazards are additional dangers initiated by the ground shaking, faulting and sudden elevation changes. Ground failures, damaging water waves, fires, chemical spills, and dam ruptures are examples of secondary hazards. In order to identify the extent of secondary hazards, research needs to identify areas susceptible to ground failures and water waves and inventory the buildings, people and objects that will be affected.

WHAT HAPPENS DURING A MAJOR EARTHQUAKE?

Earthquake ground shaking produces a number of effects that are relatively consistent regardless of the region involved. The following summarizes what can be expected to occur:

Disrupted communication - either direct physical damage to communication systems or overloaded circuits;

[1]The 1964 Alaska earthquake has a Richter magnitude of 8.4 and a moment magnitude of 9.2. The Richter magnitude scale is inappropriate for magnitudes greater than about 8 because the Richter scale was designed for a particular instrument (Wood-Anderson) at a specific distance (100 km) in California. As a result, the moment magnitude was developed which uses measurements of lower frequency waves than the Wood-Anderson is designed to record in the magnitude calculation. Comparisons of Great earthquakes (magnitudes greater than about 8) for which moment magnitudes have been computed show a better correlation to other indicators of size.

Disrupted transportation - either direct physical damage to roads, freeways, and bridges or severe congestion;

Broken utility lines - gas, electricity, and water systems may be damaged in any of a number of places within the generation and/or distribution systems hampering lifesaving efforts and delaying recovery;

Structural damage - unreinforced masonry buildings and tilt-up construction have performed poorly in past earthquakes;

Non-structural damage - shattered glass, broken light fixtures, fallen ceiling panels, displaced equipment and furniture pose serious hazards to building occupants and effect the usefulness of the building following an earthquake;

Social and economic impact - businesses without a disaster contingency plan frequently fail after an earthquake; inventory may be destroyed, vital records ruined, loan payments not made; and personnel may suffer emotional "aftershocks."

IMPACT OF EARTHQUAKES ON SCHOOLS IN THE PACIFIC NORTHWEST

School earthquake damage has occurred to many school buildings throughout the Pacific Northwest. Only limited parts of this data base, however, have been collected. The most complete study of school earthquake damage followed the 1949 Olympia earthquake (Edwards, 1950). Thirty schools in Washington normally housing 10,000 students were closed. Ten schools were permanently closed and had to be replaced. School buildings suffered a disproportionate amount of damage. Two students were killed by falling bricks while attempting to exit during ground shaking. Most Washington schools were closed for Spring break or fatalities would probably have been much higher.

SCHOOL EARTHQUAKE SAFETY AND EDUCATION PROGRAMS

The United States Federal Emergency Management Agency (FEMA) field tested the *Guidebook for Developing a School Earthquake Safety Program*, FEMA-88, (MacCabe, 1985) in Washington in 1983. The School Earthquake Safety and Education Project (SESEP) located at the University of Washington was funded by FEMA to assist in field testing the guidebook and reviewing earthquake education materials developed by the California Envirnomental Volunteers. SESEP formed an advisory committee that included representatives from education, psychology, sociology, emergency management, seismology, Red Cross, and engineering to review materials and procedures developed by SESEP.

Five pilot schools were chosen in the Seattle Public School District based upon the combined interest of the Principal and Staff at each participating school. These schools formed earthquake safety committees that used the guidebook to develop a school earthquake safety program. SESEP supplemented the staff safety training with hands-on student learning centers on the causes and effects of earthquakes. An assembly on Washington earthquakes was presented prior to the learning centers. Evaluation of student learning (Brattesani & Noson, 1985) showed significant increase in student certainty about proper safety actions and increased factual knowledge about Pacific Northwest earthquakes. Data suggests that anxiety decreased somewhat.

Focused interviews were held with school safety committees to determine the factors involved in motivation and program participation (Brattesani, 1985). Interview results indicated that the primary impetus for being active on the earthquake safety committee was knowledge that the participant's school was among those at high risk of being damaged during an earthquake. Other factors included leadership, other program involvement, district support and funding, and having clearly stated program objectives listed in order of priority. These findings stress the need to clearly communicate the level of risk at a particular site to the staff and administration.

To reach a broader audience, SESEP presented teacher workshops on school earthquake safety that included an overview of regional earthquake hazards, impact of earthquakes on schools and the elements of a school earthquake safety program as outlined in FEMA 88. Participants from Victoria and Vancouver, British Columbia attended SESEP workshops. Subsequently, SESEP workshops were held in those cities. Information and sources on school earthquake safety were shared with the Canadians. British Columbia, with permission of FEMA, included information from FEMA 88 in materials produced for distribution by the Ministry of Education in the Province of British Columbia.

Interaction between the United States and British Columbia continues to occur concerning school earthquake safety efforts. Information has been shared on techniques for reducing nonstructural earthquake hazards in schools and hospitals, and on developing a regionally tailored earthquake education curriculum.

RECENT EVALUATION OF EARTHQUAKE RISK

Scientific studies over the past decade both in Canada and the United States indicate that a greater than magnitude 8, subduction earthquake must be accepted as a possibility within the Cascadia Subduction Zone. An earthquake of that type and size was not part of previous regional risk assessments. Past earthquakes like the Olympia 1949 already established the Puget Sound region as an area of major expected earthquake damage and thus of high earthquake risk. The addition of the possibility of a "Great" earthquake along the coast would dramatically extend the area included as high risk and pose new hazards to life and property. These changes in the risk assessment for the Pacific Northwest resulted in the region being included in the development of a United States Federal Catastrophic Earthquake Response Plan. The Province of British Columbia has similarly been involved in developing a national earthquake response plan to address the need for national assistance following a catastrophic earthquake that exceeds the ability of state and provincial emergency management to meet the demand for emergency services.

SUMMARY

The Pacific Northwest is an area of noteworthy earthquake hazards. Joint scientific studies have delineated the extent of the hazard based on historical and geological records. The population and infrastructure exposed to earthquake hazards has increased dramatically over the past several decades as settlement and development continue to grow. Earthquake education is necessary to create an informed populace capable of understanding what hazards are present and what steps to take to reduce the loss of life and property.

Schools serve a population that suffers relatively greater physical and emotional harm in damaging earthquakes. Studies in Japan (Miyang, 1988) following devastating earthquakes show more fatalities to children than to adults. Emotional damage is also greater among children than adults. School earthquake safety and education programs help increase the physical and emotional preparedness of our children as well as provide compelling lessons in science, social studies, and language arts.

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THE EARTHQUAKE RISK IN THE PACIFIC NORTHWEST

Larry D. Pearce

Assistant Regional Director
Emergency Preparedness Canada
British Columbia & Yukon

ABSTRACT

British Columbia and Washington are in earthquake country. Thousands of earthquakes are recorded each year by instruments sensitive to even small motions of the earth. A number of earthquakes have shaken the region hard enough to cause wide-spread damage and alarm. Early explanations through Indian legend tell of this terrifying phenomena, include the stumbling of individuals with a mysterious disease called "Earthquake Foot" and punishment of local inhabitants by an angry god. Information now available provides a clearer understanding of why earthquakes occur in the region. This information has been gathered and studied by scientists in both Canada and the United States. Earthquakes ignore economical, political and social boundaries.

Scientists from both countries must work together to better understand where, when, and how big earthquakes will impact British Columbia and Washington. These joint attempts to define the regional earthquake hazards have led to cooperative efforts to find ways to reduce further earthquake damage and injury.

The US and Canadian Governments, in response to the threat, are developing in concert with the states and the Province of British Columbia, their National Earthquake Response Plans.

The US and Canadian plans identify those government departments and agencies, private industry and other non-government groups who would be called upon to provide support to the state or province in the event of a catastrophic earthquake. They detail the type of resources required and which agencies provide these resources. They outline the concept of operations and the organization necessary to initiate the process and procedures of the plan and they detail the command and control structures necessary to execute and prosecute their aims and objectives. The strategy is clearly to provide support to the states and province while insuring that state and provincial authorities are in charge of operations.

This paper reviews the integration of information as well as the planning process from both sides of the border to improve the understanding of the earthquake hazards and to reduce further losses.

LARRY PEARCE

Mr. Larry Pearce received his education at the Canadian Army Staff College in Kingston, Ontario and Sir George William and Carleton Universities in Montreal and Ottawa. Mr. Pearce retired from the Canadian forces with 28 years of combined service including being posted to the Canadian Embassy in Washington, D.C. as Communication Liason Officer to the U.S. Army. He is currently Assistant Regional Director of Emergency Preparedness Canada in Victoria which covers the areas of British Columbia and the Yukon.

NATIONAL EARTHQUAKE RESPONSE PLAN

Earthquakes are non-political. they know no boundaries and respect no laws or regulations made by man.

It must be obvious that a catastrophic rupture of the Cascadia subduction zone is possible. If the zone breaks along its full length, some one thousand kilometers, stretching from the Queen Charlotte Islands halfway down the California coast, then it is likely this could be the largest earthquake in recorded history. It must also be obvious that we would likely experience injuries, death, and destruction in an order of magnitude that would overwhelm our state and provincial resources in the immediate impact area and beyond. So much so, that normal local mutual aid agreements and inter-state provincial agreements would be of little value.

As a result, a decision was made at the national level in the United States and Canada that it was imperative a national earthquake support plan needed to be developed; a plan that would take cognizance not only of national requirements but one that could deal with international expressions of assistance.

I propose to provide a brief overview of the Canadian National Response Plan, the organization and the concept it employs. I should point out that the Canadian Plan was the second national plan to be drafted and in fact, we used the United State's national plan as a model. Therefore, the two plans are very similar both in the concept of providing support and in their organization and structure, as those of you who are familiar with the U.S. plan will quickly see. I might add that this comes under the heading of lend/lease; that is to say, why lease it if someone will lend it to you?

ROLE OF THE FEDERAL GOVERNMENT

As you might expect, the federal government's role in responding to a catastrophic earthquake in British Columbia is one of providing coordinated support to the province in those areas beyond the province's capability and as requested by the provincial authority.

The federal government has developed, with the assistance of the province, our national earthquake response plan which includes providing federal and national resources as required to assist local and provincial authorities.

As already mentioned, not only does the plan address the national scene, it also addresses procedures for handling international assistance that may be offered.

The plan outlines the policies' assumptions, concept of operations, organization structures, and responsibilities of the federal force and how these interlock with the provinces response. The plan achieves its objectives by establishing emergency support functions or groups.

The development of these Emergency Support Functions is the responsibility of various federal departments and/or agencies and in conjunction with non-government organizations (NGO) provide the necessary support.

The organization/structure is in support. The province is in charge.

This slide depicts the national and regional level structure which will provide the nucleus for coordination of the response.

As you can see the coordination group is the heart of the structure and drives the organization. It:

- Provides centralized liaison for departments;
- Includes members from federal departments and non-government organizations with support functions;
- Central forum for discussion and liaison;
- Serves as the National Report Centre on the status of events;
- Establishes contact with all Emergency Support Functions (ESFs); and
- It provides information to the PCO and to external affairs as required.

The next slide illustrates the Essential Support Functions which are the key parts of the organization at both the national and regional level. As you can see, departments with prime responsibilities are depicted in the small outer circles with support departments clumped in the large centre circle.

The names of the ESFs are listed 1 through 13. The department responsible is shown.

Non-government organizations are illustrated having a support role.

The concept of primary and support agencies is the basis for the process of providing national resources from across the country in a coordinated and rapid manner.

At the regional level, Essential Support Functions report to the Federal Control Officer (FCO) while maintaining a continuous liaison with their national level. The FCO, of course, is in constant contact with the Provincial Officer Coordinator (POC) and can detail the necessary requirements to the ESFs. The FCO and the POC will be located at the Disaster Field Centre.

This slide illustrates the Disaster Field Centre and provides a perspective of how the Federal Control Officer coordinates the requirements of the Essential Support Functions to coincide with the needs of the province.

The Disaster Field Centre is where the action is taking place and is located in or close to the disaster - if possible co-located with the main provincial EOC relief effort.

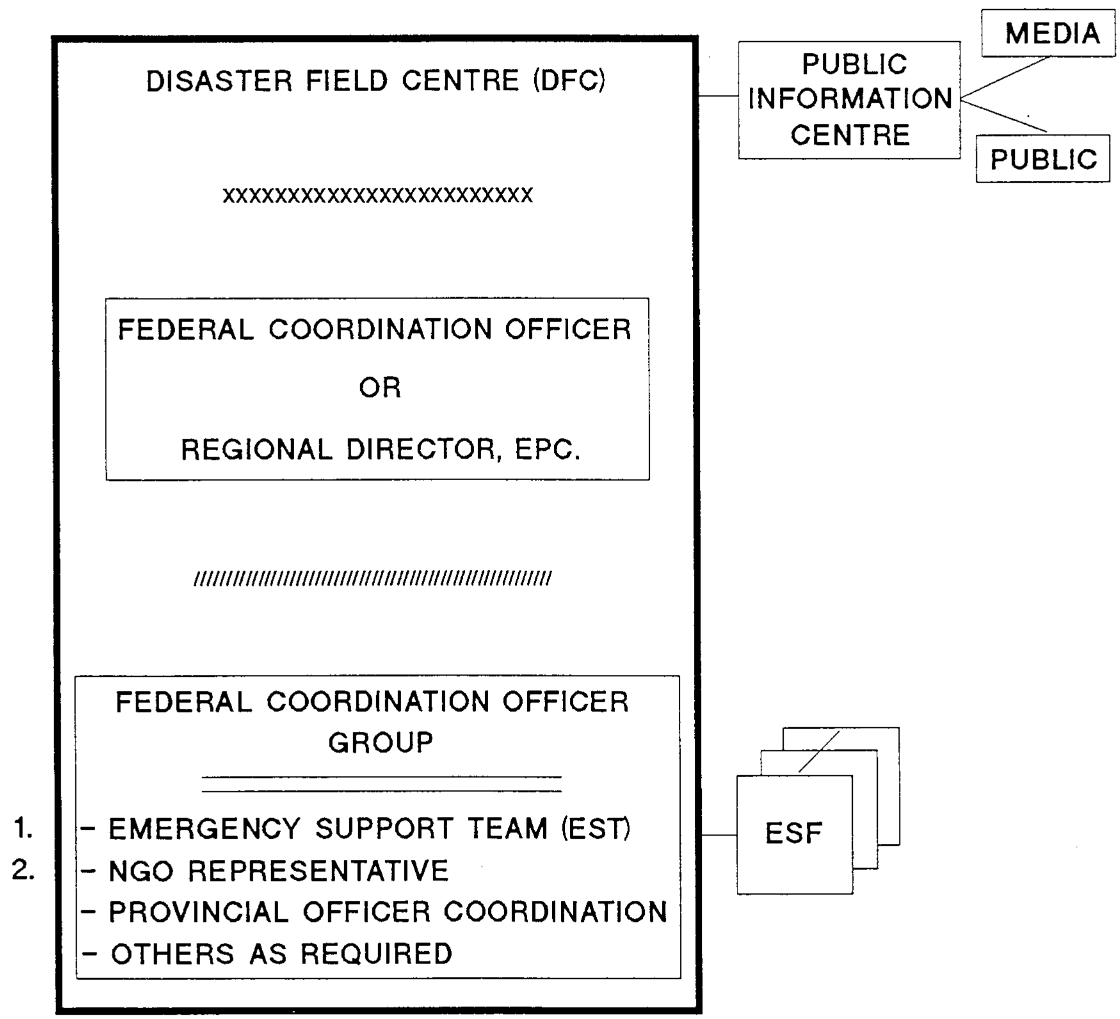
Finally, the Emergency Support Team (EST) is the group that assists the FCO in carrying out his responsibilities by overseeing, directing, coordinating and evaluating on-the-scene response activities of the Essential Support Functions, as well as other activities that are taking place.

The Emergency Support Team takes all necessary action to support the provincial/local requirements while recording and maintaining information for use in situation and after-action reports.

To summarize this in one diagram, the following slide illustrates the whole organization from top to bottom for reporting purposes.

I promised to provide you a brief overview of our draft plan. I hope I have done so and I believe that this last slide is appropriate.

REGIONAL LEVEL RESPONSE STRUCTURE



<u>NOTES:</u>

1. **EST** INCLUDES **ESF** REPRESENTATIVES, SUPPORT DEPARTMENTS, ADMINISTRATIVE, TECHNICAL ADVISORS OPERATIONS AND LOGISTICS SUPPORT.

2. THE TERM '**NGO**' INCLUDES REPRESENTATIVES FROM INDUSTRY.

Table 2

NATIONAL (OTTAWA) AND REGIONAL LEVEL

RESPONSE STRUCTURE

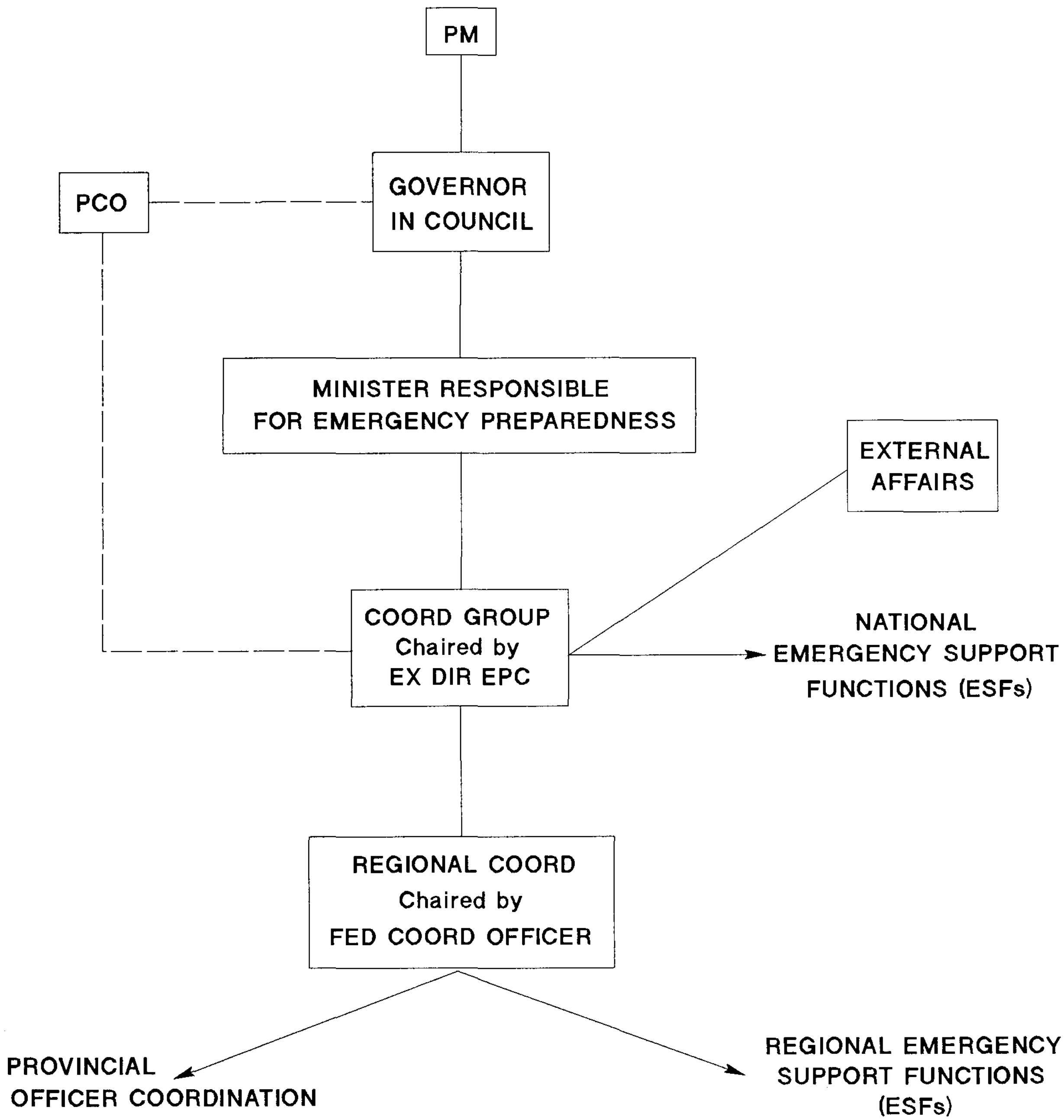
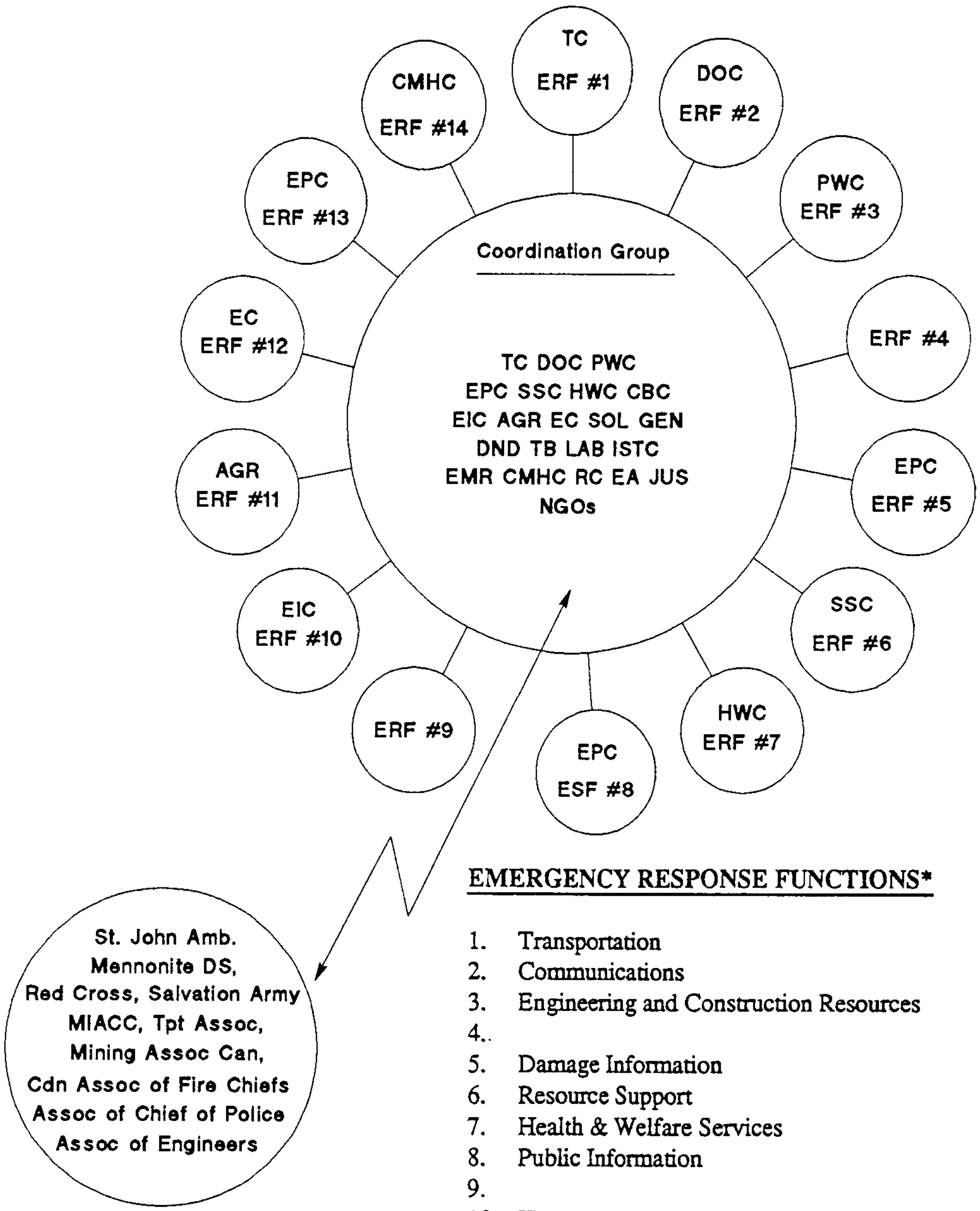


Figure 3

ORGANIZATIONS HAVING PRIMARY AND SUPPORT RESPONSIBILITIES TO THE ERFs



EMERGENCY RESPONSE FUNCTIONS*

1. Transportation
2. Communications
3. Engineering and Construction Resources
4.
5. Damage Information
6. Resource Support
7. Health & Welfare Services
8. Public Information
9.
10. Human Resources
11. Food
12. Hazardous Material
13. Logistics
14. Housing

*ERFs need not be applicable to each province. Applicability depends upon existing provincial mechanisms and/or mutal agreements to meet the emergency requirement.

NOTES:

1. Primary departments/agencies are identified in small circles.

2. All organizations listed in the large circle may serve as support agencies for one or more ERFs and may be represented on the coordination group (CG).

3. The term "department," relative to an ERF includes an agency.

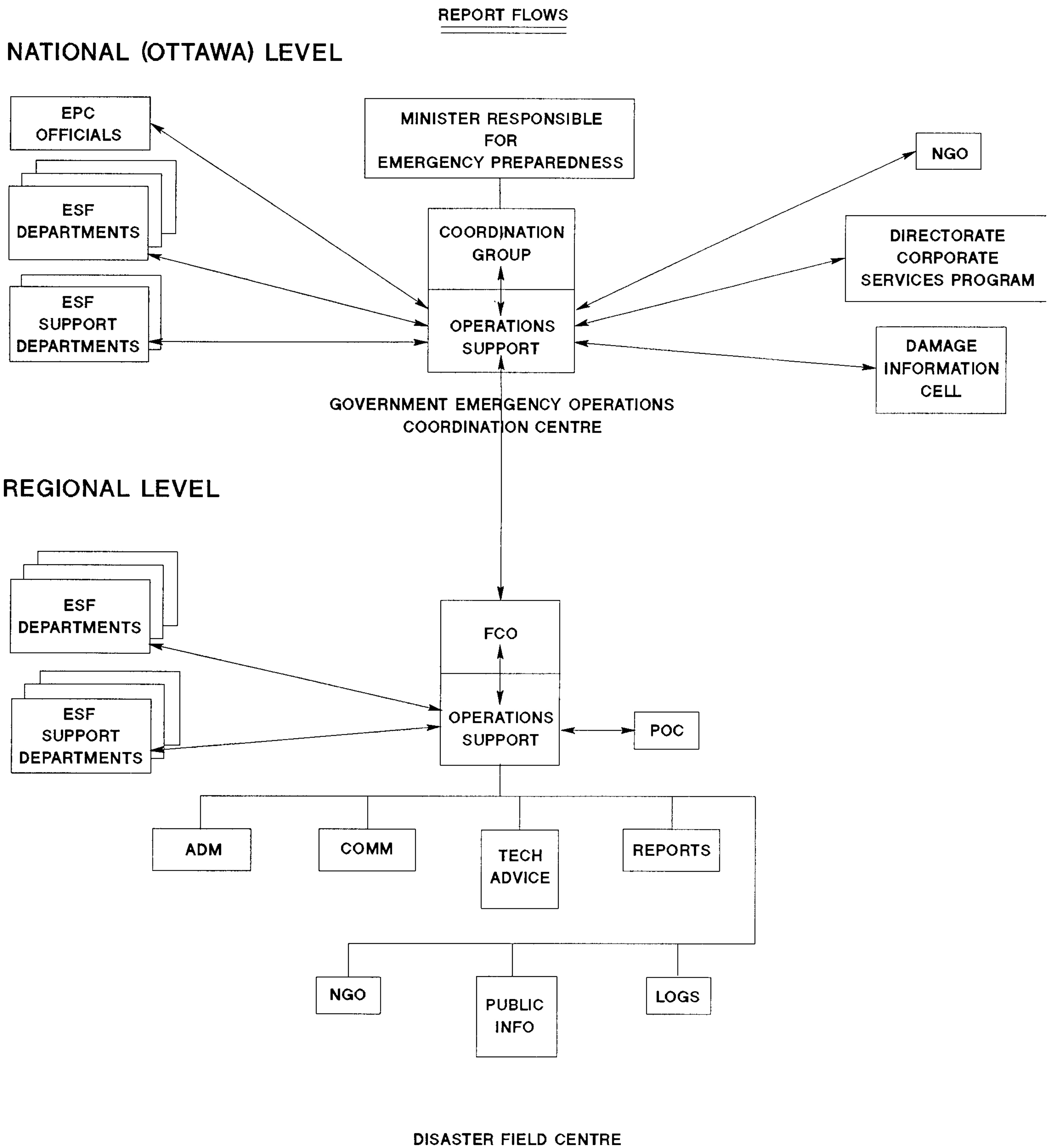
4. The status of ERFs # 4 and 9 have not yet been determined.

LIST OF ABBREVIATIONS

AGR - Agriculture Canada
AECL - Atomic Energy of Canada Limited
AECB - Atomic Energy Control Board
CAFC - Canadian Association of Fire Chiefs
CACP - Canadian Association of Chiefs of Police
CG - Coordination Group
COG - Control and Operations Group
CBC - Canadian Broadcasting Corporation
CPC - Canada Post Corporation
CMHC - Canada Mortgage and Housing Corporation
DFC - Disaster Field Centre
DND - Department of National Defence
DCSP - Directorate Corporate Support Program (EPC)
DOC - Department of Communication
DVA - Department of Veteran Affairs
EA - External Affairs
EC - Environment Canada
EIC - Employment and Immigration Canada
EMR - Energy, Mines and Resources
EPC - Emergency Preparedness Canada
ERF - Emergency Response Function
FC - Forestry Canada
FCO - Federal Coordination Officer
FIN - Finance
F&O - Fisheries and Oceans
FST - Federal Support Team
GSC - Geological Survey of Canada
GEOCC - Government Emergency Operations Coordination Centre
GIC - Governor in Council
HWC - Health and Welfare Canada
INA - Indian and Northern Affairs
ISTC - Industry, Science and Technology
JUS - Department of Justice
LAB - Labour Canada
LCG - Logistics Coordinations Group
MAC - Mining Association of Canada
NGO - Non Government Organization
NDOC - National Defence Operation Centre
PI - Public Information
PWC - Public Works Canada
POC - Provincial Officer Coordination
PEOCF - Provincial Emergency Operations Centre-Field

PEPO	- Provincial Emergency Preparedness Organization
PCO	- Privy Council Office
PGECC	- Provincial Government Emergency Coordination Centre
RCMP	- Royal Canadian Mounted Police
RC	- Revenue Canada
RD	- Regional Director
Sol Gen	- Solicitor General
SSC	- Supply and Services Canada
TB	- Treasury Board
TC	- Transport Canada

Table 4


REPORT FLOWS
NATIONAL (OTTAWA) LEVEL
EPC OFFICIALS
ESF DEPARTMENTS
ESF SUPPORT DEPARTMENTS
MINISTER RESPONSIBLE FOR EMERGENCY PREPAREDNESS
COORDINATION GROUP
OPERATIONS SUPPORT
NGO
DIRECTORATE CORPORATE SERVICES PROGRAM
DAMAGE INFORMATION CELL
GOVERNMENT EMERGENCY OPERATIONS COORDINATION CENTRE
REGIONAL LEVEL
ESF DEPARTMENTS
ESF SUPPORT DEPARTMENTS
FCO
OPERATIONS SUPPORT
POC
ADM
COMM
TECH ADVICE
REPORTS
NGO
PUBLIC INFO
LOGS
DISASTER FIELD CENTRE

THE NEED FOR EARTHQUAKE EDUCATION[1]

Ian G. Buckle
Deputy Director
National Center for Earthquake Engineering Research

ABSTRACT

In 1977 the United States Congress found that 1) all 50 States are vulnerable to the hazards of earthquakes, and at least 39 of them are subject to major or moderate seismic risk, including Alaska, California, Hawaii, Illinois, Massachusetts, Missouri, Montana, Nevada, New Jersey, New York, South Carolina, Utah, and Washington. A large portion of the population of the United States lives in areas vulnerable to earthquake hazards; and 2) earthquakes have caused, and can cause in the future, enormous loss of life, injury, destruction of property, and economic and social disruption. With respect to future earthquakes, such loss, destruction, and disruption can be substantially reduced through the development and implementation of earthquake hazards reduction measures, including (A) improved design and construction methods and practices, (B) land-use controls and redevelopment, (C) prediction techniques and early-warning systems, (D) coordinated emergency preparedness plans, and (E) public education and involvement programs. Education is seen in this extract from the Earthquake Hazards Reduction Act of 1977 to be one of five reduction measures to be undertaken under Public Law 95-124.

More than 10 years later, this need is even more urgent. A destructive earthquake is expected to occur, with almost 100 percent certainty, somewhere in the Eastern or Central United States before the year 2010. This means that every child in grade school today will most probably experience this most catastrophic of all natural disasters.

Knowing what to expect, how to prepare and how to respond to an earthquake is a proven method of mitigating the loss of life and property. Teaching this knowledge is the ultimate responsibility of today's educators.

[1] Text written in part by the late Robert L. Ketter.

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IAN BUCKLE

Dr. Ian Buckle, Deputy Director of the National Center for Earthquake Engineering Research and professor of civil engineering at SUNY/Buffalo, received both his undergraduate degree and his doctorates from the University of Auckland, New Zealand, where he later served as a member of the Civil Engineering Department. A past director of research and development at Computech Engineering Services and a past Vice President of Engineering for Dynamic Isolation Systems, Dr. Buckle has coordinated and participated in several international research projects and conferences. Co-author of the award-winning paper "Seismic Isolation - A Solution to the Earthquake Problems of the Precast Concrete Industry," Dr. Buckle is one of the world's leading experts in seismic isolation technology.

Madam Chairman, ladies and gentlemen,

It is my pleasure to be here this morning and speak to you about the need for earthquake education. This was one topic that was very close to the heart of Dr. Robert Ketter, the late Director of the National Center for Earthquake Engineering Research. It was his personal concern for the earthquake hazard in the East and Central U.S. and his conviction of the need for public awareness and education that has brought us together today. Under other circumstances, Dr. Ketter would be addressing you at this moment, but his sudden passing has intervened, and instead, I have the privilege of presenting the message that I believe he would have given to you at this time.

* * * * *

It is generally accepted that the outmost shell of the earth is composed of a dozen or so, very large and relatively rigid, crustal plates (Figure 1). These plates range from 70-150 kilometers thick, and they move slowly and continuously with respect to each other -- approximately several centimeters per year.

In the central Atlantic Ocean, along the mid-Atlantic ridge, the plates are moving apart and a new oceanic crust is continually being formed as molten lava rises within the mantle. At the boundaries of other plates, different situations exist. In some areas one plate is forced downward under another. In others; for example, along the San Andreas fault in California; plates slide relative to each other in a "stick-slip" type of motion and corresponding sudden releases of energy are responsible for the earthquakes which occur in California.

About 95% of the world's earthquakes occur along or near the boundaries of these crustal plates. However, many very destructive ones occur within the plates themselves -- far away from the boundaries. The reasons for this intraplate seismic activity are not readily apparent.

Currently, the accepted explanation is as follows: More than several hundred million years ago the central part of the United States was pushed upward by molten rock from the underlying mantle. This material was heavier than the surrounding rocks, and when the upwelling ceased, the entire region subsided. Seas covered the area, laying down thick layers of sediment which eventually hardened into limestone, sandstone and shale. Later, during the various çycles of plate movement, rifting -- faulting -- took place. Still later, molten rock moved upward along these faults, cooling before it reached the surface. Once again, the ocean advanced over the area, depositing sands, clays and gravels. At the present moment, due to the continual spreading that is occurring in the mid-Atlantic, these ancient faults are subjected to east-west compressive forces. These forces acting on these faults are responsible for most intraplate earthquakes. Unfortunately, we do not know the magnitude or distribution of the forces that exist, or even the locations of all of the ancient faults. We, therefore, cannot predict with any certainty when or where the next crustal fracture -- and therefore the next earthquake -- will occur.

In Figure 2, there is shown the locations of all known earthquakes that have occurred in the United States through 1970 and in Figure 3, we have all those events in the Eastern and Central United States since 1534.

As stated in the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124):

> "All 50 States are vulnerable to the hazards of earthquakes, and at least 39 of them are subject to major or moderate seismic risk, including Alaska, California, Hawaii, Illinois, Massachusetts, Missouri, Montana, Nevada, New Jersey, New York, South Carolina, Utah, and Washington. A large portion of the population of the United States lives in areas vulnerable to earthquake hazards."

The largest earthquakes, or series of earthquakes, known to have occurred in North America were intraplate earthquakes that occurred in the Mississippi Valley near New Madrid, Missouri, in 1811 and 1812. It has been estimated that three had surface-wave Magnitudes of 8.6, 8.4 and 8.8 on the Richter scale. Church bells, 1000 miles away in Boston, rang; the earth was observed to "roll" in waves a few feet in height; large areas of land were uplifted, while much land sank; existing lakes drained, and others were created; and sand blows spread debris over large areas, where it is still visible today.

Another major north American intraplate earthquake occurred in Charleston in 1886. There, the Magnitude was 7.7.

The earthquake problem in the central and eastern part of the United States is compounded by the fact that rocks in these regions of the country transmit seismic energy much more efficiently than do those that exist on the west coast. For example, as shown in Figure 4, the damage area for the 1811 New Madrid earthquake, which had a similar Magnitude as the San Francisco earthquake of 1906, resulted in an area of similar damage that was 15 times larger. The size of the area affected by the Charleston earthquake is also very large.

Another factor that must be taken into account: Large numbers of people live and work in these parts of the country. Eighty percent of the population of the United States live East of Rockies; and 60% live East of Mississippi. Further, very few structures have been designed or built for these circumstances. The consequences of a major seismic event, therefore, would be felt by many.

All major earthquakes that have occurred in the eastern and central parts of the United States have exhibited precursor activities. With that in mind, consider Figure 5 which shows the locations of over 2000 earthquakes that were recorded in and around the New Madrid area between 1974 and 1983 -- and I should here note that they are still occurring. On this evidence alone it is difficult for anyone to say that this region is not a prime candidate for a future major seismic event.

The most frequently asked, and the least satisfactorily answered questions concerning earthquakes is, "When will the next major one happen?" Unfortunately, seismology cannot now, nor will it be able in the near future to answer that question in a deterministic fashion; that is, accurately predict when an earthquake will occur. A probabilistic assessment, however, is possible, and this has been done for New Madrid as well as a number of other potentially active sites. Based on those calculations, the probability of a destructive earthquake occurring at a given, singular, geographic site in the eastern part of the country within the next 15 to 25 years is relatively low. However, the probability of one occurring somewhere in the eastern United States before the year 2000 can be considered better than 75 to 95 percent. Before the year 2010, nearly 100 percent.

A destructive earthquake need not be high on the Richter scale. A magnitude 6 event can be devastating in its effect on structures that have little or no lateral resistance. During the 1971 San Fernando Earthquake, bridges collapsed on the Golden State Freeway near Los Angeles. This earthquake had a magnitude of 6.4. The Olive View Hospital, which was designed and built to meet the seismic code of its day, was damaged beyond repair during this same earthquake. We are all familiar with the tragedy in Armenia after a magnitude 6.9 earthquake in December of last year. At least 25,000 people are dead, and thousands of structures destroyed. In the magnitude 6.1 Whittier earthquake of 1987, damage to school buildings alone amounted to $24 million. It should be noted that all of these examples are for earthquakes in areas where seismic design has been practiced for many years. It follows that loss of life, injury and property damage will be even more severe in areas without seismic design codes.

Johnson and Nava (1985) have estimated the probability of reoccurrence of two large New Madrid earthquakes for two separate time periods -- by the end of the century, and by the year 2035. The earthquakes they considered were presumed to have surface-wave Magnitudes of 6.3 and 8.3 on the Richter scale, the latter corresponding to one of the 1811 quakes. It was found that the probability of occurrence between now and year 2000 for the smaller earthquake would be 40 to 60 percent; for the larger, only 0.3 percent to 1 percent. By the year 2035, however, there would be an 86 to 97 percent probability of occurrence for the smaller but potentially destructive one, and a 2.7 percent to 4 percent probability of occurrence for the larger and certainly catastrophic event.

A generalized isoseismal map for the larger of the two postulated New Madrid earthquakes is shown in Figure 6. Here the intensities of shaking that would be experienced are indicated by Roman numerals. They are based on Modified Mercalli Intensity values. For example, for an Intensity of VI; that is, for Chicago, Pittsburgh, Knoxville, etc.; the shaking would be felt by everyone. Many people would be frightened; dishes, glassware and some windows would be broken; church and school bells would ring; and trees and bushes would shake visibly. In region VII; that is, for St. Louis, Carbondale, and Nashville; there would be general fright and signs of panic; some masonry walls would fall and frame-houses, if not securely bolted down, would move on their foundations; branches would break on trees, and cracks would appear in wet soil and on steep slopes. In the general vicinity of the epicenter where the Intensity has been projected to be X; that is, in Memphis; most masonry and frame structures would be destroyed with their foundations; there would be serious damage to dams, dikes and embankments, and there would be large landslides. Railroad tracks would be bent.

Should the postulated event occur at night, when most people are in their homes -- which are primarily of wood construction -- it is estimated that in the six cities nearest to the event -- Memphis, Paducah, Carbondale, Evansville, Poplar Bluff, and Little Rock -- almost 700 people would die due to structural failure. If the event occurred during the daylight hours, this number would increase to almost 5000.

Damage to transportation systems would seriously hamper rescue and relief efforts. Railway networks would be similarly affected. Riverports would be extensively disrupted, and there would be partial or limited availability of major airport facilities. These six cities would experience serious impairment or loss of their utility systems (electric, water, gas, and sewers).

Were the earthquake to occur at a time when highwater conditions existed, flooding of low-lying areas would take place. Widespread individual or small-group structural fires would occur, but it is unlikely that there would result giant fires, or conflagrations. For this six city region of major impact, four hundred and sixty thousand (460,000) persons would require shelter due to damaged residences. Finally, it is estimated that restoration and replacement costs would exceed $51 billion.

In summary:

1. Earthquakes are the most catastrophic of all natural disasters.

2. Earthquakes occur in the United States. At least 39 states are subject to either a major or moderate seismic risk.

3. A destructive earthquake is expected to occur somewhere in the U.S. within the next 25 years.

4. It follows that every child in school today will most probably experience an earthquake during his or her lifetime. The impact of this event will of course vary from child to child depending on the location and magnitude of the earthquake and how well the child has been prepared to cope with this event.

5. Given the high mobility of families in the U.S., even children now living in low risk states have a more than 50-50 chance of one day living in a moderate to high risk state.

6. Knowing what to expect, how to prepare, and what to do during and after an earthquake must therefore, be a **mandatory component** of every child's education regardless of where they live today.

7. The vital need for quality earthquake education is therefore self evident. I know it, and you know it. It remains for us to decide how best to achieve this objective and that, of course, is why we are here today.

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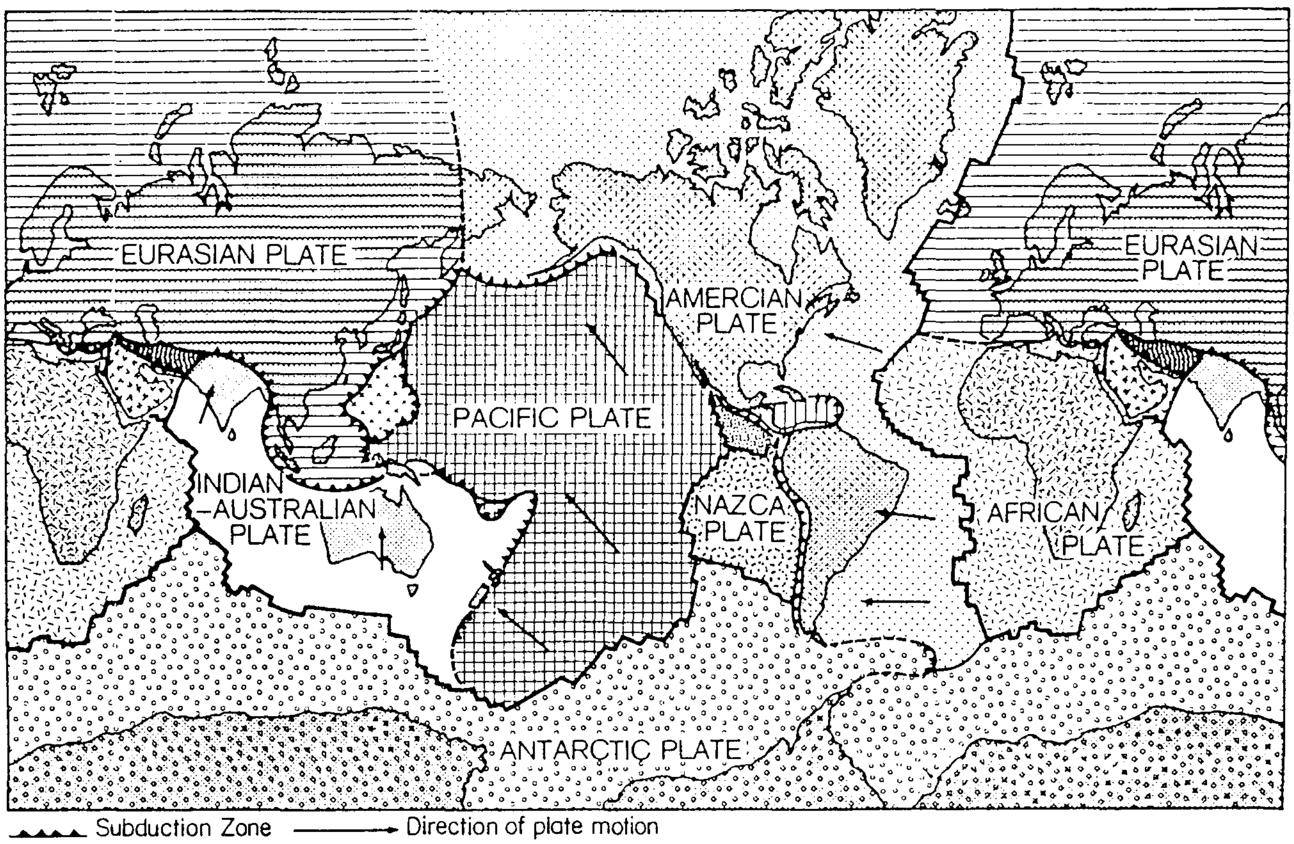

FIGURE 1

Tectonic plate map of the world, showing names of the seven largest plates and indicating subduction zones and the directions of plate movement

Source: "Earthquake Resistant Design for Engineers and Architects" by David J. Dowrick, Wiley, 1987

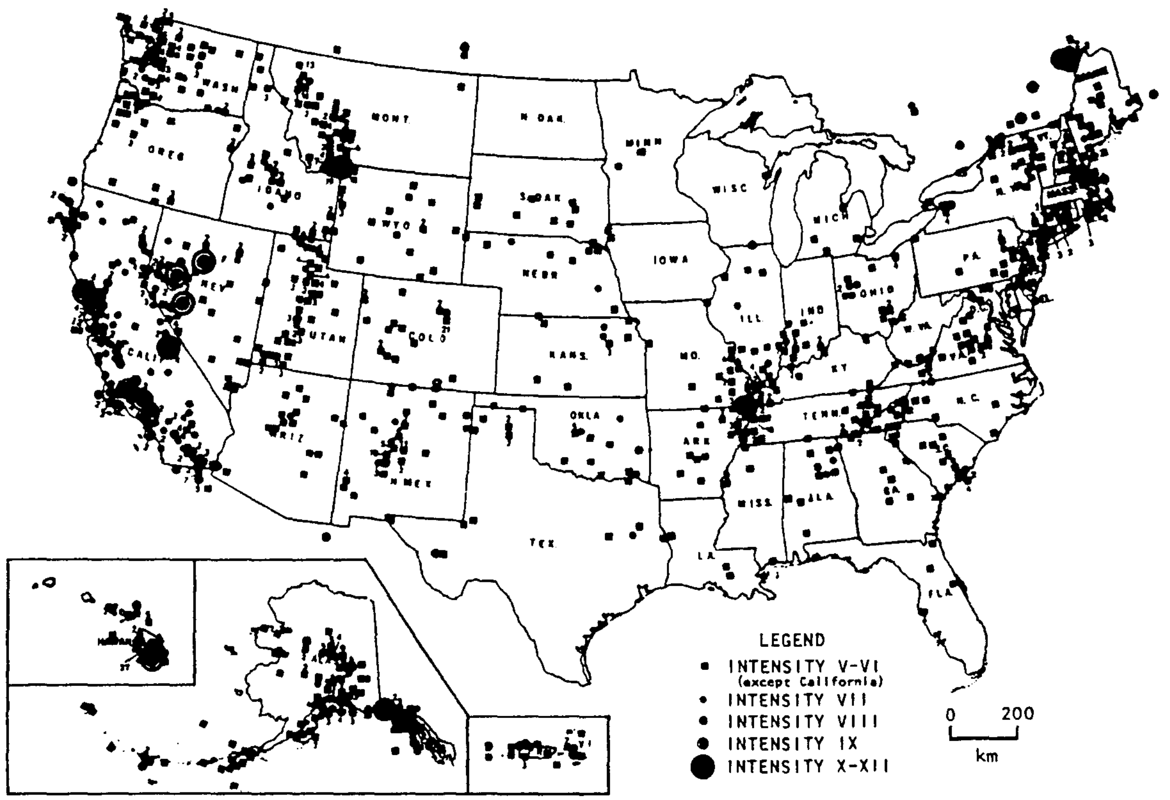

FIGURE 2

Earthquakes with maximum Modified Mercalli intensities of V or above in the United States and Puerto Rico through 1976

Source: "An Introduction to the Seismicity of the United States" by S.T. Algermissen, EERI Monograph Series, 1983

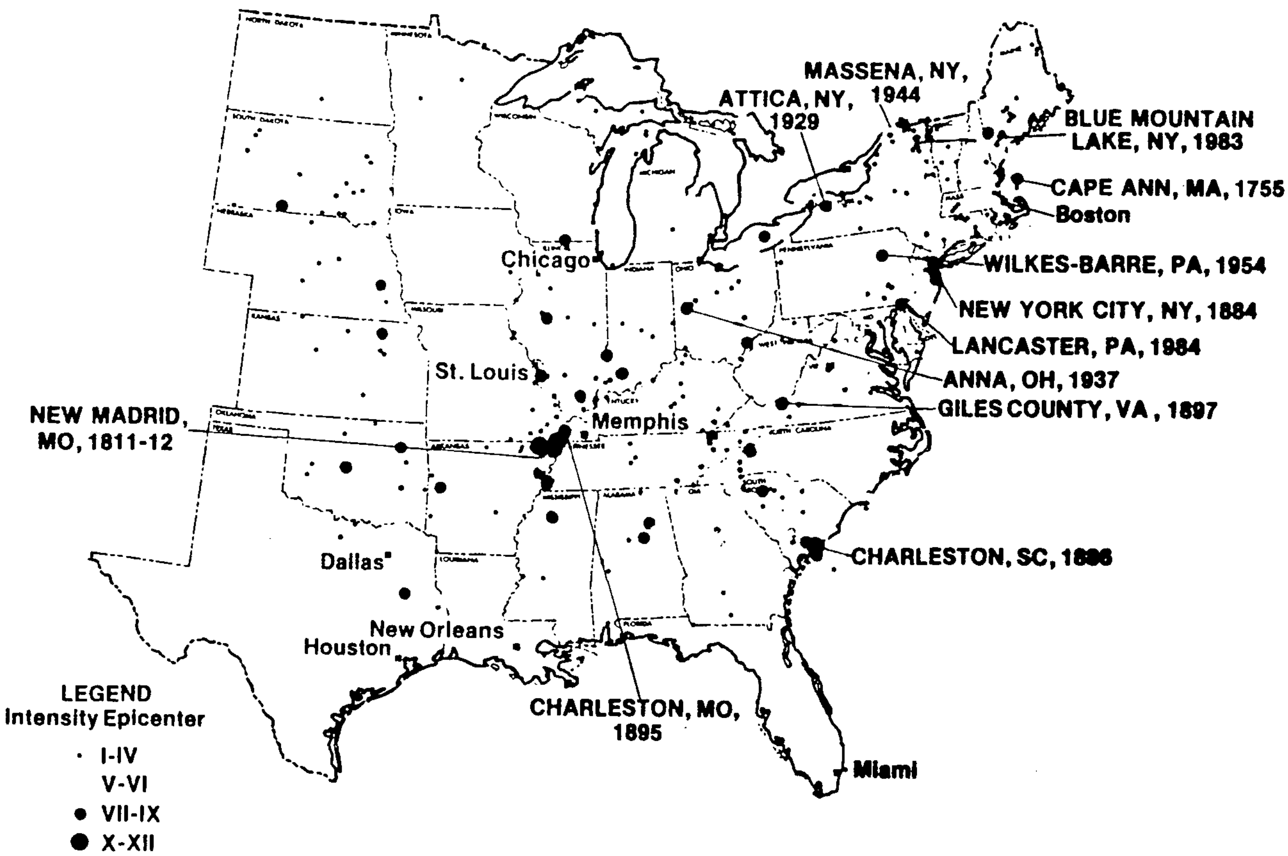

FIGURE 3

Eastern United States Earthquakes (1534-1984)

Source: United States Geological Survey

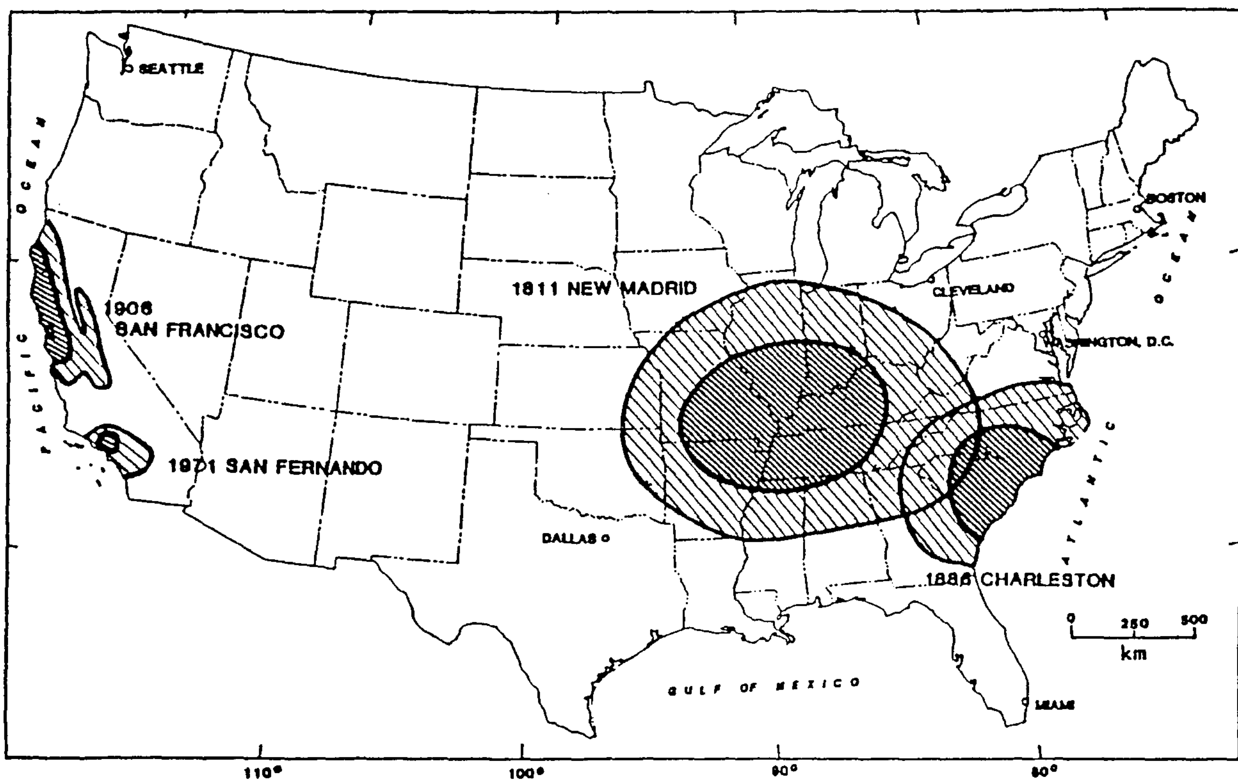

FIGURE 4

Regional areas affected by major earthquakes in the United States

Source: "Geology in the Siting of Nuclear Power Plants" Hatheway, A.W. and C.R. McClure, Eds., 1979. Reviews in Engineering Geology, Vol. 4, pages 67-94. Geological Society of America. Ed. note: Adapted from Nuttli, O.W., "Seismicity of the Central United States".

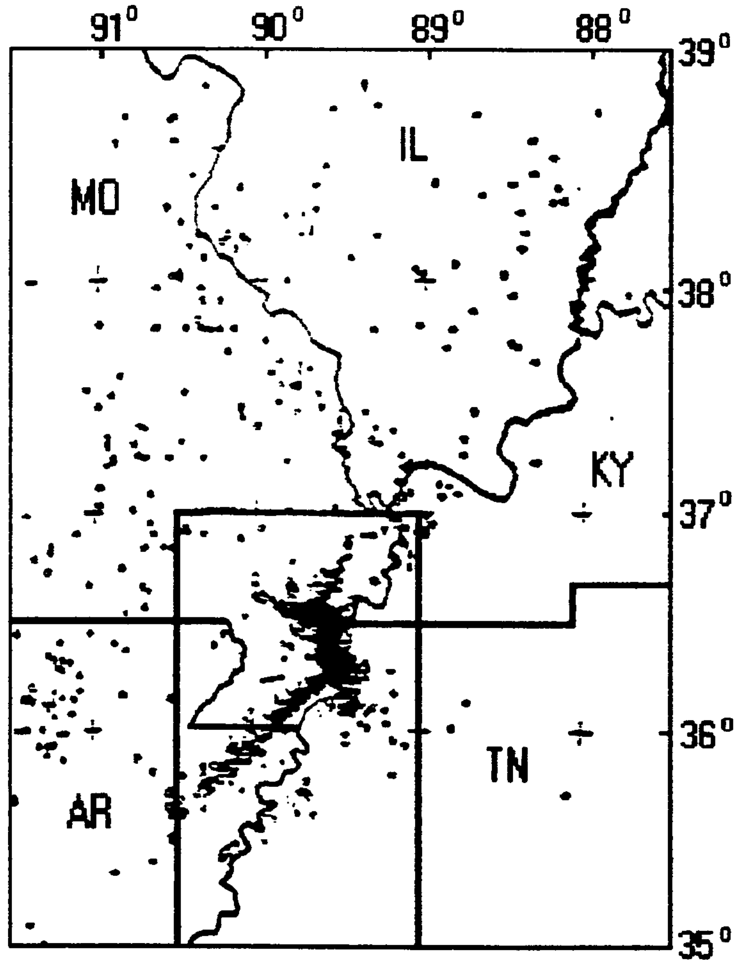

FIGURE 5

Epicenters of earthquakes in the New Madrid Zone from 1974 to 1983

Source: "Recurrence Rates and Probability Estimates for the New Madrid Seismic Zone". Journal of Geophysical Research, Vol. 90, No. B8, pages 6737-6753 (July).

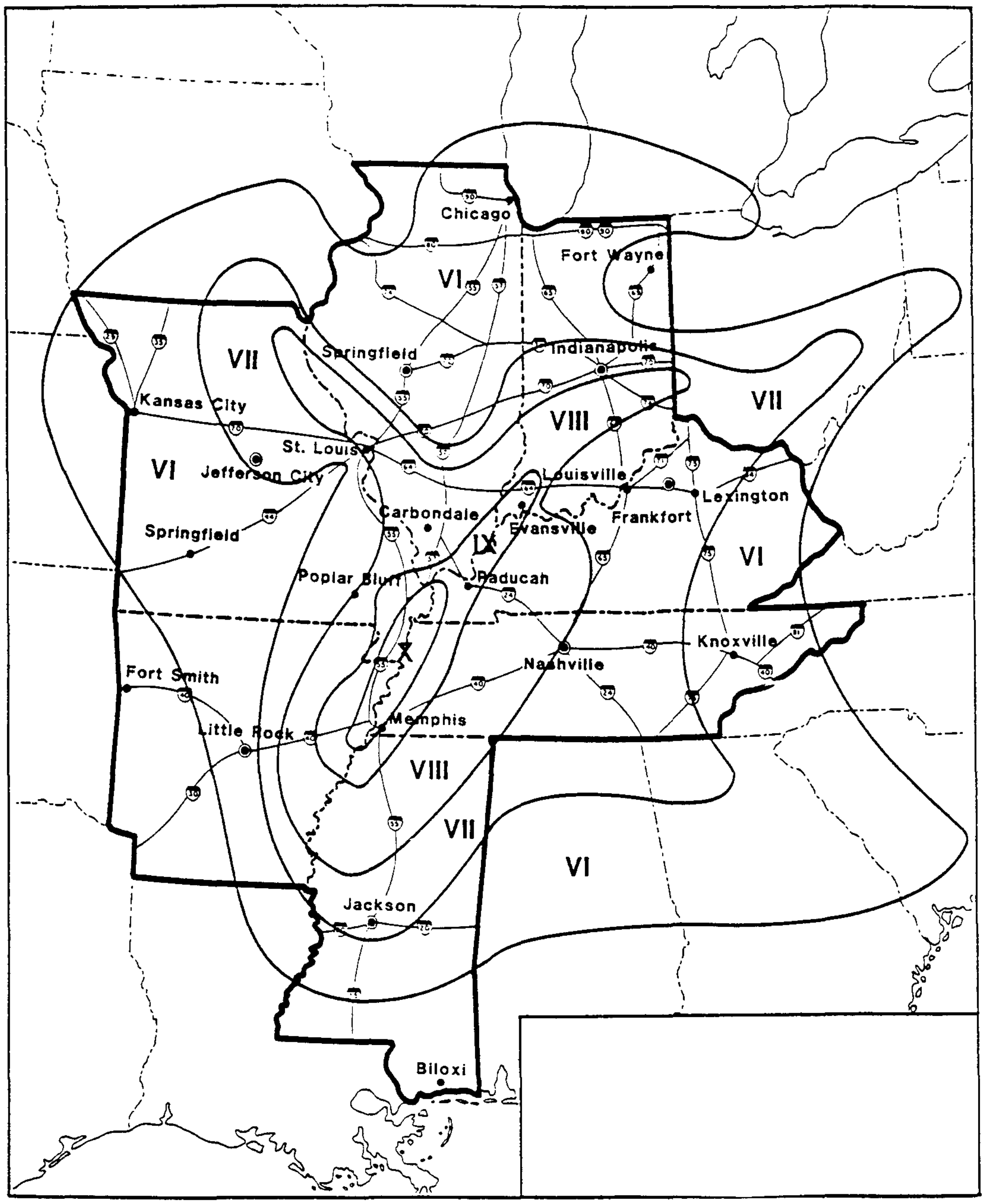

FIGURE 6

Isoseismals of intensity of ground shaking for a postulated M = 8.3 earthquake in the New Madrid Zone

Source: Central United States Earthquake Consortium, Yearly Meeting - 1985

SEISMIC SAFETY OF IDAHO SCHOOLS

Roy M. Breckenridge and Kurt L. Othberg[1]
Research Geologists
Idaho Geological Survey
University of Idaho

Kenneth F. Sprenke
Associate Professor of Geophysics
Department of Geology and Geological Engineering
University of Idaho

ABSTRACT

Idaho is an earthquake state. It ranks fifth highest in the nation in overall seismic zoning. The two largest earthquakes in the contiguous United States since 1952 occurred in Idaho or within a few miles of the Idaho border.

The seismic threat to the public schools in Idaho is critical. Many of our school buildings were built long before acceptable codes for earthquake-resistant buildings were enacted. The Idaho Bureau of Disaster Services together with the State Department of Education received funding from the Federal Emergency Management Agency for an Earthquake Hazard Mitigation Assistance project. This project developed seismic safety standards to be submitted to the State Board of Education. The project was directed by the Idaho Geological Survey at the University of Idaho and included experts from the disciplines of geology, geophysics, structural engineering, and education.

Our study had three components. First, the geotechnical group characterized the earthquake threat in the state based on the record of historical seismicity and interpretations of the geologic setting. Second, the structural engineering group mailed questionnaires to all the schools in the state and analyzed the seismic vulnerability of approximately 670 school buildings in 109 of the 115 school districts in Idaho. Finally, the education group studied nonstructural mitigation measures necessary to minimize the threat of injury to school occupants and investigated establishing a school-based disaster preparedness program. We completed the project in December 1988 and presented the results and recommendations to the Department of Education.

There are three recommendations as a result of this study:

1. Future school building construction and renovation should comply with the current Uniform Building Code (1988 UBC).

[1] Speaker

2. All school buildings in the state must be able to withstand seismic shaking of Intensity VII (Modified Mercalli scale) with priority given to the high risk buildings in the most hazardous parts of the state.

3. Every school building in Idaho is at some risk. Therefore, a program of planning for earthquake preparedness should be implemented on a statewide basis.

Standards based on the recommendations of our study will be presented to the State Board of Education in June 1989. Mr. Eldon Nelson of the Idaho Department of Education will present details of the standards recommended and discuss implementation. At this point the project has met with strong support from all parties involved and we anticipate substantive standards will be adopted.

KURT OTHBERG

Mr. Kurt Othberg was a research geologist in the state of Washington. Currently he is a research geologist for the Idaho Geologic Survey and runs their Earth Science Education program.

INTRODUCTION

Idaho is an earthquake state. We rank fifth highest in the nation in overall seismic zoning. The two largest earthquakes in the contiguous United States since 1952 have occurred in Idaho or within a few miles of the Idaho border.

The seismic threat to the public schools in Idaho is critical. Many of our school buildings were built long before acceptable earthquake resistant building codes were enacted. The purpose of this project was to develop seismic safety standards for Idaho schools to be submitted to the Idaho State Board of Education. This study had three components. First, we evaluated the seismic hazard in the state from the geological point of view. Second, we analyzed the seismic vulnerability of approximately 670 public school buildings in the state. Finally, we investigated the establishment of a school-based disaster preparedness program.

THE SEISMIC THREAT IN IDAHO

Seismic intensity (Figure 1) is a twelve point scale that describes the effects of shaking. From the point of view of school safety in Idaho, seismic intensity level VII is a critical threshold. At this intensity and above, damage is considerable in poorly built or badly designed structures. Two children were killed by intensity VII shaking at Challis in 1983. School buildings at Challis, Mackay, Arco, and Gooding were condemned as a result of intensity VII shaking. Intensity VII shaking occurs somewhere in the Idaho region at least once every 3 to 4 years.

To evaluate the shaking hazard in Idaho, we have developed maps of the state depicting probable seismic intensities. This report summarizes the results. Appendix A by Sprenke and Breckenridge gives the details of the geotechnical study. The intensities shown have a 90% chance of not being exceeded in any 50 year period. This is a standard criteria endorsed by engineering associations and commonly used by state and federal agencies for hazard mapping.

The seismic intensity experienced by a structure depends on two factors: bedrock acceleration and site conditions. The ideal site condition is bedrock. Structures on bedrock will shake at minimum levels during an earthquake. The worst local site condition is unconsolidated material. At certain thicknesses, the elastic properties of such foundation materials may cause magnification of bedrock acceleration. The result can be extreme shaking at the surface.

Figure 2 shows the probable seismic intensities for structures tied to bedrock in the State of Idaho. Figure 3 shows the actual historic record of shaking in the same units. The difference is substantial. In the Boise area, for example, structures tied to bedrock should experience no more than intensity V shaking; however, the historical record shows that intensities as high as IX can occur in the Boise area if site conditions are poor.

Figure 2 was derived directly from state and federal maps of maximum probable acceleration in bedrock (Algermissen et. al., 1982; Greensfelder, 1978). Accelerations were converted to seismic intensities using an empirical formula.

Figure 3 was derived from the actual historical record of seismic intensities in Idaho for the past century. Extreme value statistics were used to derive 50-year seismic intensities in the same manner that hydrologists predict 50-year floods (Gumbel, 1958).

A compilation of the results of our hazards study is summarized on Figure 4. This map divides the state into three geographical areas on the basis of relative seismic shaking hazard. A comparison of this map with the 1988 Uniform Building Code (UBC) seismic zone map (Figure 5) shows agreement. The most hazardous areas delineated in our study generally correspond with UBC zones 3 and 4. The less hazardous areas are in UBC zone 2b. Users should note that all seismic boundaries are gradational. At this scale and state of knowledge there is no significant difference in the maps. We therefore recommend the UBC seismic zone map be used for development of school safety standards.

VULNERABILITY OF PUBLIC SCHOOL BUILDINGS IN IDAHO

We have many older schools not built to modern earthquake resistant standards. These school buildings may suffer considerable damage at intensity VII. Individual schools should be reinforced or replaced if it can be shown that they may experience intensity VII shaking.

On the other hand, it is impractical at the present time to upgrade Idaho schools to survive intensity VIII or IX. At such intensities, even well-built, substantial buildings will suffer considerable damage. One defense against such earthquakes lies in emergency preparedness training for school personnel and earthquake response training for the children. Another defense lies in careful site selection for future school construction. Figure 2 shows that less than 1% of the area of Idaho is subject to intensity VIII shaking if structures are on bedrock. Hence, careful site selection alone can greatly reduce the hazard of large earthquakes to future schools.

Figure 2 shows that 26% of the area of the state is subject to intensity VII shaking even if the buildings are on bedrock. These areas are in central Idaho and in eastern Idaho both to the north and south of the Snake River Plain.

Figure 3 shows that an additional 38% of the state may experience shaking at intensity VII or higher if the historic record of worst-case shaking can be believed. Using such worst-case conditions, Sack and Lavin (Appendix B) estimated the damage ratios for all individual school buildings in the state. This data was based on a questionnaire survey of school type construction with no direct information on the site conditions.

A summary of the data for 670 school buildings in the state as collected by Sack and Lavin is shown in Table 1. This table lists for each school building: a) the possible building types (see Table 2); b) the risk estimated for that building class (M=Moderate risk, H=High risk, E=Extreme risk); c) the year of construction; d) the foundation type (1=spread footings; 2=concrete mat; and 3=piling foundation); and e) the enrollment of the school. Also, for each school district, we have listed the worst-case expected Modified Mercalli intensity level(s). A question mark (?) indicates missing data.

Table 2 lists the building classes and the risks assigned to them by Richard Nielson (Department of Civil Engineering, University of Idaho) for this study. These risks are based soley on the type of construction determined from the survey performed by Sack and Lavin. The building risks in Table 1 show that many school buildings in Idaho are at "extreme" risk if seismic shaking should occur. The likelihood of shaking can be determined from the seismic hazard maps in Figures 2,3,4.

EARTHQUAKE PREPAREDNESS

At all levels of seismic risk, non-structural mitigation measures are necessary to minimize the threat of injury to the children and staff. Even at low shaking levels injury can be suffered from the movement of building contents and attachments. At high shaking levels earthquake response actions can be life saving. Marten has presented an outline of non-structural earthquake considerations in Appendix C. We have developed a prototype of a earthquake education booklet in Appendix D.

RECOMMENDATIONS

1. All future school building construction and renovation should comply with the Unified Building Code standard. The current (1988) UBC seismic zone map appears to be adequate.

2. All school buildings in the state of Idaho must be able to withstand seismic shaking of intensity VII. Certainly, those schools identified as being under "extreme" risk in Table 1 do not meet this standard. The highest priority for retrofitting of these schools should be given to those that are located in the most hazardous areas of the state as shown in Figures 4 or 5.

3. Every school building in the state of Idaho is at some risk from earthquakes. Therefore a program of earthquake preparedness planning should be implemented on a statewide basis.

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Modified Mercalli Intensity Scale of 1931
(abridged) (NOAA)

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like a passing truck. Duration estimated.

IV. During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.

V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.

VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with their foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

Figure 1. The seismic intensity scale.

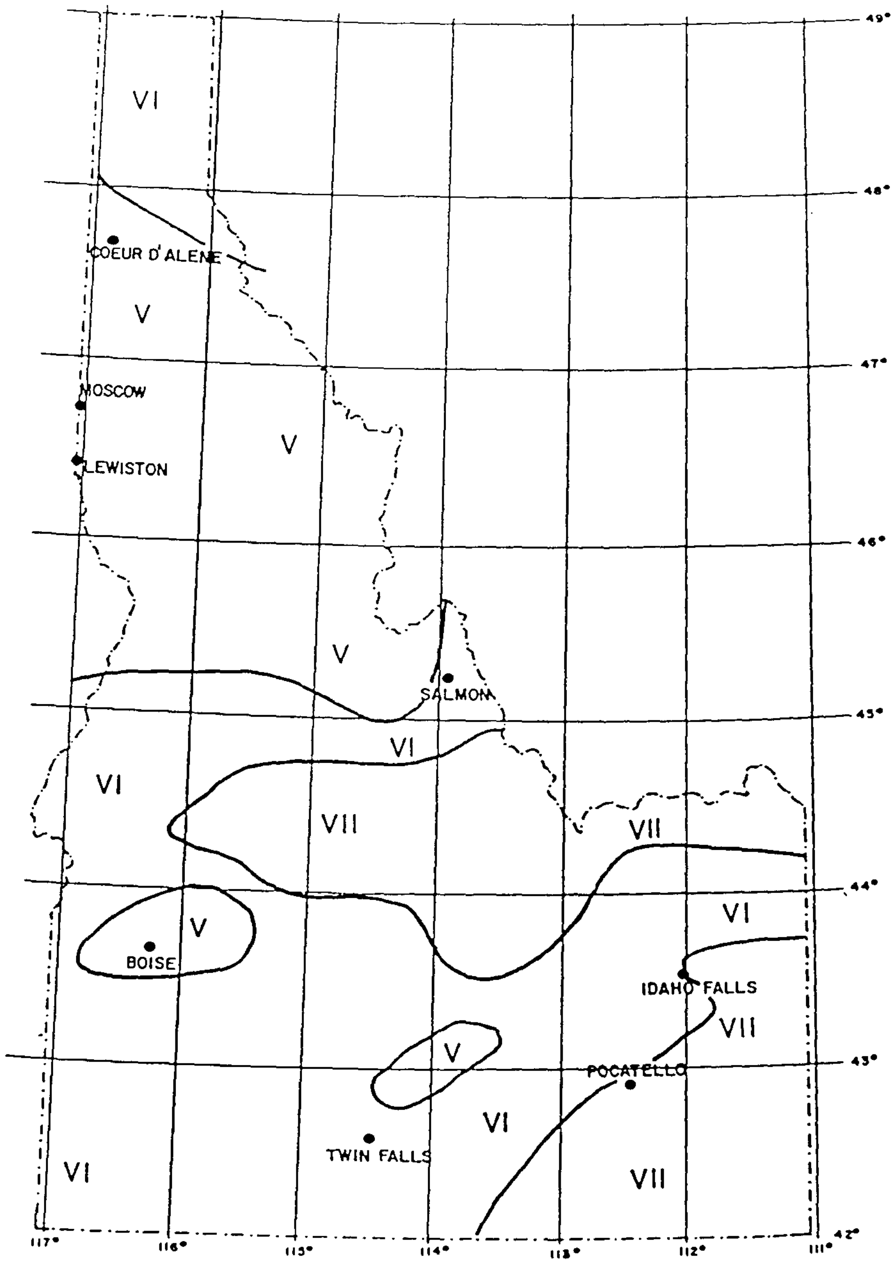

Figure 2. Map of seismic intensities on bedrock in Idaho with a 90% probability of not being exceeded in 50 years.

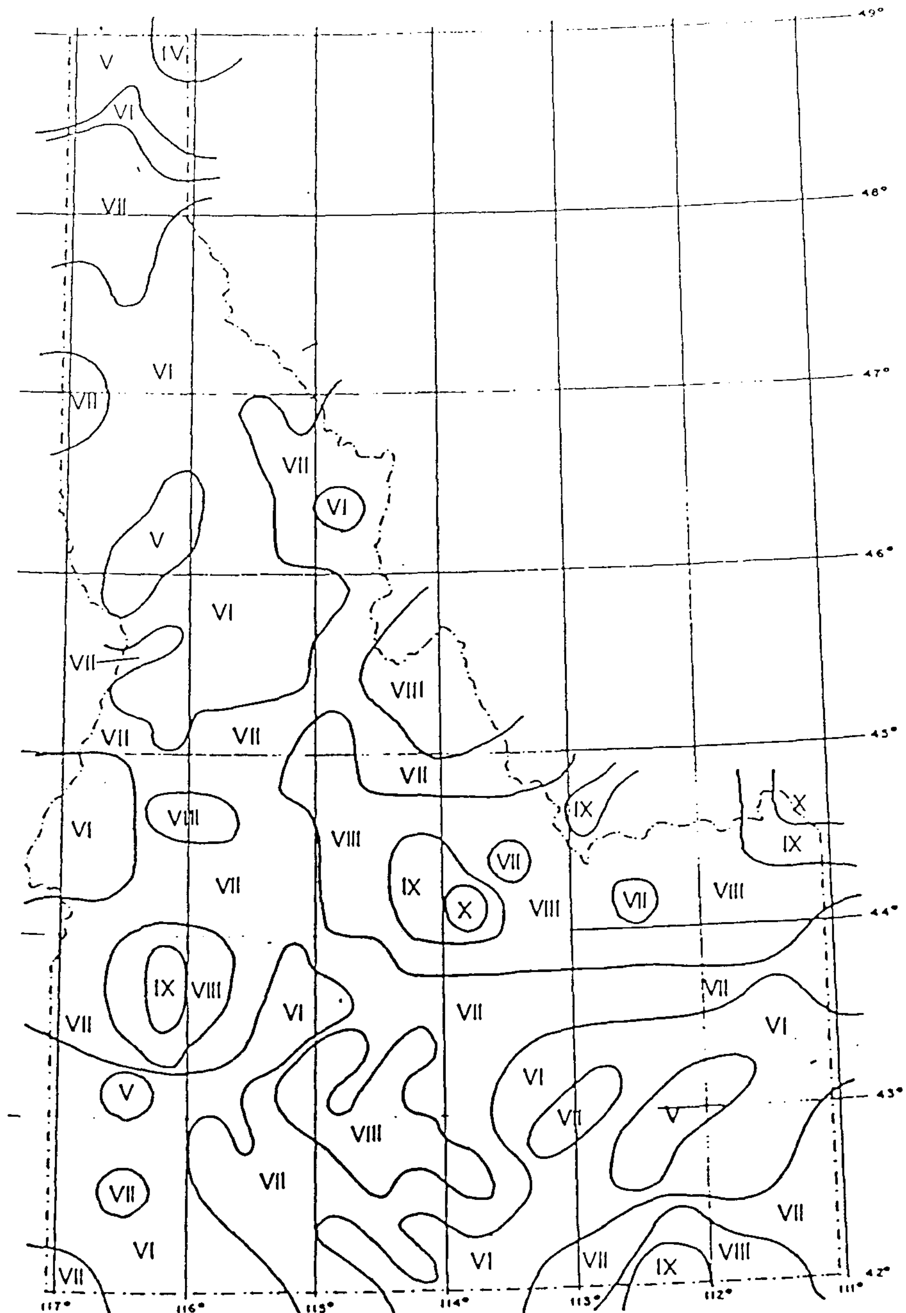

Figure 3. Map of seismic intensities on the ground surface in Idaho with a 90% probability of not being exceeded in 50 years.

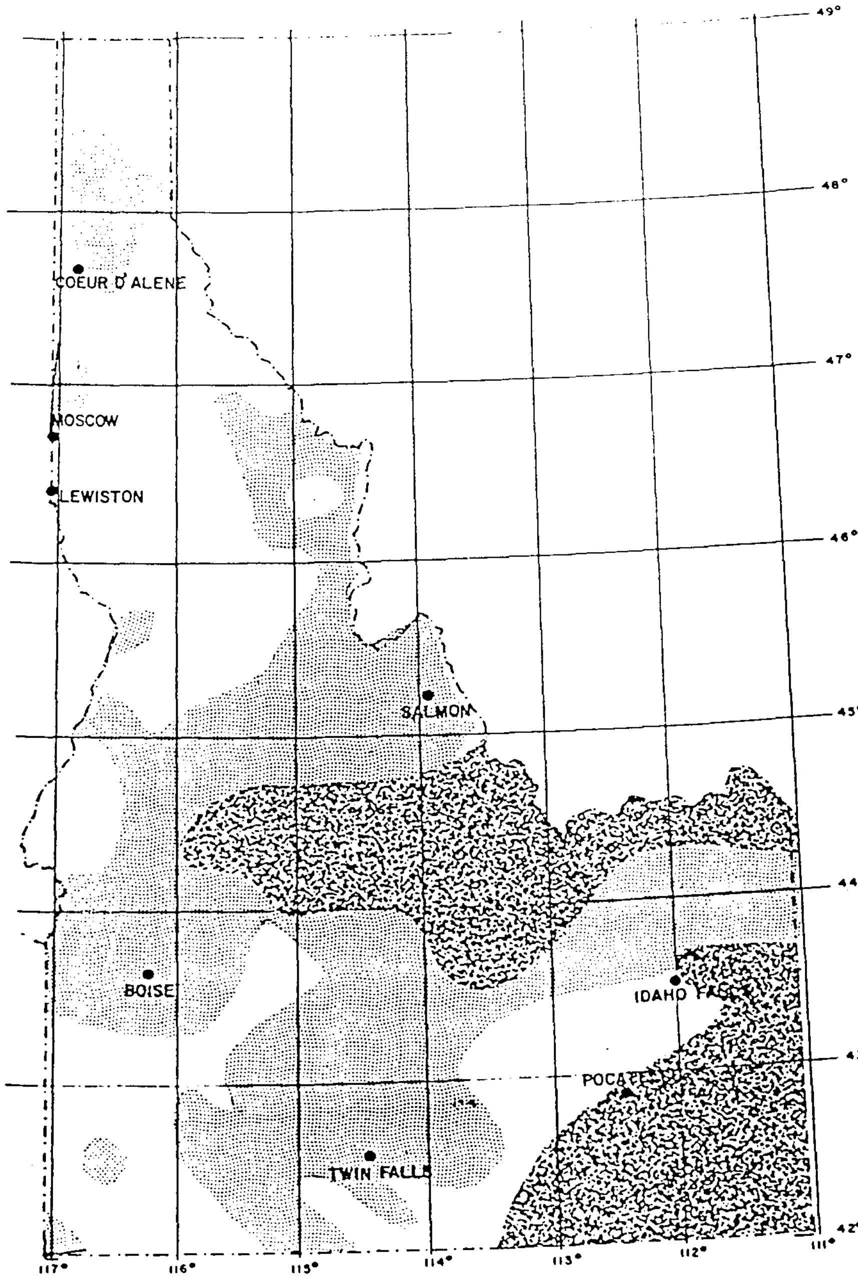

Figure 4. Map of Idaho showing areas of relative seismic shaking hazard. The darkest areas have the greatest hazard and the lightest areas have the least.

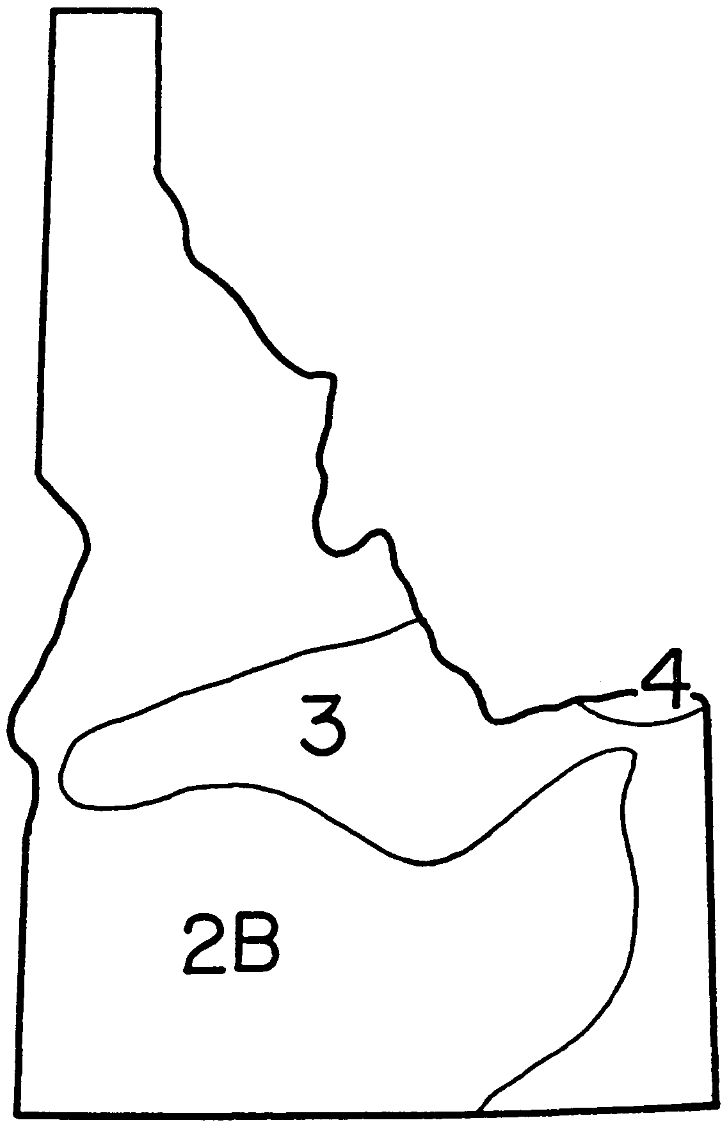

Figure 5. Unified Building Code (1988) seismic zone map for Idaho.

Table 1-Data Used in Analysis

County: Ada
School District No.: 1
Worst Case MMI Intensity Level: IX

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Boise HS-Main	3,6	E	1903	1	1569
Boise HS-IA	1,3,4,6	E	?	1	1569
Boise HS-Gym	4,6	E	1936	1	1569
Borah HS-Main	3	E	1958	2	1900
Borah HS-IA	3	E	1959	2	1900
Borah HS-Gym	3	E	1959	2	M1900
Capital HS-Main	4	E	1964	1	1800
Capital HS-Boiler	4	E	1964	1	1800
Capital HS-Plntrm	4	E	1969	1	1800
East JHS-Main	3,4,6	E	1953	2	870
East JHS-IA	2	M	?	2	870
East JHS-Portables	1	M	?	2	870
Fairmont JHS-Main	3,4,6	E	1964	1	900
Hillside JHS-Main	1	M	1961	1	800
North JHS-Main	3,4,6	E	1936	1	750
North JHS-Cafeteria	3,6	E	1969	1	750
South JHS-Main	3,4,6,7	E	1948	1	870
West JHS-Main	3	E	1953	1	860
West JHS-IA	2	M	1970	1	860
West JHS-Cafeteria	6	M	1968	1	860
Adams Elem	3,4,6,7	E	1955	1	150
Amity Elem	5	M	1977	1	797
Campus Elem	3,4,6	E	1952	1	250
Cole Elem-2 Story	5	M	1910	2	500
Cole Elem-1 Story	8	H	1951	2	500
Cole Elem-Gym	1	M	1940	2	500
Collister Elem	3	E	1912	1	324
Franklin Elem-Main	5	M	1936	1	500
Franklin Elem-Annex A	1	M	1974	1	500
Franklin Elem-Annex B	1	M	1920	1	500
Garfield Elem	3,4,6	E	1929	1	739
Hawthorne Elem	6	M	1958	2	500
Highlands Elem	6	M	1961	1	300
Hillcrest Elem	3	E	1959	2	458
Jackson Elem	3	E	1960	1	451
Jefferson Elem	3,4,6	E	1949	1	491
Koelsch Elem	3	E	1956	1	450
Liberty Elem	4	E	1984	2	870
Longfellow Elem-Main	3	E	1947	1	235
Longfellow Elem-Gym	6	M	1969	1	235
Lowell Elem	3	E	913	1	500
Madison Elem	3,4,6	E	1953	1	152
Maple Grove Elem-Main	1	M	1969	2	550
Maple Grove Elem-Annexes	1	M	1969	2	550

Table 1-Data Used in Analysis
(continued)

County: Ada
School District No.: 1
Worst Case MMI Intensity Level: IX

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
McKinley Elem	3,4,6	E	1951	1	450
Monroe Elem	5	M	1953	1	300
Mountain View Elem	1	M	1959	1	446
Owyhee Elem	6	M	1969	1	361
Pierce Park Elem	5	M	1937	1	580
Roosevelt Elem	3,4,6	E	1919	1	375
Taft Elem	3	E	1960	1	490
Valley View Elem	1	M	1968	2	486
Washington Elem	3,4,6	E	1917	1	300
Whitney Elem	5,8	H	1923	1	475
Whittier Elem	3,4,5,6	E	1948	1	400
Lincoln School	3,4,6	E	1946	2	100

<u>Table 1-Data Used in Analysis</u>
(continued)

County: Ada
School District No.: 2
Worst Case MMI Intensity Level: VIII-IX

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Centennial HS	6	M	1987	2	1750
Meridian HS-Main	6	M	1974	1	1750
Meridian HS-Auditorium	6	M	1974	1	1750
Meridian HS-Gym	6	M	1974	1	1750
Meridian HS-Vo-Tech	6	M	1980	1	1750
Meridian HS-Shop	6	M	1974	1	1750
Meridian HS-Cafeteria	6	M	1980	1	1750
Lake Hazel MS	6	M	1980	2	1100
Lowell Scott MS	6	M	1972	2	820
Meridian MS-Main	6	M	1960	2	1000
Meridian MS-DEd	5	M	1982	2	1000
Meridian MS-Cafeteria	6	M	1980	2	1000
Meridian MS-Gym	6	M	1983	2	1000
Meridian MS-Shop	6	M	1960	2	1000
Meridian MS-Clsrm 1	6	M	1960	2	1000
Meridian MS-Clsrm 2	6	M	1960	2	1000
Eagle Elem-Main	1	M	?	?	409
Eagle Elem-Addition	6	M	1971	?	409
Eagle Hills Elem	6	M	1978	2	420
Frontier Elem-Bldg 1	8	H	1979	2	730
Frontier Elem-Bldg 2	8	H	1979	2	730
McMillan Elem-Main	6	M	1971	2	555
McMillan Elem-Office	6	M	1985	2	555
Summerwind Elem-Main	6	M	1976	?	557
Summerwind Elem-Gym	6	M	1976	?	557
Joplin Elem	6	M	1977	?	489
Lake Hazel Elem-Main	6	M	1974	?	569
Lake Hazel Elem-Gym	6	M	1980	?	569
Ridgewood Elem	6	M	1976	?	547
Linder Elem	6	M	1979	?	586
McPhereson Elem-Clsrm 1	1	M	1965	2	586
McPhereson Elem-Library	6	M	1965	2	586
McPhereson Elem-Clsrm 2	1	M	1984	2	586
McPhereson Elem-Cafeteria	6	M	1965	2	586
McPhereson Elem-Clsrm 3	6	M	1972	2	586
Meridian Int-Main	4	E	1916	?	424
Meridian Int-Cafeteria	1	M	1960	?	424
Meridian Int-Maintenance	1	M	1945	?	424
Meridian Primary-Clsrm 1	6	M	1958	1	600
Meridian Primary-Clsrm 2	1	M	1984	1	600
Meridian Primary-Clsrm 3	6	M	1958	1	600
Meridian Primary-Gym	6	M	1958	1	600

Table 1-Data Used in Analysis
(continued)

County: Ada
School District No.: 2
Worst Case MMI Intensity Level: VIII-IX

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Meridian Primary-Clsrm 4	1	M	1984	1	600
Silver Sage Elem	6	M	1981	3	317
Star Elem-Main	3	E	1976	?	300
Star Elem-Gym	4	E	1945	?	300
Ustick Elem-Bldg 1	6	M	1969	?	506
Ustick Elem-Bldg 2	6	M	1969	?	506
Ustick Elem-Bldg 3	6	M	1969	?	506
Ustick Elem-Bldg 4	6	M	1984	?	506
Ustick Elem-Library	6	M	1978	?	506

County: Ada
School District No.: 3
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class		Year of Const	Fndtn Type	Occp
Kuna HS-Main	5	M	1975	2	620
Kuna HS-Gym	5	M	1975	2	620
Kuna HS-Cafeteria	5	M	1975	2	620
Kuna JHS	6	M	1973	?	316
Hubbard Elem-Main	6	M	1977	2	487
Hubbard Elem-Addition	6	M	1977	2	487
Indian Creek Elem-Bldg A	1	M	1940	1	300
Indian Creek Elem-Bldg B	1	M	1940	1	300
Ross Elem-Bldg A	1	M	1963	?	316
Ross Elem-Bldg B	1	M	1963	?	316
Ross Elem-Bldg C	1	M	1963	?	316

County: Adams
School District No.: 11 & 13
Worst Case MMI Intensity Level: VI & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Meadows Valley School	2,4	E	1969	?	225
Council HS	1	M	1966	2	180
Council Elem	6	M	1958	2	214

Table 1-Data Used in Analysis
(continued)

County: Bannock
School District No.: 21
Worst Case MMI Intensity Level: VI-VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Marsh Valley HS-Main	8	H	1957	2	425
Marsh Valley HS-Ag Bldg	6	M	1960	2	425
Marsh Valley HS-Auto Shop	2	M	?	2	425
Marsh Valley MS	6	M	1975	2	275
Downey Elem	4	E	1939	2	172
Inkom Elem	1	M	1981	2	339
Lava Elem	3	E	1908	2	130
Mountain View Elem	6	M	1975	2	360

Table 1-Data Used in Analysis
(continued)

County: Bannock
School District No.: 25
Worst Case MMI Intensity Level: V

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Highland HS-Bldg A	6	M	1962	1	1370
Highland HS-Bldg B	6	M	1962	1	1370
Highland HS-Bldg C	6	M	1962	1	1370
Highland HS-Bldg D	6	M	1962	1	1370
Highland HS-Bldg E	6	M	1968	1	1370
Pocatello HS-Main	7	M	1938	2	1253
Pocatello HS-Gym	7	M	1938	2	1253
Pocatello HS-Auto Shop	3	E	1940	2	1253
Pocatello HS-Weight Rm	3	E	1920	2	1253
Alameda JHS-Main	4	E	1952	1	756
Alameda JHS-Heat Plant	6	M	1958	1	756
Alameda JHS-Annex	1	M	1956	1	756
Franklin JHS	7	M	1965	1	600
Hawthorne JHS-Main	6	M	1956	1	905
Hawthorne JHS-Annex	1	M	1962	1	905
Irving JHS-Main	6	M	1923	1	560
Irving JHS-Addition	3	E	1962	1	560
Irving JHS-Band Rm	3	E	1950	1	560
Irving JHS-Annex	1	M	1965	1	560
Bonneville Elem-Main	3	E	1924	1	510
Bonneville Elem-Annex	1	M	1950	1	510
Chubbuck Elem	6	M	1969	2	600
Edahow Elem	6	M	1964	1	381
Gate City Elem	6	M	1980	1	537
Greenacres Elem	6	M	1952	1	389
Indian Hills Elem	1	M	1968	1	729
Jefferson Elem	6	M	1981	2	560
Lewis-Clark Elem	6	M	1952	1	600
Lincoln Elem	1	M	1959	1	335
Roosevelt Elem	6	M	1932	2	232
Syringa Elem	3	E	1963	2	500
Tendoy Elem	6	M	1956	1	390
Tyhee Elem-Main	3	E	1903	1	700
Tyhee Elem-Addition	1	M	1963	1	700
Washington Elem	3	E	1920	1	350
Whittier Elem	3,4	E	1948	?	?
Wilcox Elem	3	E	1975	1	694
Ellis Elem	6	M	1983	2	525

Table 1-Data Used in Analysis
(continued)

County: Bear Lake
School District No.: 33
Worst Case MMI Intensity Level: VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Bear Lake HS	3,4,6	E	1982	2	400
Paris Elem	3,4,6	E	1981	2	226
Georgetown Elem	3,4,6	E	1927	1	145
Winters Elem	3,4,6	E	1960	2	470

County: Benewah
School District No.: 41 & 42
Worst Case MMI Intensity Level: VI & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
St. Maries HS	1	M	1976	2	333
St. Maries JHS-Main	1	M	1957	1	180
St. Maries JHS-Annex	1	M	1957	1	180
Heyburn Elem	3,4,6	E	1925	1	315
St. Maries Primary	3,4,6	E	1920	1	105
Up River Elem	1	M	1974	2	200
Plummer HS-Bldg 1	3	E	?	?	212
Plummer HS-Bldg 2	4	E	?	?	212
Plummer HS-Ag Bldg	3	E	?	?	212

Table 1-Data Used in Analysis
(continued)

County: Bingham
School District No.: 52
Worst Case MMI Intensity Level: V

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Snake River HS	3,4,6,7	E	1980	2	560
Snake River JHS	3,4,6	E	1952	2	352
Snake River MS	3,4,6,7	E	1920	2	400
Moreland Elem	3,4,6	E	1971	2	411
Pingree Elem	3,4,6	E	1934	2	151
Riverside Elem	3,4,6	E	1965	2	275
Rockford Elem	3,4,6	E	1974	2	221

County: Bingham
School District No.: 55
Worst Case MMI Intensity Level: V

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Blackfoot HS-Main	3,6	E	1955	1	1100
Blackfoot HS-Annex	3,6	E	1963	1	1100
Blackfoot HS-Auto Shop	3,6	E	1986	1	1100
Mountain View MS	3,4,6,7	E	1976	2	975
Elmwood Elem	3,5,6	E	1922	2	276
Fort Hall Elem-Main	3,4,6	E	1975	2	175
Fort Hall Elem-Kgtn	1	M	1970	2	175
Groveland Elem	3,6	E	1952	?	375
Shilling Elem	3,6	E	1928	2	320
Stalker Elem	3,4,6,7	E	1963	1	375
Stoddard Elem	4,7	E	1961	1	385
Wapello Elem	3,4,6,7	E	1920	1	150
Irving Kindergarten	3,5,6	E	1937	2	390

County: Bingham
School District No.: 58, 59, & 60
Worst Case MMI Intensity Level: VI, V, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Aberdeen HS	6	M	1951	2	200
Aberdeen Elem	6,7	M	1976	2	600
Firth HS	3,4,6	E	1967	2	260
Gibbs MS	3,4,6	E	1922	2	230
Johnson Elem	3,4,6	E	1962	1	525
Shelley HS	3,5,6,8	E	1950	?	375

Table 1-Data Used in Analysis
(continued)

County: Blaine
School District No.: 61
Worst Case MMI Intensity Level: VII-VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Wood River HS	3,4,6,7	E	1976	2	360
Carey School	3,4,6	E	1964	1	300
Wood River JHS	3,4,6,7	E	1938	1	351
Bellevue Elem	3,4,6	E	1965	1	490
Hailey Elem	3,4,6	E	1965	1	304
Hemingway Elem	3,4,6	E	1968	1	345

County: Boise
School District No.: 71, 72, & 73
Worst Case MMI Intensity Level: VII-VIII, VIII, & IX

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Garden Valley HS-Main	3	E	1963	1	109
Garden Valley HS-Multi	1	M	1977	1	109
Garden Valley HS-Shop	2	M	1970	1	109
Garden Valley Elem	1	M	1927	1	66
Lowman Elem	1	M	1942	1	12
Basin Elem	3,6	E	1962	1	225
Horseshoe Bend Elem-Main	1	M	1964	2	200
Horseshoe Bend Elem-Gym	6	M	1964	2	200
Horseshoe Bend Elem-Computer	1	M	1964	2	200

Table 1-Data Used in Analysis
(continued)

County: Bonner
School District No.: 82
Worst Case MMI Intensity Level: VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Clark Fork HS	6	M	1923	3	120
Priest River -Lamanna HS	3,4,6	E	1977	2	480
Sandpoint HS-Gym	6	M	1952	2	880
Sandpoint HS-Clrm	6	M	1952	2	880
Sandpoint HS-Walkway	6	M	1952	2	880
Sandpoint HS-Offices	6	M	1952	2	880
Sandpoint HS-Industrial	6	M	1952	2	880
Sandpoint HS-Maintenance	6	M	1952	2	880
Priest River JHS	6	M	1940	1	236
Stidwell-Sagle Elem	3,4,6,7	E	1973	2	445
Farmin Elem	1	M	1963	1	552
Hope Elem	1	M	1987	2	154
Idaho Hill Elem-Main	3,4,6	E	1923	1	174
Idaho Hill Elem-Gym	3	E	1923	1	174
Northside Elem	1,5	M	1952	2	270
Priest Lake Elem	1	M	1960	1	62
Priest River Elem	1	M	1962	1	532
Southside Elem	3,4,6	E	1970	?	225
Washington Elem	3	E	1962	1	331

Table 1-Data Used in Analysis
(continued)

County: Bonneville
School District No.: 91
Worst Case MMI Intensity Level: VI-VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Idaho Falls HS-Main	6	M	1952	1	1050
Idaho Falls HS-W Stdm	6,7	M	1952	1	1050
Idaho Falls HS-Et Stdm	6,7	M	1952	1	1050
Skyline HS	6	M	1968	1	990
Eagle Rock JHS	6,7	M	1974	1	1006
Gale JHS-Main	6	M	1961	1	1028
Gale JHS-Wood Shop	6,7	M	1961	1	1028
Gale JHS-East Wing	6,7	M	1961	1	1028
Boyes Elem	6	M	1965	1	619
Hawthorne Elem	6	M	1938	1	380
Bunker Elem	3,6	E	1963	1	362
Bush Elem	3,6	E	1954	1	601
Edgemont Gardens Elem	3,6	E	1958	1	552
Emerson Elem-Main	3,6	E	1921	1	193
Emerson Elem-Annex	3,4,6	E	1921	1	193
Erickson Elem	6	M	1955	1	542
Linden Park Elem	6	M	1955	1	439
Longfellow Elem	6	M	1957	1	559
Osgood Elem-Main	3,6	E	1928	1	172
Osgood Elem-Cafeteria	3,4,6	E	1928	1	172
Temple View Elem	6	M	1958	1	376
West Side Elem	6	M	1980	1	467
York Elem	3,4,6	E	1930	1	8

Table 1-Data Used in Analysis
(continued)

County: Bonneville
School District No.: 93
Worst Case MMI Intensity Level: VI-VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Bonneville HS-Main	4,7	E	1956	1	1210
Bonneville HS-Shop	3,4,6	E	1976	1	1210
North Bonneville JHS	3,4,6,7	E	1956	?	800
South Bonneville JHS	3,4,6	E	1987	2	750
Ammon Elem-Main	3,6	E	1936	3	528
Ammon Elem-Annex	3,6	E	1970	3	528
Cloverdale Elem	3,4,6	E	1981	?	600
Fairview Elem	4,7	E	1927	2	335
Falls Valley Elem	3,6	E	1968	2	700
Hill View Elem	3,4,6	E	1960	1	545
Iona Elem	3,4,6	E	1929	2	392
Lincoln Elem-Main	3,6	E	1905	1	317
Lincoln Elem-East Bldg	3,4,6	E	1962	1	317
Lincoln Elem-West Bldg	3,4,6	E	1915	1	317
Ucon Elem	3,6	E	1987	1	560

County: Boundary
School District No.: 101
Worst Case MMI Intensity Level: VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Bonners Ferry HS-Main	6	M	1972	2	460
Bonners Ferry HS-Music	6	M	1972	2	460
Evergreen Elem	1	M	1954	1	75
Mt. Hall Elem	3,6	E	1950	1	220
Naples School	6	M	1935	2	126
Northside School	3,4,6	E	1912	2	105
Valley View School	3,6	E	1948	1	525

County: Butte
School District No.: 111
Worst Case MMI Intensity Level: VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Butte County HS	3,4,6	E	1951	1	327
Arco Elem	3,4,6,7	E	1962	2	270
Howe Elem	3,4,6	E	?	2	50

Table 1-Data Used in Analysis
(continued)

County: Camas
School District No.: 121
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Camas County School	3,4,6	E	1913	1	170

County: Canyon
School District No.: 131
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Nampa HS-100 Bldg	1	M	1950	2	1500
Nampa HS-200 Bldg	1	M	1950	2	1500
Nampa HS-300 Bldg	6	M	1950	2	1500
Nampa HS-400 Bldg	6	M	1950	2	1500
Nampa HS-500 Bldg	1	M	1950	2	1500
Nampa HS-Fld House	1	M	1950	2	1500
Nampa HS-Grand Stand	3	E	1950	2	1500
Nampa HS-Physical Plant	6	M	1950	2	1500
Nampa HS-600 Bldg	1	M	1950	2	1500
Nampa HS-700 Bldg	1	M	1950	2	1500
Nampa HS-800 Bldg	1	M	1950	2	1500
South JHS-Main	6	M	1972	2	900
South JHS-Gym	6	M	1972	2	900
South JHS-DEd	6	M	1972	2	900
West JHS	3,4,6,7	E	1972	2	800
Central Elem	3,5,6,8	E	?	?	759
Centennial Elem	3,4,6,7	E	1975	2	650
Eastside Elem	6	M	1940	3	500
Greenhurst Elem	3,4,6,7	E	?	2	51
Lincoln Elem	6	M	?	?	548
Lakeview Elem	6	M	?	?	490
Parkview Elem	6	M	?	?	123
Roosevelt Elem	3,6	E	1937	2	300
Sunny Ridge Elem	3,4,6	E	1969	2	600

Table 1-Data Used in Analysis
(continued)

County: Canyon
School District No.: 132
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Caldwell HS	3,4,6	E	1958	1	836
Jefferson JHS	7	M	1974	1	617
Lincoln Elem	6	M	1944	2	868
Van Buren Elem-2 Story	3,5,6,8	E	1941	?	637
Van Buren Elem-1 Story	6	M	?	?	637
Washington Elem-Bldg 1	3,6	E	1905	2	720
Washington Elem-Bldg 2	5	M	1949	2	720
Washington Elem-Bldg 3	6	M	1958	2	720
Wilson Elem	3,4,6	E	1962	2	620

County: Canyon
School District No.: 133, 134, 135, 136, 137, 138, & 139
Worst Case MMI Intensity Level: VII, VII, VII, VII, VII, VII, & VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Wilder HS	3,4,6	E	?	2	200
Middleton JHS	3,4,6,7	E	1973	2	430
Middleton Primary	3,4,6	E	1934	2	400
Notus HS	3,4,6,7	E	1976	2	91
Notus Elem	1,5	M	1929	2	227
Melba HS	3,4,6	E	1935	1	235
Melba Elem	3,4,6	E	1959	2	290
Parma HS-Gym	3,5,6,8	E	1950	2	286
Parma JHS-Main	3,6	E	1928	2	160
Parma JHS-Gym	1	M	?	2	160
Roswell Elem	3	E	1922	1	126
Johnson Elem	6	M	1920	2	350
Scism Elem	3,4,6	E	1920	2	60
Vallivue HS	6	M	1962	1	700
Vallivue JHS	6	M	1974	1	360
East Canyon Elem	6	M	1971	2	436
Midway Elem	6	M	1950	1	205
West Canyon Elem	1	M	1971	2	625

Table 1-Data Used in Analysis
(continued)

County: Caribou
School District No.: 148, 149, & 150
Worst Case MMI Intensity Level: VI-VII, VI, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Grace HS	3,6	E	1950	1	190
Grace JHS	1	M	1982	1	100
Grace Elem	3,5,6,8	E	1929	1	280
Thatcher Elem	3,4,6	E	1923	1	180
North Gem HS	3,6	E	1930	2	250
Soda Springs HS	3,5,6,8	E	1960	2	255
Soda Springs JHS	3,6	E	1919	1	170
Grays Lake Elem	1	M	1940	1	20
Hooper Elem	3,6	E	1954	1	450
Thirkill Elem	6,7	M	1967	3	335

County: Cassia
School District No.: 151
Worst Case MMI Intensity Level: VII-VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Burley HS-Main	3,4,6	E	1956	2	575
Burley HS-Weight Rm	3,4,6	E	1956	2	575
Raft River HS	3,4,6	E	1955	1	120
Dworshak Elem	3,6	E	1960	2	590
Malta Elem	3,4,6	E	1931	1	289
Overland Elem	3,4	E	1912	1	145
Springdale Kindergarten	3,4,6	E	1930	3	400

County: Clark
School District No.: 161
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Clark County School	3,5,6,8	E	1920	?	68

Table 1-Data Used in Analysis
(continued)

County: Clearwater
School District No.: 171 & 172
Worst Case MMI Intensity Level: VI & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Orofino HS	3,6	E	1968	2	550
Timberline HS	3,4,6	E	1969	2	176
Orofino JHS	3,4,6,7	E	1935	?	204
Weippe MS-Clsrm	3,4,6	E	1955	?	70
Weippe MS-Gym	3,4,6,7	E	1936	?	70
Cavendish-Teakean Elem	5,8	H	1952	2	22
Grangemont School	3,4,6	E	1955	2	16
Orofino Elem	3,4,6	E	1954	2	640
Peck Elem	3,4,6	E	1963	2	40
Pierce Elem	3,4,6,7	E	1979	1	154
Weippe Elem	3,4,6,7	E	1926	2	201
Elk River School	1	M	1911	2	35

County: Custer
School District No.: 181 & 182
Worst Case MMI Intensity Level: IX & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Challis HS-Main	3,6	E	1983	2	280
Challis HS-Shop	3,6	E	1983	2	280
Challis JHS-Main	3,6	E	1984	1	0
Challis JHS-Gym	1	M	1945	1	0
Challis JHS-Shop	2	M	1950	1	0
Challis Elem	3,6	E	1967	1	300
Clayton Elem	1	M	1985	2	20
Patterson Elem	5,8	H	1950	2	25
Stanley Elem	6	M	1978	2	30
Mackay HS-Main	6	M	1983	1	150
Mackay HS-Shop	2	M	?	1	150
Mackay Elem	6	M	1967	2	190

Table 1-Data Used in Analysis
(continued)

County: Elmore
School District No.: 191, 192, & 193
Worst Case MMI Intensity Level: VI-VII, VII, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Prairie Elem	1	M	1900	1	11
Glenns Ferry HS	3,4,6	E	1965	2	625
Mountain Home HS	3,4,6	E	1954	?	700
Mountain Home AFB JHS	3,4,6	E	1963	1	216
Mountain Home JHS	3,4,6,7	E	1928	2	563
East Elem	3,4,6	E	1952	?	420
Base INT	3,4,6	E	1962	1	360
Base Primary	3,4,6	E	1955	2	395
North Elem	3,4,6	E	1964	1	415
West Elem	3,4,6,7	E	1960	2	490

County: Franklin
School District No.: 201 & 202
Worst Case MMI Intensity Level: VIII & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Preston HS-Main	6	M	1955	1	550
Preston HS-Seminary	3	E	1939	1	550
Preston HS-Shop	6	M	1975	1	550
Jefferson MS	3	E	1914	2	450
Oakwood Elem-Main	1	M	1972	2	1225
Oakwood Elem-Annex	6	M	1972	2	1225
Westside HS-Bldg 1	3	E	1949	1	211
Westside HS-Bldg 2	3	E	1960	1	211
Clifton Elem	3	E	1939	2	183
Weston Elem	1	M	1949	?	154

County: Fremont
School District No.: 215
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
North Fremont HS	3,6	E	1951	3	250
South Fremont HS	3,4,6,7	E	?	2	466
South Fremont JHS	3,6	E	1937	2	300
Central Elem	3,6	E	1974	2	421
Parker-Egin Elem	3,4,6	E	1965	2	200

Table 1-Data Used in Analysis
(continued)

County: Gem
School District No.: 221
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Emmett HS-Clsrm Pod	5	M	1988	?	700
Emmett HS-Clsrm Pod	5	M	1988	?	700
Emmett HS-Wood Shop Pod	5	M	1988	?	700
Emmett HS-Auto Shop Pod	5	M	1988	?	700
Emmett HS-Vo-Ag Pod	5	M	1988	?	700
Emmett MS-Bldg 1	5	M	1954	2	348
Emmett MS-Bldg 2	6	M	1954	2	348
Emmett MS-Bldg 3	6	M	1954	2	348
Emmett MS-Bldg 4	6	M	1954	2	348
Emmett MS-Annex 1	1	M	1954	2	348
Emmett MS-Annex 2	1	M	1954	2	348
Emmett MS-Annex 3	1	M	1954	2	348
Brick Elem-Main	3	E	1926	2	200
Brick Elem-Annex	1	M	1926	2	200
Brick Elem-Clsrm Bldg	1	M	1926	2	200
Butteview Elem-Main	1,6	M	1960	2	880
Butteview Elem-Annex	1	M	1960	2	880
Hanna Elem	3	E	1935	2	76
Letha Elem	1	M	1957	2	80
Letha Kindergarten	1	M	1960	2	80
Ola Elem-Main	1	M	1910	2	30
Ola Elem-Library	1	M	1910	2	30
Sweet Elem	6	M	1974	2	75

County: Gooding
School District No.: 231, 232, & 234
Worst Case MMI Intensity Level: VIII, VIII, & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Gooding HS-Main	3,6	E	1972	?	288
Gooding HS-Vo-Ag	3,4,6	E	1984	?	288
Frahm JHS	3,4,6	E	1939	3	250
Gibbons Elem	3,5,6	E	1950	2	515
Wendell HS	3,4,6	E	1926	3	376
Wendell Elem	3,4,6	E	1964	2	550
Bliss School	3,4,6	E	1916	1	145

Table 1-Data Used in Analysis
(continued)

County: Idaho
School District No.: 241 & 242
Worst Case MMI Intensity Level: VI & V

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Grangeville HS	1	M	1957	2	300
Elk City School	3,4,6	E	?	2	90
Grangeville Elem-Bldg 1	3,4,6	E	1965	1	675
Grangeville Elem-Bldg 2	2	M	?	1	675
Grangeville Elem-Bldg 3	1	M	1960	1	675
Grangeville Elem-Bldg 4	3,4,6	E	?	1	675
Grangeville Elem-Bldg 5	1	M	?	1	675
Valley Elem	3,4,6	E	1969	2	420
Prairie HS-Main	3,4,6,7	E	1951	1	140
Prairie HS-Industrial Arts	2	M	1951	1	140
Prairie MS	3,4,6,7	E	?	1	154

County: Jefferson
School District No.: 251, 252, & 253
Worst Case MMI Intensity Level: VII, VII, & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Rigby HS	3,4,6,7	E	1987	3	720
Midway JHS	3,4,6,7	E	1955	1	485
Roberts JHS	3,4,6,7	E	1939	1	165
Midway Elem	3,4,6	E	1968	2	580
Harwood Elem	3,4,6,7	E	1969	2	636
Kinghorn Elem	4,7	E	1939	2	525
Roberts Elem	3,4,6,7	E	1968	1	185
Ririe HS	3,6	E	1927	2	281
Ririe Elem	3,4,6	E	1950	1	400
W. Jefferson HS	3,4,6,7	E	1959	1	180
Hamer Elem	3,4,6	E	1937	2	130
Terreton Elem	3,4,6	E	1968	2	430

Table 1-Data Used in Analysis
(continued)

County: Jerome
School District No.: 261 & 262
Worst Case MMI Intensity Level: VIII & VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Jerome HS-Main	6	M	1976	1	733
Jerome HS-Shop	6	M	1980	1	733
Jerome JHS-Main	6	M	1948	2	427
Jerome JHS-Annex	3	E	1956	2	427
Central Elem	3	E	1918	1	638
Jefferson Elem	6	M	1956	2	415
Washington Elem	3,4,6	E	1937	2	340
Valley HS	6	M	1954	2	300
Eden Elem-Main	6	M	1925	2	150
Eden Elem-Cafeteria	1	M	1955	2	150
Hazelton Elem	3	E	1927	2	150

County: Kootenai
School District No.: 271
Worst Case MMI Intensity Level: VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Canfield MS	6,7	M	1976	2	700
Lakes MS	4,6	E	1952	2	890
Borah Elem	3,6	E	1953	2	450
Bryan Elem	3,4,6	E	1962	2	505
Dalton Gardens Elem	3,4,6	E	1954	1	300
Harding Elem	3,4,6	E	1926	2	315
Hayden Lake Elem-So Bldg	3,6	E	1936	2	533
Hayden Lake Elem-No Bldg	3,6	E	1953	2	533
Ramsey Elem	3,4,6,7	E	1975	2	530
Sorenson Elem	3,4,6	E	1957	2	330
Winton Elem	3,6	E	1936	2	300

Table 1-Data Used in Analysis
(continued)

County: Kootenai
School District No.: 272, 273, & 274
Worst Case MMI Intensity Level: VII, VI, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Lakeland HS	5	M	?	2	533
Lakeland JHS-Main	3	E	1963	2	550
Lakeland JHS-Shop	6	M	1963	2	550
Lakeland JHS-East Bldg	1	M	1963	2	550
Athol Elem	1	M	1968	2	193
Brown Elem-Main	1	M	?	?	544
Brown Elem-Annex	1	M	?	?	544
Rathdrum Upper Elem	3,4,6	E	1939	2	200
Spirit Lake Elem	1	M	1968	2	210
Post Falls JHS	3,6	E	1956	1	466
Post Elem	3,5,6,8	E	1951	?	496
Seltice Elem	3,4,6	E	1973	1	611
Kootenai HS	3,4,6,7	E	1956	1	175
Harrison Elem-Main	3,5,6,8	E	1985	1	145
Harrison Elem-Gym	1	M	?	1	145

County: Latah
School District No.: 281, 282, 283, 284, & 285
Worst Case MMI Intensity Level: VI-VII, VI, VI, VI, & VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Moscow HS-Main	3,6	E	1938	1	625
Moscow HS-Annex	6	M	1968	1	625
Moscow JHS-Main	6	M	1957	1	582
Moscow JHS-Gym	5	M	1957	1	582
McDonald Elem	6	M	1968	2	351
Russell Elem	3	E	1928	1	322
West Park Elem	6	M	1959	2	310
Whitmore Elem	6	M	1951	1	380
Genesee HS	1,7	M	1939	2	319
Kendrick HS-Main	3,4,6	E	1960	2	160
Kendrick HS-Vo-Ag	2	M	1968	2	160
Juliaetta Elem	3	E	1932	3	150
Troy HS	3	E	1908	1	188
Troy Elem	6	M	1974	1	170
Bovill Elem	1	M	?	?	111
Deary HS	6	M	1934	1	181
Deary Elem	3	E	?	1	181
Potlatch HS-Main	1	M	1969	1	238
Potlatch HS-Vo-Ed	2	M	1969	1	238
Potlatch Elem	3	E	1953	1	300

Table 1-Data Used in Analysis
(continued)

County: Lemhi
School District No.: 291
Worst Case MMI Intensity Level: VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Salmon HS	3,4,6	E	1978	3	430
Salmon JHS	3,4,6,7	E	1939	2	350
Brooklyn Elem	3,4,6	E	1905	2	210
Pioneer Elem	3,4,6	E	1958	2	425

County: Lewis
School District No.: 302, 304, & 305
Worst Case MMI Intensity Level: V, VI, & V

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Nez Perce HS	3,4,6	E	1955	1	50
Nez Perce Elem	3,4,6	E	1963	1	100
Kamiah HS-Main	3	E	1959	1	170
Kamiah HS-Multi	3	E	1974	1	170
Kamiah JHS	6	M	1970	1	170
Kamiah Elem	3	E	1952	2	330
Highland HS-Main	3,4,6	E	1953	2	300
Highland HS-Multi	3,4,6,7	E	1964	2	300
Highland HS-Shop	5,8	H	1978	2	300

County: Lincoln
School District No.: 312 & 314
Worst Case MMI Intensity Level: VIII & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Shoshone HS	6	M	1929	2	175
Lincoln Elem	3,4,6	E	1929	2	200
Dietrich School	3,4,6	E	1936	1	150

Table 1-Data Used in Analysis
(continued)

County: Madison
School District No.: 321 & 322
Worst Case MMI Intensity Level: VIII & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Madison HS	3,4,6	E	1972	1	1000
Madison JHS	3,4,6,7	E	1955	1	917
Adams Elem	6	M	1984	2	550
Archer Elem	3,4,6	E	1938	1	153
Burton Elem	3,4,6,7	E	1940	?	152
Hibbard Elem	3,4,6,7	E	1978	2	171
Kennedy Elem	6	M	1963	2	480
Lincoln Elem	3,4,6	E	1964	2	424
Lyman Elem	3,4,6,7	E	1953	2	263
Washington Elem	3	E	1922	2	475
Sugar-Salem HS	3,4,6	E	1973	2	319
Kershaw MS	3,4,6	E	1980	2	458
Central Elem	3,4,6	E	1965	2	650

County: Minidoka
School District No.: 331
Worst Case MMI Intensity Level: VII-VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Minico HS	3,4,6	E	1955	2	900
East Minico JHS	3,6	E	1970	2	580
West Minico JHS	3,6	E	1970	2	488
Acequia Elem	3,4,6,7	E	1936	2	431
Heyburn Elem	3,4,6,7	E	1927	2	630
Memorial Elem	3,4,6	E	1961	3	500
Paul Elem	3,4,6	E	1978	2	640
Pershing Elem	3,4,6	E	1915	2	273
Big Valley Elem	3,4,6,7	E	1986	2	530

Table 1-Data Used in Analysis
(continued)

County: Nez Perce
School District No.: 340, 341, 342, & 343
Worst Case MMI Intensity Level: VI, VI, VI, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Lewiston HS-Main	3,6	E	1928	2	1289
Lewiston HS-Science Bldg	3	E	1970	2	1289
Lewiston HS-Auto Shop	3	E	1963	2	1289
Lewiston HS-Art Studio	3	E	1963	2	1289
Lewiston HS-Machine Shop	1	M	1958	2	1289
Lewiston HS-Gym	3	E	?	2	1289
Jennifer JHS-Clsrm	6	M	1959	2	597
Jennifer JHS-Gym	6	M	1959	2	597
Sacajawea JHS-Clsrm	3,4,6,7	E	1959	2	568
Sacajawea JHS-Gym	3,4,6	E	1959	2	568
Camelot Elem-Bldg 1	3,4,6	E	1969	2	282
Camelot Elem-Bldg 2	3,4,6	E	1977	2	282
Camelot Elem-Bldg 3	3,4,6	E	1978	2	282
Centennial Elem	3,4,6	E	1962	2	287
McGhee Elem	3,4,6	E	1948	2	378
McSorley Elem-Bldg 1	3,4,6	E	1966	2	326
McSorley Elem-Bldg 2	3,4,6	E	1968	2	326
McSorley Elem-Bldg 3	3,4,6	E	1971	2	326
Orchards Elem-Bldg 1	6	M	1956	2	338
Orchards Elem-Bldg 2	3,4,6	E	1973	2	338
Webster Elem	3,4,6	E	1948	2	299
Whitman Elem	6	M	1948	2	355
Lapwai Elem	3,4,6,7	E	1987	2	310
Culdesac School-Main	3,6	E	1939	1	165
Culdesac School-Shop	2	M	1974	1	165
Tammany Elem	3,4,6	E	1937	1	275

County: Oneida
School District No.: 351
Worst Case MMI Intensity Level: IX

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Malad HS	3,6	E	1981	2	400
Malad Elem	3,4,6	E	1955	1	500
Stone Elem	3,4,6	E	1955	1	60

Table 1-Data Used in Analysis
(continued)

County: Owyhee
School District No.: 363, 365, & 370
Worst Case MMI Intensity Level: VII, VI-VII, & VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Marsing HS	3,6	E	1987	2	250
Marsing MS	3,4,6,7	E	1979	2	183
Marsing Elem	3,4,6,7	E	1953	2	189
Rimrock HS	3,4,6	E	1976	?	200
Bruneau Elem	3,4,6	E	1958	1	75
Grand View Elem	3,4,6	E	1958	1	225
Homedale HS	3,6	E	1940	2	450

County: Payette
School District No.: 371, 372, & 373
Worst Case MMI Intensity Level: VII, VII, & VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Payette HS-Main	6	M	1962	1	415
Payette HS-Dome	2	M	1974	1	415
McCain MS	3,6	E	1919	1	325
Eastside Elem	5	M	1926	1	456
Westside Elem	3,6	E	1950	1	350
New Plymouth HS-Main	3,4,6	E	1986	2	346
New Plymouth HS-Music Bldg	3	E	?	2	346
New Plymouth HS-Shop	6	M	?	2	346
New Plymouth Elem-Main	1	M	1961	1	473
New Plymouth Elem-Multi	6	M	?	1	473
Fruitland HS-Main	3,4,6,7	E	1954	1	310
Fruitland HS-Music Bldg	6	M	1960	1	310
Fruitland JHS-Bldg 1	3,4,6,7	E	1928	1	280
Fruitland JHS-Bldg 2	1	M	1979	1	280
Fruitland Elem	6	M	1968	1	525

Table 1-Data Used in Analysis
(continued)

County: Power
School District No.: 381, 382, & 383
Worst Case MMI Intensity Level: VI, VI, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
American Falls HS-Main	3,4,6	E	1934	1	550
American Falls HS-Gym	3,5,6,8	E	1965	1	550
Thomas MS	3,4,6,7	E	1978	1	550
Hillcrest Elem	3,4,6,7	E	1956	2	620
Rockland School	3,4	E	1936	?	183
Arbon Elem	1	M	1920	1	24

County: Shoshone
School District No.: 391, 392, 393, & 394
Worst Case MMI Intensity Level: VI, VI, VI, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Kellogg HS	7	M	1954	2	600
Kellogg MS	6	M	1970	2	552
Pinehurst Elem-Bldg 1	6	M	?	2	336
Pinehurst Elem-Bldg 2	6	M	1960	2	336
Pinehurst Elem-Bldg 3	1	M	?	2	336
Sunnyside Elem	3	E	1949	?	312
Elk Creek School	6	M	1938	2	18
Mullan HS-Main	3,6	E	1929	2	138
Mullan HS-Pavillion	3,6	E	1967	2	138
Mullan Elem	1	M	1959	2	154
Wallace HS	5,8	H	1949	1	250
Silver Hills JHS	6	M	1976	2	325
Murray Elem	1	M	1950	1	13
Osburn Elem	3	E	1939	1	400
Wallace Elem	3,4,6	E	1926	1	400
Avery School	1	M	?	?	22
Clarkia School	1	M	?	?	11

County: Teton
School District No.: 401
Worst Case MMI Intensity Level: VII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Teton HS	3,4,6,7	E	1952	1	240
Teton MS	3,4,6,7	E	1950	1	200
Tetonia Elem	3,4,6	E	1949	2	185
Victor Elem	3,4,6	E	1948	2	240

Table 1-Data Used in Analysis
(continued)

County: Twin Falls
School District No.: 411
Worst Case MMI Intensity Level: VII-VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Twin Falls HS-Main	3	E	1952	2	1350
Twin Falls HS-Vo Bldg	3	E	1955	2	1350
Twin Falls HS-DEd	1	M	1965	2	1350
Twin Falls HS-Boiler Bldg	3	E	1952	2	1350
Twin Falls HS-Cafeteria	7	M	1952	2	1350
Twin Falls HS-Gym	6	M	1952	2	1350
Twin Falls HS-Library	6	M	1952	2	1350
O'Leary JHS-Clsrm Bldg	6	M	1978	?	1000
O'Leary JHS-Gym	6	M	1978	?	1000
O'Leary JHS-Auditorium	6	M	1978	?	1000
Stuart JHS-Main	3	E	1962	2	575
Stuart JHS-Annex	3	E	1962	2	575
Bickel Elem-Main	3	E	1937	2	550
Bickel Elem-Annex	1	M	1970	2	550
Harrison Elem	3	E	1956	2	650
Perrine Elem	6	M	1985	2	600
Lincoln Elem-Bldg 1	3	E	1942	2	650
Lincoln Elem-Bldg 2	6	M	1976	2	650
Morningside Elem	3	E	1956	1	680
Sawtooth Elem	1,3,4,6,7	E	1974	2	707

County: Twin Falls
School District No.: 412 & 413
Worst Case MMI Intensity Level: VII & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Buhl HS-Main	6	M	1978	?	435
Buhl HS-Vo-Ed	2	M	1978	?	435
Buhl JHS	3	E	1909	?	365
Popplewell Elem	3	E	1961	1	750
Filer HS-Main	3	E	1952	1	340
Filer HS-Maintenance Bldg	3	E	1952	1	340
Filer Elem	3	E	1966	1	670
Hollister Elem	3	E	1912	1	120

Table 1-Data Used in Analysis
(continued)

County: Twin Falls
School District No.: 414, 415, 417, & 418
Worst Case MMI Intensity Level: VII, VII, VII, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Kimberly HS-Main	1	M	1967	1	400
Kimberly HS-Gym	5	M	1942	1	400
Kimberly HS-Ag Bldg	6	M	1967	1	400
Kimberly HS-IA Bldg	6	M	1981	1	400
Kimberly JHS	3	E	1916	1	400
Kimberly Elem	6	M	1954	1	625
Hansen HS	3	E	1924	2	100
Hansen JHS	1	M	1920	2	60
Hansen Elem	4	E	1973	1	200
Castleford HS-Main	3	E	1985	1	100
Castleford HS-Gym	2	M	1966	1	100
Castleford HS-Special Ed	1	M	1966	1	100
Murtaugh HS	1	M	1932	1	84
Murtaugh Elem	3	E	1930	1	172

County: Valley
School District No.: 421 & 422
Worst Case MMI Intensity Level: VII & VIII

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
McCall-Donnelly HS	1	M	1958	2	800
McCall-Donnelly JHS	6	M	1932	2	130
Cascade HS-Main	1,6	M	1935	1	170
Cascade HS-Gym	1	M	1935	1	170
Cascade Elem	1	M	1970	1	182

Table 1-Data Used in Analysis
(continued)

County: Washington
School District No.: 431, 432, & 433
Worst Case MMI Intensity Level: VI, VI, & VI

Bldg Name	Bldg Class	Risk	Year of Const	Fndtn Type	Occp
Weiser HS-Main	6	M	1966	2	430
Weiser HS-Auto Shop	6	M	1966	2	430
Weiser HS-Vo-Ag	6	M	1966	2	430
Weiser JHS-Main	3	E	1980	2	227
Weiser JHS-Gym	3	E	1912	2	227
Park MS	1	M	1956	2	263
Pioneer Elem-Main	1	M	1955	2	520
Pioneer Elem-Clsrm Bldg	1	M	1955	2	520
Pioneer Elem-Special Ed	1	M	1955	2	520
Cambridge HS	3	E	1925	1	130
Cambridge Elem	6	M	1965	2	175
Midvale School-Clsrm Bldg	3	E	1911	2	100
Midvale School-Music Bldg	1	M	?	2	100
Midvale School-Office	3	E	1911	2	100
Midvale School-Gym	3	E	1911	2	100
Midvale School-Ad Bldg	3	E	?	2	100

TABLE 2-RISK ASSESSMENT FOR MODEL BUILDING TYPES

1. Wood frame: Moderate risk (M)
2. Light metal: Moderate risk (M)
3. Unreinforced masonry (low rise) bearing wall: Extreme risk (E)
4. Unreinforced masonry with load bearing frame: Extreme risk (E)
5. Reinforced concrete shear wall-w/o moment-resisting frame: Moderate risk (M)
6. Reinforced masonry shear wall-w/o moment-resisting frame: Moderate risk (M)
7. Reinforced masonry shear wall-w/o moment-resisting frame: Moderate risk (M)
8. Precast concrete: High risk (H)
9. Mobile homes: Moderate risk (M)

THE BENEFITS OF EARTHQUAKE EDUCATION TO THE SCHOOLS

James L. Tingey

Earthquake Preparedness Coordinator
Utah Comprehensive Emergency Management
Salt Lake City, Utah

ABSTRACT

As earthquake awareness in the seismically active areas of the United States has increased, so have many of the myths and misconceptions which have been with us for decades. This intuitive observation underscores the necessity to have awareness put in a structured form and taught in schools - beginning in the elementary grades. Besides the obvious benefit of increased safety and preparedness for students, many other short and long-term advantages can be postulated from such institutional programs. A few of the most important of these advantages are: increased social responsibility, especially for the local area; increased acceptance of earthquake mitigation programs which have an economic impact such as seismic building codes; a broader view of the role of the environment and man's interaction with it; building confidence of the student to adapt and modify risk situations; the proper perception of what a progressive, responsible society is; and the application of scientific information.

JAMES TINGEY

Mr. James L. Tingey has served as a teacher, researcher, geologist, consultant and media spokesman for Comprehensive Emergency Management in Utah. Educated in Geology at Brigham Young University, he is currently earthquake program coordinator for the state of Utah, Division of Comprehensive Emergency Management.

INTRODUCTION

A recent survey by researchers at Utah State University under a USGS grant, showed that the degree of earthquake awareness in metropolitan Utah, as gauged by the perceived importance of undertaking earthquake mitigation, is over 70%. That is, over 70% of the respondents believed this was an issue of high importance (Madsen, 1989).

This awareness and concern level was achieved in large measure by very non-specific educational methods. Ad hoc earthquake presentations to civic groups, schools, religious organizations, and businesses are given two or three times a week by any one of three groups active in earthquake education activities in Utah. Special programs on television and actual earthquakes with the attending news follow-up contribute to the overall earthquake awareness level.

In contrast to the relatively high level of awareness and concern, is the apparent low level of actual understanding, even at a very simple level, of what living in a seismically active area means and what would be the most effective actions to take. I don't mean a perfect understanding of what a "hanging wall" is or the difference in motion between a Rayleigh and Love wave, but just the basic facts of cause and effect.

The primary way to avoid the tedious process of trying to educate an adult population with preconceived and in many cases inaccurate ideas about earthquakes, is to institute earthquake education in the curriculum of schools - especially in areas of high risk. The fallout from such a program can be postulated based on the attitudes which have developed in the current adult population as a result of other organized educational efforts.

LOCAL AND REGIONAL INTEGRATION AND ACCEPTANCE

Integrating earthquake concepts into the local cultural atmosphere can be a critical aspect leading to acceptance of an active program of earthquake or other natural hazard education. A more homogenous community probably requires less effort in terms of fitting the information to the audience, ascertaining the present level of understanding, and the area of earthquake education which should or can be addressed, e.g. science or safety. The concept of knowing the audience can be applied at any level, but the acceptance and implementation in a formal teaching arena requires a larger amount of research showing that the concepts taught are correct and can be understood by the students.

EARTHQUAKE EDUCATION BENEFITS

The "assumed" most obvious benefit resulting from earthquake education is the increased level of safety to students and faculty achieved in the school building. The safety aspect will probably be the easiest point to sell, especially in areas with frequent earthquakes. However, when event probabilities are taken into account, the long term benefits, which will only be measurable as the students begin to affect local and regional decisions, will have the greatest beneficial results. For this reason, the concept of earthquake education should not be perceived or promoted on a single platform. Initially, earthquake education may have to be integrated with other safety or science programs in a diluted form. But I believe it can stand on its own as a significant issue of earth and social science.

The first step in achieving preparedness and loss reduction in the schools is the performance of a hazard analysis. This process and the resulting conclusions are a benefit to the school for several reasons. First of all it exposes the level of risk at the site or to the school population. This then becomes a motivator for planning and provides a basis for the amount of planning needed. Actual building site mitigation needs are also identified and a long term retrofitting/retirement plan can be established. In regions with a large number of schools needing modernization, the degree of seismic retrofitting needed can serve as a prioritization method.

A recent study of this sort for a school district in Utah (Reaveley, 1987), has attracted much attention and will probably result in some structural mitigation to a few structures. The reaction of the local district board and some concerned parents to this same study illustrates the nature of misconceptions about earthquakes. The school board was ridiculed by some for not taking immediate action on the studies results. In truth, the general seismic condition of these buildings has been known for many years. This report only quantified it so the buildings could be dealt with in an engineering format. The school district should have been praised for undertaking the study at all, then encouraged to take the next step of addressing the results in a rational manner. On the other hand, the school district board is wondering if retrofitting buildings will have any effect in reducing losses to their old buildings and its occupants.

How would earthquake education in the schools improve this real situation? The basic problem rests in the school board and parents misunderstanding of fundamental earthquake facts - in spite of the high level of awareness and concern. An earthquake education program in the schools could possibly have averted the problem by making the board aware of why they were having the study done, the likely conclusions of the hazard analysis and how to address the concerns of the parents. The parents attitude would probably be moderated by an understanding of the earthquake planning process and a recognition that the school board is on the right track.

Anyone conducting a hazard analysis will realize before or during the process that certain risk levels will be clearly identified. If the entities commissioning the study are not prepared to accept and take some positive action based on the results, then the analysis becomes a dark cloud - possibly increasing liability after the earthquake event.

At the present time, I believe the schools have the opportunity to take the lead in promoting earthquake resistant building practices. Schools should be our safest structures, models of a progressive society which recognizes its vulnerabilities and acts to reduce them. However, without a program to educate the students about the hazard the school is trying to mitigate, the base of support is never created to accomplish real mitigation.

PAST ANALOGS

Earthquake education can easily be put into the category of environmental science or human ecology. These two topics should be of great interest to those attempting to promote seismic education. Over the past two decades, environmentalism and ecology have gone from fairly obscure subspecialties of biology to major disciplines which now shape many attitudes and attendant policies affecting all our lives. While Rachel Carson's Silent Spring, combined with environmental disasters around the world, may have been the springboard for this "new age awareness," it wasn't long before textbooks began carrying the message and soon after that, that it became the major subject which introduces biology to students.

Earthquakes or earthquake science and safety may be integrated into this same realm to form a bridge between the natural and physical sciences. The boundary between the two is becoming increasingly difficult to distinguish, and some scientists/educators have suggested that no such differentiation should be characterized (Lovelock, 1987).

SHORT AND LONG-TERM BENEFITS

The safety aspect of earthquake education should first be taught as personal safety measures during and after the shaking and preparedness based on the expected intensity. Postulated benefits from teaching these ideas are: students, faculty and administration which accept and promote earthquake planning, drills and cooperation with local emergency preparedness and response agencies. This same audience will also gain a broader understanding of the role of fire departments, police and other local and state agencies.

In the five years I have been talking to students and teachers, there has never been a group unimpressed by the list of responsibilities these agencies have in an emergency situation. In nearly all instances, the introduction of these concepts in the school has overflowed into homes with resulting opportunities for additional awareness campaigns and Parent-Teacher organization activity to address the issue.

At a more advanced level, the concepts of structural mitigation should be introduced. Seismic design and retrofitting are fundamental topics in peoples' relationship with their environment when they live in an earthquake prone area. What could be more basic than recognition of unalterable environmental conditions and processes as development takes place? The economics of such issues can also be a way of bringing this new topic into an established discipline. The real benefits to the school from these earthquake subjects will probably be realized as the students are integrated into the adult society. Short of an actual damaging earthquake, which can cause large change in the short-term, the attitude of increased social responsibility leading to a forward-looking perception of what a progressive, responsible society should be, may be the greatest overall benefit. This learned attitude, if based on scientific and empirical facts can lead to the types of life and property saving actions which can make the prospect of a moderate or large seismic event less disconcerting. The school should be the first to receive mitigatory action and receive the most benefit from a sense of real safety in their building, because the occupants may be, in reality, the most at risk and the most distressed by the prospect of a disaster in our society.

SUMMARY AND CONCLUSIONS

The benefits of earthquake education to schools will probably not be measurable from a hit-and-miss program of lectures given by outside experts. The most effective results may be achieved by an organized program of earthquake education which is initially integrated into existing programs with the prospect of it standing on its own. The school should not expect to gain benefits outside of the opportunity to expose the students, faculty and community to a broader scientific and social perspective. Long-term advantages may look less attractive but account for significant safety improvements to the facilities and a higher level of understanding and awareness for people.

A subtle approach to any issue which may seem sensitive always appears to be the best route to take. However, in my work I have found that a slightly more aggressive posture - one that is based on the "Principle of Saturation" has met with some (not measured) success.

The "Principle of Saturation" is based on the following "Murphyistic" observation: I, like many others who work in offices and seem to always be filling out forms and writing reports, bring a good many pencils and pens into the small confines of my working space. These pencils and pens are actually absorbed into some fifth-dimensional labyrinth where they apparently begin to fill this unseen volume. About the time I have lost my one hundredth pencil, one of the earlier lost graphite sticks appears on the floor, on the desk or even miraculously in my hand! The pencil saturation factor for my office is then calculated to be about 100. The factor is larger for small objects such as paperclips, and smaller for larger things like out-of-print publications. Saturation appears to be directly proportional to the importance of the object.

The point of this observation is that with enough earthquake education, over some period of time, the concepts being taught will begin to surface in important places. I don't know what the saturation point and its corresponding benefit output is for earthquake education - it is bound to be quite high. This would indicate a high level of effort, especially in regions that do not have a history of damaging events.

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INTERNALIZING MITIGATION EDUCATION IN THE SCHOOLS

Daniel J. Cicirello

Earthquake Preparedness Supervisor
Arkansas State Office of Emergency Services

We are uniting our efforts at this conference in order to determine the best ways to succeed in providing earthquake preparedness education in our school systems.

There is one concept I wish to put before you, that I believe should be a major ingredient in our deliberations. I firmly feel if we ensure that INTERNALIZATION of earthquake preparedness information is a major result of our activities in our home areas, we will all have a resounding positive effect on earthquake preparedness during the next generation.

During the fall of 1985, I traveled to Santa Cruz, Bolivia to assist in developing emergency planning as it related to severe flooding that the city experienced in the past. One Sunday, our host took us to a small village north of Santa Cruz so that we could participate in their annual festival. Bolivia is a poor country, when you consider per capita income, and education levels are very low. Consequently basic sanitation education is greatly lacking among the people.

The oxen and cattle roamed freely about the church yard where the major activity of the festival was taking place. The major activity was preparing food to sell to the festival participants. Flies were busily moving between animal droppings and the food displayed on the tables. Little concern was paid by the villagers to these insects visiting their culinary offerings. I, on the other hand, began having visual flashbacks to 1949, when I was a Boy Scout. I could vividly see the magnified picture of a fly's feet leaving deposits of bacteria on food. The picture was in a health merit badge study manual. We had to respond correctly to the majority of questions put before us by the Scout Master in order to earn our merit badge. So, at the ripe old age of nine, I was eager to learn.

The bacteria being deposited by the fly in the picture was tuberculosis bacillus. According to the picture's caption, the fly had just recently collected bacteria by walking on cow droppings. Needless to say, I didn't eat any of the food at the festival in Bolivia. Later that day, I asked a Bolivian physician about the incidence of tuberculosis in Bolivia. He stated it was extremely high.

The reason I didn't eat the food was not because I'm squeamish about insects. I'm not. But rather because 36 years previous to that experience in Bolivia, I had internalized the information that would help guard my health and prolong my life. For 36 years, thereafter, I used that information whenever a situation called for it. That information had become incorporated into my thinking process. Even 36 years later it affected my behavior. I did not eat so that I would not ingest bacteria possibly provided by those little bitty fly feet.

INTERNALIZATION: TO INCORPORATE (AS VALUES OR PATTERNS) WITHIN THE SELF AS CONSCIOUS OR SUBCONSCIOUS GUIDING PRINCIPLES THROUGH LEARNING OR SOCIALIZATION.

It is this concept of "Internalization" that we must utilize in preparing our children for the potential damage of earthquakes they may experience in their adult lives.

Yes, as children it is important they learn to find a safe place when the ground starts shaking.

Yes, as children it is important they learn what they must do and what they must not do after an earthquake.

But it's equally important for them, as children, to internalize knowledge that will motivate them, as adults, to insist: that school boards mandate earthquake resistant school buildings where appropriate; that school boards eliminate earthquake hazards in, on or around those buildings; and that school boards ensure that earthquake preparedness education is included within the curriculum.

It is also important for children to internalize knowledge that will cause them, as adults, to insist that hospital boards, public officials, and regulating agencies ensure that appropriate earthquake resistance design be utilized in all hospitals and nursing homes.

It is equally crucial that children internalize knowledge that will direct them, as adults, to vote for appropriate seismic design building codes and the effective enforcement thereof, within their cities, counties, and states.

Finally, it is important for children to carry internalized knowledge that persuades them, as adults, to appropriately prepare their homes and families for earthquakes: to remove earthquake hazards; to tie down water heaters; to be prepared to turn off utilities; and to store essentials for a two week period of isolation.

Yes, I firmly believe that we must keep this concept of internalization in mind as we interact during this conference, and especially after we return to our home areas to implement earthquake preparedness curricula in our schools. For, if we succeed - and we must succeed - we will effect a change in the next generation that will prevent unnecessary death and injury when earthquakes occur. This is our overall goal, isn't it?

DANIEL CICIRELLO

Mr. Daniel Cicirello has served in Radiological Defense for the Arkansas Department of Health, as an instructor for the University of Central Arkansas in their Civil Preparedness University Extension Program, Bureau Administrator of the Bureau of Community Health Services in the Arkansas Department of Health, and as Nuclear Civil Protection Planner for the Arkansas Office of Emergency Services. Currently he is the Earthquake Preparedness Program Supervisor for the Arkansas Office of Emergency Services.

WHAT CURRENTLY EXISTS IN EARTHQUAKE EDUCATION

Katharyn E. K. Ross
Education Specialist
National Center for Earthquake Engineering Research

ABSTRACT

May, 1988, an education project was initiated at the National Center for Earthquake Engineering Research. An initial focus of this project was the initiation of a survey of state education departments to see who was offering earthquake education. In addition to discerning whether a state or particular school was offering earthquake education, surveyed programs were also asked the following: whether FEMA's Guidebook for Developing a School Earthquake Safety Program (December, 1985) was being used, what natural hazards curricula was being implemented, and if there was a school or classroom with a model natural hazards program. Throughout the time of the survey, copies of and information about earthquake education curricula, related software, and supplemental informational materials and books was collected and compiled. The result of this was a bibliography of earthquake education materials. This presentation will present a general overview of earthquake education curricula, highlighting differences in curricular emphases.

KATHARYN E.K. ROSS

Ms. Katharyn E.K. Ross joined the National Center for Earthquake Engineering Research (NCEER) at the State University of New York at Buffalo after many years as a teacher and developer of programs for children, primarily for those who are developmentally disabled. Educated at the State University of New York College at Buffalo, she is currently Education Specialist at NCEER where she is responsible for the development and oversight of earthquake education programs created by the Center.

Earthquake education curricula, as well as its implementation, has had varying emphases. It has been a part of science, safety, social studies, and even integrated throughout the curriculum.

Some curriculum developers feel it is important to fully understand the science to appreciate the hazard and thereby consistently respond appropriately in an earthquake. Other curriculum developers emphasize that all students need to know is what to do in the event of an earthquake. As a result, some materials focus primarily on earthquake science while others emphasize earthquake safety.

Busy teachers do not have time to debate where earthquake education belongs in the existing curriculum. Their time is compromised by other demands. They need to be given quality materials that fit comfortably into their existing curricula. It is hoped that conferences such as this one will provide a forum in which to discuss the benefits of varying curricula and implementation techniques so that conflicting focuses or approaches will not interfere with the integration of earthquake education into the school program.

The following is a brief overview of the existing curricula:

CALEEP Curriculum **For grades 4-8**

Lawrence Hall of Science
University of California
at Berkeley
Berkeley, CA 94720
* More information can be found:

1. Dr. William Ritz
   Science & Math Institute
   CSU
   Long Beach, CA 90840
2. Dr. Bonnie Brunckhorst
   Associate Professor of Science Education
   CSU
   San Bernardino, CA 92407

"Mini-Kit" consists of 14 Hands-On earthquake education activities:

- a. Teacher's Guide - including blackline masters
- b. Computer Disk - (Apple II+ and/or IIe with disk drive)
  Quake: A Computer Simulation and
  Survival: A Computer Simulation Game
- c. Filmstrip
- d. Audio Cassette Tape - disc jockey, Mr. Pate, experiencing 1964 Alaska Earthquake
- e. AAA map California

Can purchase Quake BINGO, Await the Quake game and Simulator Kit separately.
The Complete CALEEP Kit contains 22 activities.

I Can Make A The Difference
Chair
Emergency Preparedness Committee
Utah State PTA
1037 E. South Temple
Salt Lake City, UT 84102
* Mrs. Patty Sandstrom

For Primary Grades, written at 4th grade reading level.

This contains a series of units on a number of areas involving emergency preparedness: fire, earthquake, flood, nuclear war, and weather problems. Each unit is organized according to the same format and includes: a picture of a house in the student's community which becomes a home when each child imagines he lives there; an introductory poem; "What Would I Do" exercises; "Things I Should Know;" and games and puzzles. The earthquake section includes a map showing Utah earthquakes, an earthquake work hunt, and safety rules crossword puzzle.

Crustal Evolution Education Project
available from:
Ward's Natural Science Establishment, Inc.
5100 W. Henrietta Rd.
P.O. Box 92912
Rochester, NY 14692-9012
(p. 111-116)
1-800-962-2660

Designed primarily **for grades 7-12**

This consists of 33 individual activity modules designed to provide students with an understanding "of the concepts behind plate tectonics and the physical Earth." Each module is individual, self-contained and designed for the Earth Science classroom. Modules include: "Locating Active Plate Boundaries by Earthquake Data," "Earthquakes and Plate Boundaries," "Plate Boundaries and Earthquake Prediction," "Hot Spots in the Earth's Crust," "Volcanoes: Where and Why?" and "Quake Estate," a board game to be played by two to four students at a time and whose goal is, "to achieve success in net income based on accuracy of assessing earthquake risks" (copyright, 1979).
The CEEP is not intended to be a complete curriculum but designed to adapt to any teacher's curriculum.

Earthquake Awareness and Preparedness Curriculum
Junior League of Oakland-East Bay
3730 Mt. Diablo Blvd.
Suite 310
Lafayette, CA 94549
* Linda Grandt
Patricia Monson

For grades Pre-K-6; has been used with students up to 8th grade.

This is a 1 hour curriculum that anyone can pick up and do. It is aimed at elementary students. There is a curriculum guide that provides lessons for each grade level, an Instructor's Guide from Environmental Volunteers, Inc., and role playing situations from CALEEP. There are also supporting videotapes that show each level of the curriculum that were prepared by JLOEB, the Albany Unified School District, and the Audubon Nature Training Society: preschool level, middle school, high school-adult (not included in the curriculum), and "School Facilitation." These can be borrowed from BAREPP.

Earthquakes: A Teacher's Package for K-6/FEMA 159 — **For grades: K-6**

Federal Emergency Management Agency
Earthquakes and Natural Hazards
Programs Division
500 C Street, S.W.
Washington, DC 20472

This 250 page curriculum includes background material; sets of lessons and classroom activities on earthquake science and safety topics for each of three grade levels (K-2, 3-4, 5-6); scope and sequence charts depicting multidisciplinary connections; masters for reproduction; references; and resources. This package is designed for teachers who have little or no science background.

Earthquakes (Module) — **For grades: 8-10**

"Minorities in Engineering" Project
Currently used by MESA
University of Washington
353 Loew Hall, FH-18
Seattle, WA 98195
* Dr. Tom Liau
SUNY at Stony Brook

This is a module designed to interest students in earthquakes through activities, modeling, engineering applications, and simulation strategies. Has 12 lessons: 1-5 introduce students to earthquakes; 6-9 talks about observed precursors of earthquakes and introduces seismograms; and 10-12 try to make earthquake investigation relevant to students. Includes directions for making related items and doing experiments, i.e. making your own tiltmeter, creepmeter, shoebox model of a fault simulator, liquefaction simulation, resonating building demonstration, and earthquake simulation. Includes reproducible charts and maps. Can be used in part or total in an earth science or general science course. NCEER has been given permission to reproduce copies of this module on request.

Guidebook for Developing a School Earthquake Safety Program/ FEMA 88
Federal Emergency Management Agency
P.O. Box 70274
Washington, DC 20024
* Marilyn P. MacCabe

Designed to assist school community to develop and tailor an earthquake safety program for the school.

This is a 60-page guide plus appendices that include reprints of FEMA 46, 48, and 113.
The Guidebook includes:
"The Planning Process"
"Hazard Identification"
"Earthquake Drills"
"Immediate Response and Care Requirements"
"Communication"
"Post-Earthquake Shelter Planning"

Appendices include: "Teacher's Package On Earthquake Drills," an example of an earthquake safety program plan; sections on "Children and Disasters" and "Non-Structural Earthquake Damage."
This is designed mainly as a guidebook, not a curriculum. It allows the school to be its own planner. It is included in this listing because many districts noted that it was the curriculum they were using.

Hands-On Earthquake Learning Package

For grades: K - 12

Environmental Volunteers
2448 Watson Court
Palo Alto, CA 94303
(415) 424-8035

1. **Instructor's Guide**
   a. 17 illustrated, plastic-protected Activity Folders
   b. 16 information/activity inserts (including quake myths, games, puzzles, math activity, "tremor tales").
   c. Illustrated text on basic earthquake geology: The Story of the Earth
   d. Red Cross' Safety and Survival in an Earthquake
   e. "Getting Ready for a Big Quake" - Sunset magazine
   f. Complete guide to school earthquake planning
   g. Neighborhood Preparedness Guide
   h. "Plans for the Teaching Materials"

2. **Hands-On Teaching Materials**
   a. Plate Tectonics Globe (removable plates)
   b. Earth Hemisphere Model

c. Plate Puzzle map (ocean floor features)
d. Wood Plate/Fault Blocks
e. 9 ft. sq. plate tectonics rug (pattern also available)
f. Sea Floor Basalt rock sample
g. Sea Floor spreading box
h. Time cards, markers and time-tape
i. Continental Drift film (computer-generated)
j. Fault Zone Model
k. Magni-tube Model
l. Motor driven shaking table and accessories

I - Science Mate Program (Integrating Math, Science and Technology) **For grades: K-6**

Math Science Nucleus
3710 Yale Way
Fremont, CA 94538
* Dr. Joyce Blueford

Plate Tectonic Cycle - The Earth on the Move (part of a master science curriculum consisting of six master themes and 24 subthemes).

1. Lab manuals for grades 2-6
2. Shaker tables (made of cardboard, marbles, wood, etc.)
3. Lessons/with experiments and worksheets for grades K-6. Plate Tectonics Cycle includes: Volcanoes, Earthquakes, Plate Tectonics, and Hazards. NCEER has copies of the lessons, experiments, and worksheets from K-6 and some books used in the lessons.
4. Also available from Math Science Nucleus:
   a. Historical Earthquake Slides
   b. Recent Earthquake Slides
   c. Inflatable globe
   d. Glue Balls - to illustrate faults have memory
   e. Physiographic Relief Globe

K-12 Earthquake Science Curriculum **For grades: K-12**

Los Angeles Unified School District
Office of Emergency Services
Room G-314
450 North Grand Avenue
Los Angeles, CA 90012
* Jerry Kurilich

Teachers receive an 8 hour inservice and then are given either an elementary (K-6) or secondary (7-12) guide; also have a resource kit. This curriculum is currently waiting for Board approval and funding for completion and distribution.

Plan to Live
Chair
Emergency Preparedness Committee
Utah State PTA
1037 E. South Temple
Salt Lake City, UT 84102
* Mrs. Joy Bossi

For Secondary grades; written at 11th grade reading level

This includes a series of lessons on various natural and manmade hazards, including earthquakes. Earthquake related lessons include: "What to Do in Case of an Earthquake," "How to Prepare for an Earthquake," and "Information You Should Know About Earthquakes." Test questions are included at the end of each lesson.

Project Quake
* Linda Noson

For grades K-6

This "is an interdisciplinary, supplementary, environmental and safety program emphasizing the impact of earthquakes on the human physical, social and emotional environment." (p. 1)
It consists of 2 parts: a curriculum package and facilities package. The curriculum package has 4 goals: 1. Awareness 2. Understanding 3. Preparedness in the schools 4. Preparedness in the community. Section #4 has not been developed.
* Since our bibliography was completed, "Project Quake" is no longer at the Washington state legislature. It was not funded for further development through the state. Currently it exists as a preliminary curriculum and it will be reviewed by the Pacific Science Center for a trainer's workshop along with other earthquake materials. In that workshop they will select activities to include in an instructor's guide and develop activities where there are curriculum gaps, such as in the area of seismic design.

Teaching Earthquake Safety in the Elementary Classroom
Utah Museum of Natural History
University of Utah
Salt Lake City, UT 84112
* Deedee O'Brien

For grades: K-3

A 1/2 hour session gives children basic earthquake information utilizing simple activities, myths and factual information. It includes the Kamchatka Myth poster (originally obtained from CALEEP), Wasatach Fault poster and five follow-up activities (adapted from CALEEP to reflect the Utah scene). A Fault Blockset available from NASCO science is recommended. This curriculum is easily adaptable for general use outside of Utah. Note: Utah Museum of Natural History currently only source for CALEEP's Kamchatka Myth Posters.

Utah Geologic Hazards

For Grades 4 - Senior High School

Utah Museum of Natural History
University of Utah
Salt Lake City, UT 84112
* Deedee O'Brien

This includes a two-part slide presentation and a two foot square model of a section of the Wasatch Front. Part I - mountain leveling processes of rockfall, landslide, mudflow, flood, and lake level rises. Part II - mountain building process-earthquake. It gives a general explanation of earthquakes, reviews the situation in Utah and what could happen in a major earthquake. This is followed by an earthquake safety session. Follow-up activities on earthquake safety are left with the classroom teacher. These were adapted from CALEEP materials to reflect the Utah scene.

* Notes principle author

PLATE TECTONICS - LEARNING THE SCIENCE TO UNDERSTAND THE HAZARD

Joyce R. Blueford, Ph.D.
Geologist
Math/Science Nucleus
Fremont, California

ABSTRACT

The scientific evidence for Plate Tectonics can help students understand earthquake hazards. Overcoming fear and anxiety of any hazard starts in the elementary grades. Activities and lesson plans that emphasize critical thinking skills and content about a particular type of hazard gives students confidence to deal with problems if the student should experience that hazard. An elementary science program, Integrating Science, Math, and Technology (I. Science MATE) has students develop the skills within a year long science program. Learning about earthquake hazards requires a coherent, grade leveled, and scientifically rigorous look at volcanoes, earthquakes, and plate tectonics (Plate Tectonic Cycle). The hands-on materials were designed to highlight the evidence that geologists and seismologists use to "prove" plate tectonics as a working model. These lines of evidence include data from the structure of the surface of the earth, geophysical data from earthquakes, and paleontological clues. This scientific rationale has guided the development of activities so students learn sequential concepts that provide insight on prevention of hazards.

JOYCE BLUEFORD

Dr. Joyce Blueford is a geologist, educated at the University of California at Berkeley and the University of California, Santa Cruz. She has been an instructor of general geology, oceanography, and paleontology; worked in the U.S. Geological Survey; and is founder and currently president of the Board of Math/Science Nucleus in Fremont, California, a non-profit organization to increase science in schools. The author and co-author of numerous publications and papers, she has served as president of and was co-founder of the Association of Women Geoscientists.

INTRODUCTION

Fear and anxiety is common when a subject is not understood. It is easy to explain unknown phenomena by blaming a "higher" spirit then to research the real cause. Terrifying temblors, swaying of land, the rumbling sound during an earthquake, can cause any person to be in complete awe of the earth's powers. The steaming, hot magma, oozing down the sides of an erupting volcano, reveals another mystical power created by our earth. This fear led ancient people to create myths to explain these events. Modern people usually just live with the danger, without really knowing what is happening to the earth. Not understanding leads to apathy, which is the main reason why people do not want to think or prepare for a disaster before it happens.

Scientifically, it was very difficult for geologists prior to the mid-1900's to explain what was happening to the earth. Geophysical equipment was developed that would help obtain new data that scientists used to unlock the mystery of the moving earth. There were clues, but it was not until the 1960's that geologists began putting the pieces of the puzzle together and felt confident that the plate tectonic theory was a new working model. Active research in seismology, tectonophysics, geophysics, and engineering may someday provide information that will help predict and possibly control the earth's movement. Because new data may change the current philosophy, one who teaches about plate tectonics must make students understand that this is an evolving, dynamic subject. Solutions for today's hazard might also change as we learn more and more about how our earth releases stress.

An integrated elementary science curriculum helps to teach earthquakes and volcanoes effectively. Scientists and educators associated with the Math/Science Nucleus have developed and piloted a year long science curriculum for elementary grades, Integrating Science, Math, and Technology (I. Science MATE). It is not an added program that demands certain materials to be used, as much as it is an integration of science materials for use by all teachers at a school. Science in this program is taught as a way of thinking, using content materials from the different science disciplines to illustrate concepts. The I. Science MATE curriculum is designed to allow a school to build a basic science program that is tailored to that specific school. The philosophy of the curriculum is that Applied Sciences can be explained by the five interlocking cycles of Universe, Plate Tectonics, Rock, Water, and Life (figure 1). The evolution of the universe gave birth to our solar system. The heating up of the Earth's internal engine created movement within the earth's interior, expressed as volcanoes and earthquakes on the surface (Plate Tectonics). Erupting volcanoes expelled steam creating the first step toward the water cycle. Different environments on earth caused the creation of different types of rocks. The water created conditions for the miracle of life to develop.

The Plate Tectonics Cycle, a 4 week portion of the I. Science MATE program, is divided into Volcanoes, Earthquakes, Plate Tectonics, and Hazards. A secondary curriculum is also being piloted, however the curriculum evolves around plate tectonics as a unifying theme in teaching how rocks were created.

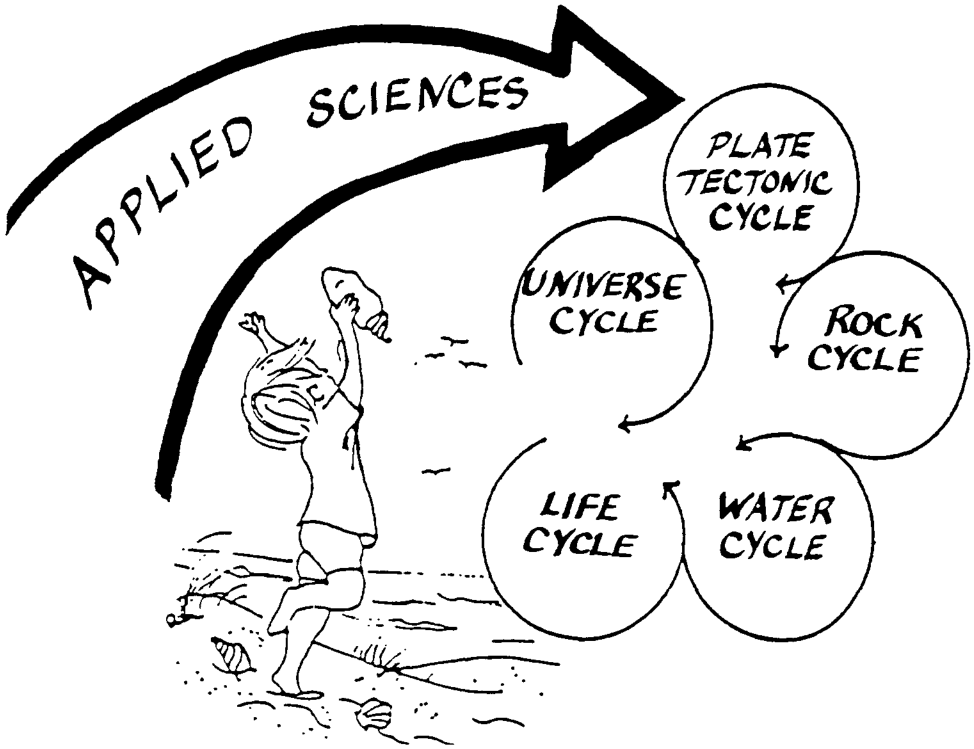


Figure 1. The main components of the I. Science MATE program.

SCIENTIFIC RATIONALE

In the Kindergarten through sixth grade, I. Science MATE Program (Blueford, 1989), earthquakes is a theme of the unit on the PLATE TECTONIC CYCLE (figure 2) (Blueford,

PLATE TECTONIC CYCLE

OBJECTIVES AT A GLANCE - 4 WEEK PROGRM

K	1	2	3	4	5	6	THEME
Volcanoes produce rocks	Volcanoes have definite shapes	Products of volcanoes	Creating rocks from lava	3 basic types of volcanoes	Volcanoes produce different rocks	Location of volcanoes	VOLCANOES 1 week
Shaking during an earthquake	Earthquakes release energy	Earthquake faults	Energy waves cause damage	Measuring earthquakes	Wave move-ments and seismograms	Dividing the earth by waves	EARTHQUAKES 1 week
Continents and oceans	Continents have moved	Evidence from continents	Pressure in the earth	Diverging, converging, transform	Crustal movement	Definition of plate boundaries	PLATE TECTONICS 1 week
Earthquakes and volcanoes cause damage	Volcanic eruptions	Where do you go for help?	Historical damage (volcanoes)	Damage during earthquakes	Mudslides and volcanoes	Earthquake "proof" structures	HAZARDS 1 week

Figure 2. An overview of the Plate Tectonic Cycle.

1988). The Plate Tectonic Cycle refers to the movement of large portions of the earth's lithosphere in what is termed plates. The boundaries of these plates are generally defined by the occurrence of volcanoes and earthquakes. The driving forces that move these plates are a combination of events that occur within the earth and external stresses on the earth caused by a rotating sphere. The immediate fueling of the movement occurs within the asthenosphere which includes the crust of the earth and the upper portion of the mantle. There are 2 divisions that geologists use to divide the earth - one that deals with the entire earth (core, mantle, and crust) and one that deals with the outer portion (asthenosphere, lithosphere, hydrosphere, and atmosphere) (figure 3). The hydrosphere refers to the water on the earth. The atmosphere is the gaseous envelope that surrounds the earth. The lithosphere is a term that includes the crust and portions of the upper mantle and defines the thickness of the "plates." The asthenosphere is a more viscous portion of the upper mantle on which the plates move. Exactly how the various layers of the earth interact is still being investigated.

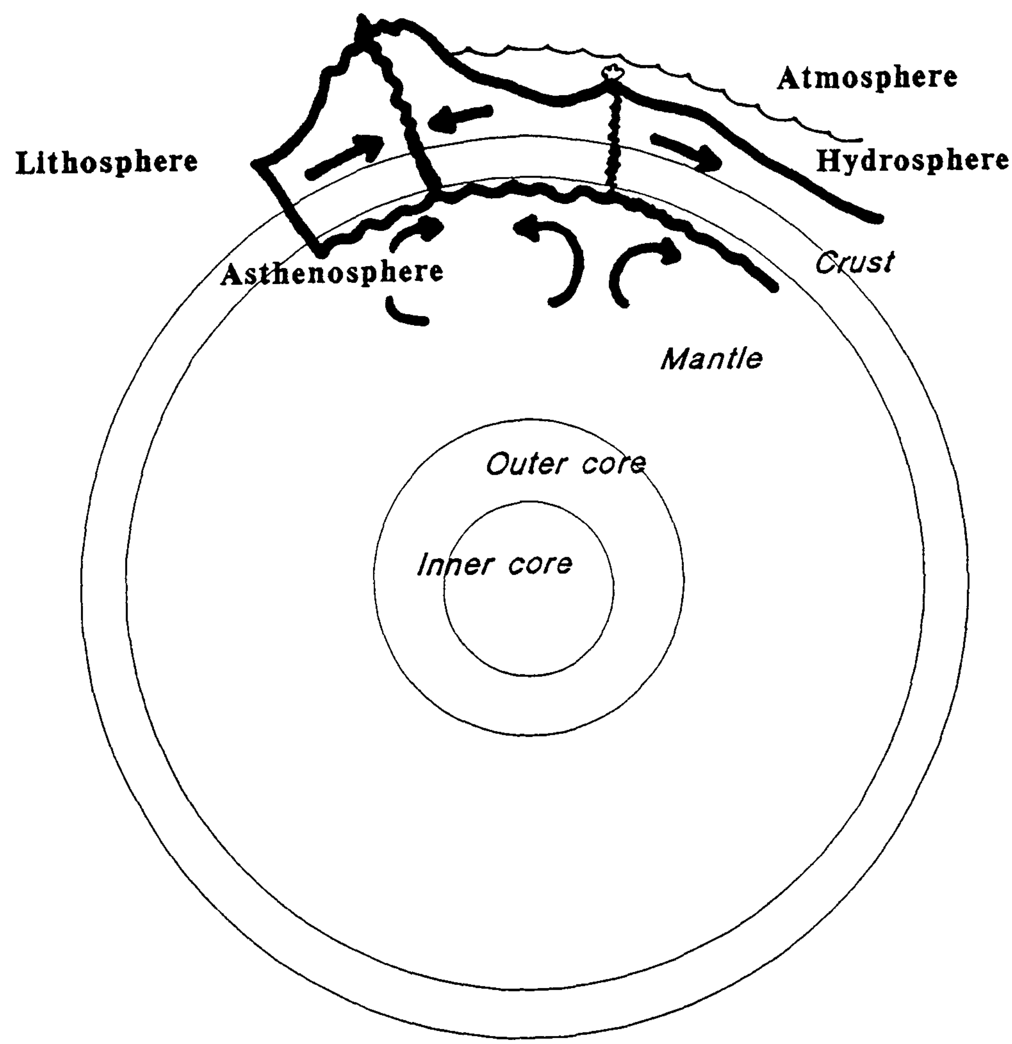
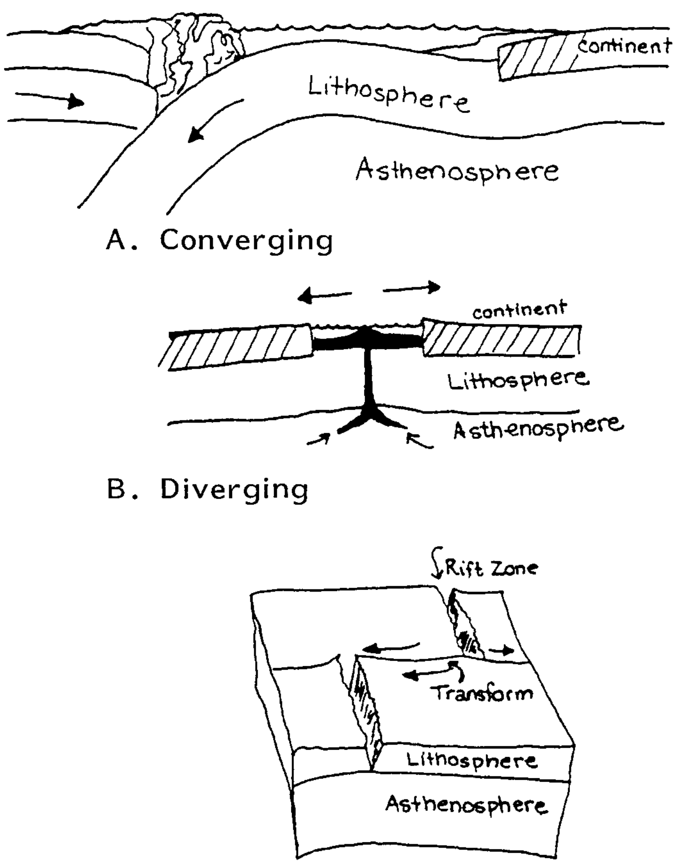


Figure 3. Cross section of the earth with the 2 types of divisions.

The boundaries of the plates are defined by earthquakes and volcanoes. These boundaries seem to move in 3 general ways. Apart (rift zone, spreading center, divergence); together (subduction, obduction, converging); or past each other (transform fault, slip slide) (figure 4). It is from the active boundaries of the plates that geologists and seismologists derive most of their information about plate tectonics, because volcanoes and earthquakes provide quantitative data.

Elementary students don't need to know all the evidence for plate tectonics, which includes paleontological, structural, and geophysical evidence. In elementary grades, structural and geophysical evidence is emphasized because the concepts are more definitive. Since we stress the use of real data, paleontological parameters require more background than most elementary students have. Historically, paleontological data were the first pieces of evidence that made geologists "think" about moving continents but it wasn't until geophysical data confirmed it that many geologists viewed plate tectonics as a good working model. At the secondary level, all three lines of evidence are taught. You can present the data in a historical context for secondary students, so students realize how difficult it was to convince even the scientific community of plate tectonics. Remember it wasn't until the 1960's that "plate tectonics" was included in many of the college level geologic textbooks, and not until the 1970's did it start appearing in the pre-college text.



C. Transform

Figure 4. Three basic types of plate boundaries. A. Converging; B. Diverging; and C. Transform.

PALEONTOLOGICAL DATA

Paleontologists had long recognized that the east coast of South America and the west coast of Africa have many fossils in common, especially land organisms. Coal-bearing beds and associated paleofaunas also seem to connect. Biologists had also noted that some North Atlantic organism's land distribution like garden snails, earthworms, mussels, and mud minnows also "linked" across the ocean. The data only started to accumulate when explorers to the "New World" started bringing naturalists on their ships. The more they looked, the more they realized that there were similarities. By the late 1800's, geologists started to notice these "links." The similarities were explained by the "land bridge" theory. Simply, this referred to the connection of the continents by extensive land, which was thought to be now underwater. However, many of the geologists felt this theory had serious problems. Imagine a little road connecting South America with Africa...how bizarre! Geologists started to visualize a moving continent or "continental drift" to account for this similarity. The continents must have been together once, but had moved apart. Paleontological evidence was convincing for those paleontologists and biologists who knew that fossils are very reliable evidence. Many geologists without this understanding of biological life, were still not convinced. They wanted more evidence.

STRUCTURAL DATA

As the world was being charted and mapped, the structural fit of many of the continents became obvious. As mountain ranges, active volcanoes, island arcs, and faults were mapped, a pattern started to emerge. Geologists noticed that certain areas on the earth have a higher concentration of these structures. Later, geologists realized that many of the structures outlined what is called the "plate boundaries."

The best method to introduce this material to your students is for them to plot volcanoes on a world map. Advanced students can take a state like California, Oregon, and Washington or countries like Chile, and try to find added information, like hot springs, parallel mountains, and valleys to find more evidence. Students can also look at detailed maps of Italy, the Middle East, East Africa, India, and China to find more structural evidence.

When discussing the structural data, volcanoes can be explained as mountains which are built by the accumulation of their own eruptive products - lava, bombs, and ash flows. There is a vent that connects the reservoirs of molten rock (magma) below the surface of the earth to the surface. Driven by buoyancy and pressure, the molten rock, which is lighter than the surrounding solid rock, forces its way upward and breaks through weak zones in the earth's crust. These zones of volcanoes define certain plate boundaries. However, not all volcanoes are on plate boundaries. For instance, the Hawaiian volcanoes do not define a plate boundary. There are a few theories about why this is so...but not one fits all the data.

GEOPHYSICAL DATA

Geophysical data is the evidence that confirmed plate tectonics as the probable cause of crustal movement to all those doubting geologists. There were many lines of evidence including magnetic anomalies, heat flow, seismic, and gravity. It is only through these investigations that a geologist can "see" inside the earth. Evidence from earthquakes record how energy passes through different substances, which is the cornerstone of present-day investigations. However, geophysical evidence is the most difficult to explain, because it involves high-level physics to really understand the principles. A teacher in the pre-college area, has to introduce the material in a simple, but logical manner as suggested below.

Earthquakes are generally thought to be caused by the fracturing of rock masses along faults and to be associated with sudden displacements along pre-existing faults. The point on the fault at which the displacement occurs is called the FOCUS OF THE EARTHQUAKE and the point on the surface of the earth above the focus is the EPICENTER. Your students must understand that earthquakes are part of the earth's lithosphere that has been stressed. This stress is stored until the actual break (the earthquake) releases the energy. This energy travels in the form of waves, which is what seismologists can record and study.

The waves generated by an earthquake can be recorded and measured on a seismogram. The interpretation of the waves and how they go through a different substances as they go through the earth, helps seismologists distinguish the different layers of the earth. Since we cannot drill very far into the crust, the evidence from different waves becomes important in interpreting the earth's structures.

There are many types of waves generated from earthquakes. The major types are P (push/pull; compression; primary) and S (shear; secondary). The simple facts are (1) P waves are faster than S waves; (2) S waves cannot travel through liquid; (3) P waves can travel through liquid and solid. These basic facts (plus many more) have helped seismologists to interpret the inner structure of the earth.

ACTIVITIES

The Plate Tectonic Cycle has a total of 72 activities centered around 4 hands-on labs per grade level with pre- and post material that reinforces the concepts of the lab. The time required to complete the materials is a minimum of 150 minutes per week. The entire school follows the same themes in order to coordinate materials more effectively. Individual activities are modified to a particular area to reflect the local geology. For instance, Los Angeles students use a fault map of Southern California and not one from the San Francisco Bay area. The main components of each of the units are explained in more detail below.

VOLCANOES

Children are fascinated with the spectacular volcanic eruptions that occur throughout the world. In geology, volcanoes are very important to help interpret what is going on inside the earth. Volcanoes have played an important part of the developing earth. As the new earth developed, volcanoes helped to create steam, which later became the major source of water on this planet. In the lower primary grades, recognizing the various shapes that volcanoes can take and that volcanoes produce igneous rocks should be emphasized. In the upper primary grades, learning where volcanoes are and plotting them on a map will help them to understand how volcanoes unravel clues about earth movements. Activities include discovering volcanic rocks; making shapes of volcanoes; and evaluating the different types of volcanoes around the world.

EARTHQUAKES

Understanding earthquakes teaches students about the inside of the earth and what causes movement on the outside of the earth. Students first have to understand what tensions occur in the earth. When the crust breaks, the energy is released in the form of waves. The transmission of these waves can cause minor to major damage to structures on the surface of the earth, depending on the intensity of the earthquake. Students will see where earthquakes occur on the earth; try to figure out why earthquakes happen; and relate earthquake occurrence with plate tectonics. Activities include making shake tables to visually see movement; making waves go through different substances; and using sticky glue balls to develop a relationship between stress and strain.

PLATE TECTONICS

Plate Tectonics is just a fancy name for explaining how and why the outer crust of the earth has moved through time. The continents that are recognized today have not always had their present shape nor been in their present location. They have shifted and moved since the inception of the continents. The Plate Tectonic units relate how earthquakes and volcanoes provide data to understand plate tectonics. Activities include making geographic puzzles, locating plate boundaries, and testing other theories of earth's movement.

HAZARDS

Natural disasters have occurred throughout time. Catastrophies caused by volcanoes and earthquakes can not only be spectacular, but devastating. This unit describes what hazards can be produced by volcanoes and earthquakes. Students will begin to learn that these hazards are natural. But if a student experiences such an event, they should be prepared to act sensibly. Students should also be acquainted with past damages to see that "mother nature" is a force that you cannot tame. Humans must understand volcanoes and earthquakes, in order to avoid the danger. Activities include simulating earthquakes on shake tables, learning to engineer structures to withstand earthquakes, and discovering damage caused by landsliding.

CONCLUSIONS

The Plate Tectonics Cycle is a unique subject to teach students, because it is important in understanding the Rock Cycle, Water Cycle, and Life Cycle. How can this be? If it wasn't for the moving of the crust, we wouldn't have a mechanism that would produe the three different types of rocks. Pressures caused by this movement creates metamorphic rocks. Volcanic eruptions along plate boundaries creates igneous rocks. The volcanoes over eons of time produced the chemical merger of hydrogen and oxygen inside the earth. Then, outgassing of volcanoes in the form of steam occurred, which gave us the vast amounts of water we presently have. Water not only sustains life, but the erosive powers of water on and through rocks and its ability to act as a solute, creates the majority of sedimentary rocks. The internal engine creates the magnetic field that surrounds our earth, which is needed for our existence on this planet.

So most people are in fear of the powers of earthquakes and volcanoes, but without them, humans would not be on this planet. Understanding the mechanisms of plate tectonics can alleviate that fear. The Plate Tectonics Cycle of the I. Science MATE program stresses the importance of the dangers and damage that are associated with volcanoes and earthquakes. Extensive damage is usually associated with poorly engineered centers of urbanization which in many cases could be avoided. The units in the elementary grades are a natural extension of the science content that precedes the units on hazards because it makes children understand the importance of it all.

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EARTHQUAKE PREPAREDNESS FROM A SCHOOL'S PERSPECTIVE

Karl E. Naugle

Dorchester Two School District Computer Coordinator

Why teach earthquake safety in schools? What better place to start than the place where statistics show that children spend the majority of their waking hours? Many advocate that we should build our hotels, shopping malls, and resorts more earthquake resistant. What about the buildings that house the future of America - our children? On a recent episode of the television show "Our House," they showed a family that exercised a great deal of common sense action in dealing with a potentially devastating earthquake. The truths that come from this two-part episode are frightening. First is the social apathy that allows a square box in our houses to teach us what our parents don't have time to teach. The second truth is the already bulging curricula of our schools which do not allow them the opportunity to incorporate earthquake safety education. We have been piloting earthquake safety curricula for many years and are still debating what should be incorporated. Meanwhile, earthquakes continue and many die.

What did our pilot study in Summerville bring to light? It showed that there are similarities between earthquakes, tornadoes, and fire drills. All deserve equal time and planning. The problem is exemplified by Xenia, Ohio which was leveled by a tornado while children were in school. The devastation caused massive drilling and planning for the new few years. But as the memory faded, the awareness also waned.

Our safety search revealed that there were many hazardous conditions in classrooms and buildings. There were many objects in classrooms that were not bolted down and could fall on children during a quake: book cases, cabinets, shelves, cubbyholes, light fixtures, and wall partitions. The air conditioners are located on the roof and could potentially crash through and block all exits. There were no battery-powered safety lights in the hallways or the bathrooms. The water cut-offs were outside the building and were stripped to the point that few could turn them. The safety assembly areas outside the building were located directly over 440-volt power lines which could be brought out of the ground during afterquakes.

Separated families and their attempts to communicate presents another kind of problem. Attempts by hundreds of students to contact their parents and attempts by those parents to reach their children or even to learn of their welfare could result in panic. Panic increases the intensity of an already catastrophic event.

The real question yet to be answered by all of those in attendance at this conference is "What is our plan of action?" Who will be in charge? What can we do in advance in terms of preparedness for any, if not all, emergencies? From my perspective as a parent of three children, I would like to know the answer to one question: are my children going to be safe? If I can say "yes" by our proactive planning, then the parents of the other 13,000 students in Summerville can rest easier. You don't have time not to plan.

KARL NAUGLE

Mr. Karl Naugle has taught elementary school, been an assistant principal of an elementary school, and is currently Computer Coordinator for Dorchester School District #2, in South Carolina. He has been a team leader for the development of an Earthquake Preparedness Pilot Curriculum at Newington Elementary School in South Carolina, one of 2 sites chosen in the U.S., and a member of the FEMA 5-year Earthquake Preparedness Committee.

TEACHER PARTICIPATION IN EARTHQUAKE CURRICULA

Jeffrey C. Callister

Earth Science Teacher
Newburgh Free Academy
Newburgh, New York

ABSTRACT

In the development of curricula to educate the K-6 children of the United States in Earthquake Awareness, a series of alternative projects has been developed by various federal, national, state, and local organizations. These projects/curricula should, at least in part, be designed and written by the teacher-practitioners who have, and will be using, these materials in the classrooms. The National Science Teacher Association-Federal Emergency Management Agency 1988 K-6 Curriculum Project is an example of such a program involving numerous teacher-participants. Selected characteristics and aspects of the development of this curriculum are contained herein.

JEFFREY CALLISTER

Mr. Jeffrey Callister has been and continues in the position of instructor of Earth Science and Geology at a public high school and an instructor in Earth Science and Geology at two community colleges. He is also on the staff of the State University College at New Paltz in the Education and Geology departments. The author of numerous publications, most recently Mr. Callister was one of three major authors of Earthquake: A Teacher's Package for K-6 and largely responsible for the grade 5 and 6 materials and a major proportion of the approximately 70 audio visual blackline masters. In the week following this conference, Mr. Callister will be one of three "Train-the-Trainer" people for FEMA to teach a 3 day workshop related to Earthquakes: A Teacher's Package for K-6 in St. Louis, Missouri.

To assure maximum use and minimum waste of our precious and limited time and resources the development of pre-college curricula in earthquake disaster preparedness should be produced, at least in large part, by those teacher/practitioners that will be implementing the curricula in the classrooms. I will state some reasons why I strongly believe in this concept using the 1988 curriculum project by FEMA/NSTA, called Earthquakes: A Teachers Package for K-6, as an example.

Earthquakes: A Teachers Package for K-6 is a good example because it is the result of the vision of Marilyn MacCabe from FEMA, reflected in how the grant was written, and the tradition of insistence on teacher involvement at NSTA as implemented by Phyllis Marcuccio.

This curriculum has 6 units: Defining an Earthquake, Why and Where Earthquakes Occur, Physical Results of Earthquakes, Measuring Earthquakes, Recognizing an Earthquake, and Earthquake Safety and Survival. It is divided into 3 grade levels (K-2, 3-4, and 5-6).

Because those developing the curriculum felt that students learn holistically, this curriculum includes lessons and materials from language arts, mathematics, social studies, art, and music as well as earth science and geology. Most of this curriculum is a series of student involvement activities based on the central theme of earthquakes. Each unit has background reading, a scope and sequence chart, materials list, instructional resources, references, and blackline masters designed for reproduction and production of overheads.

Pre-college teachers should comprise a large part of the teams that produce earthquake curricula for a number of reasons:

1. User teachers feel comfortable using materials produced by colleagues.

2. Pre-college teachers have students that are readily available to test out ideas and materials in the early design and writing stages of a curriculum project. In the development of Earthquakes, the authors found that many of our "great ideas" just did not work in the classroom.

3. Pre-college teachers have the colleague contacts needed to provide the all important function of field testing. You can't use people that just want their name in print. Pre-college teachers know which of their colleagues are going to do a quality job.

4. The appropriateness of vocabulary for grade level will be maintained by the pre-college teachers. For example, "lateral" or "sideways plate boundary" is acceptable terminology for grade school instead of transform fault (p. 45). The vocabulary used, in large part, should be those words already commonly used in present day school curricula and texts. The use of some alternate synonym or new buzz word (such as hypocenter versus epicenter) will be discouraged with use of pre-college teachers (p. 28).

5. Pre-college teachers will select and create activities appropriate for the various age levels. This is important since teachers selecting curricula are more likely to select appropriate as well as familiar materials and activities for their students. Teachers are only going to use materials they feel will work.

6. Pre-college teachers will select and design activities that use materials and supplies that already exist in most schools. This is so important because curricula that demand materials that are expensive, very specific, or not readily available will cause teachers NOT to elect to use such curricula. When curricula are photocopied, or otherwise passed along, special kits, materials, etc. are often not transferred thus, a part of the curriculum becomes useless.

7. During trial testing, students will pass along suggestions to teachers for alternate procedures and materials. In the Earthquakes development process, students suggested the use of a plastic bag of hot water instead of a "fancy" immersion heater (p. 52). Another student suggested the use of quart milk containers instead of gutter sections (p. 84). Without the vast number of uninhibited, open-minded students the entrenched ideas of adults would dominate most curriculum projects.

8. Finally, the importance of reducing pre-college teacher burnout is a further reason why these individuals should be used in curriculum development projects. If many pre-college teachers are not allowed to use knowledge, content background, writing and investigation development skills they will either leave the profession or become a poorer teacher. Working on curriculum projects is a stimulating and satisfying activity that meets the needs of skillful, pre-college classroom teachers. With the graying and early retirement of a vast proportion of the pre-college teacher profession, working on curriculum projects can be one of the ways to keep the skilled practitioners in the classrooms.

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IT'S NOT MY FAULT: THE ROLE OF DENIAL IN SCHOOL EARTHQUAKE PREPAREDNESS

Ferne J. Halgren

Coordinator
School Earthquake Management Program
Education Extension, UCLA

ABSTRACT

A damaging earthquake, which strikes without warning, seemingly at random and reduces thriving entities to rubble, is a terrifying metaphor for death. Individuals normally employ a variety of defense mechanisms to alleviate the stress of coping with negative emotional states. It is argued that these defense mechanisms, often appropriate when employed on a personal level, can and do adversely impact decisions regarding policy and planning for school earthquake preparedness. This theme is discussed with reference to parents, teachers and principals at the site level, and superintendents and school boards at the district level. Suggestions are made for dealing with these powerful defense mechanisms so that the serious work of upgrading schools' earthquake management plans can begin.

FERNE HALGREN

Ms. Ferne Halgren has spent her entire professional life as an educator. A Los Angeles native, she taught English at Burbank High School before switching to parenting as a full-time occupation in 1970. In the aftermath of the 1971 Slymar earthquake Ferne vowed to learn all she could about earthquake safety in order to be better prepared. In 1983, she founded Quake Safe, a non-profit organization dedicated to bringing earthquake education and readiness to those segments of the population who need it most. Ferne's commitment to earthquake preparedness led to her current position of Earthquake Project Coordinator for UCLA Extension. In this capacity she's produced, "Before It's Too Late," a videotape addressing problems in school earthquake preparedness; developed an awareness course and a certified school earthquake management training program for educators.

INTRODUCTION

National Geographic reporter Thomas Canby was talking about earthquakes with a bartender who worked on the 30th floor in San Francisco's Fairmont Hotel. The bartender wasn't worried. "Up here," he said, "you're away from those things."

Prior to a recent TV interview, I chatted with my host about school earthquake safety. She assured me that she never worried about her children because their school was in Pasadena, where there were no earthquakes. When I reminded her that the 1987 Whittier Narrows quake caused extensive damage nearby, she told me I was paranoid.

In order to live on the fault line, we Californians have convinced ourselves that a damaging earthquake is at best irrelevant; at worst a non-believable event. This "What - me worry?" approach is summed up by the typical resident who boasts that he's lived in California all his life and earthquakes are no big deal.

Less harmless is the attitude of an administrator at one of our sister campuses who feels that there is no need to replicate UCLA's proposed school earthquake management program because her rural communities will not have the major problems an urban area will face in a damaging quake; or the administrator who once confided to me that he didn't see the point in reducing non-structural hazards because his principals were men of God, and his schools would therefore be spared.

No one wants to see children suffer. However, if a damaging earthquake strikes during school hours, many will die and many more will be severely injured. Although some of these casualties will be unavoidable - simply a matter of being in the wrong place at the wrong time - many more are preventable. It is unconscionable and potentially litigable if those responsible for children's school earthquake safety allow their emotional defenses to interfere with the establishment, implementation, and regulation of programs designed to reduce earthquake risks.

DISASTER PLANS? OR PLANS FOR DISASTER?

April is Earthquake Preparedness Month in California. Last spring, school officials pointed with pride as students and teachers obediently performed disaster drills as a show of their school's preparedness. As a member of a special task force currently reviewing the level of preparedness in California schools, I know that these exercises disguised the fact that most of the state's 1027 districts are unprepared to handle the multiple crises that will arise when a major earthquake strikes.

According to a teacher at a Los Angeles Unified School District high school, "Improper routes were laid out to follow to assembly areas, ignoring potentially deadly hazards. These were: a 120 foot water tower directly at the end of the assembly area; high tension lines along and over the routes to safety; paths...between high walls and through narrow passages; fences and gates which inhibit ingress to the assembly area, causing crowding and potential for injury and further panic; lack of safety equipment and first aid materials as well as water and food for the [72 hour] minimal time period."

Whose fault is this? No one's, because no one person or agency in the state of California is directly accountable for school earthquake safety - and everyone's, because parents, staff, and principals at the site level and district superintendents and members of boards of education have by and large responded inadequately to the threat. Why? Because we humans tend to avoid facing stressful situations by employing an arsenal of defense mechanisms. Those of us who are concerned about the low level of school earthquake preparedness can benefit from a better understanding of these defense mechanisms and their role in avoidance of responsibility in policy making and implementation.

At the Local Level:

Parents assume that schools are safe. (I first became involved in this field when I learned that only one person at my children's school - the custodian - knew where the utility valves were. When he went to Florida for a week to tend to his sick mother, not one person at that site could have turned off the gas in an emergency). Yet when the parents are made aware of their school's disaster needs they often respond with resounding indifference. A teacher writes, "...only 25% of the student body brought their supplies...to school...I think...the main reason [is] a general lethargic attitude [in] the community. 'It won't happen to us!'"

Teachers who have attended awareness conferences and classes are often doubly frustrated - first by their school's vulnerability; second by the resistance of many of their colleagues towards increased preparedness efforts. Says one, "To quote one teacher when the subject of earthquake preparedness comes up, 'Please, I don't want to talk about it, it scares me too much.'"

Public school principals look to their districts for direction. These administrators cite more pressing priorities: an assistant superintendent in a small school district angrily writes, "Just recently it was necessary to test drinking fountains for lead in the water. Apples and apple products were thrown away because of the Alar scare. A parent called last week and wanted the schools tested for radon. The local newspaper called to ask about school buses that are older than 1977, and therefore do not meet the current federal safety standards (new buses cost $90,000 each)."

Of course money is a problem. That's because most district school boards consistently ignore the threat of a major earthquake. One year after the deadly 1987 Whittier Narrows quake, the giant Los Angeles Unified School District, with over 600,000 students, had not budgeted one penny for school preparedness.

As a result, says one teacher in a district which strides the San Andreas fault, "The current disaster plan for the district is inadequate and the staff is largely ignorant of its requirements." Adds another, close to the Newport-Inglewood fault, "The school had a written plan...However, it had not been updated in three years, and many staff members were no longer working. Few staff members had knowledge of this plan."

These examples illustrate the defense mechanisms people routinely employ to avoid dealing with stress. Chief among them are:

repression, which relegates fear to the subconscious, allowing one to remain oblivious (the typical parent's belief that "it won't happen to MY kid"),

suppression, in which the individual is keenly aware of the fear but refuses to think about it (our teacher who begs, "Don't talk to me about earthquakes - I'm already terrified"), and

denial, in which a person, such as our harried assistant superintendent, copes with a threat by juggling its impact so that it becomes less important and therefore less stressful.

At the State Level:

Repression, suppression and denial don't work on the policy-making level. It would be political suicide for an elected official to state that there is no earthquake threat in California, or that he or she is simply too frightened to face it. The threat is real, of course, and it demands acknowledgement. However, it is abstract. Unlike AIDS or the homeless, the Big One is not perceived as an immediate event and it therefore requires no immediate response. Once acknowledged, it can be ignored. Thus, on the state level, we find **detachment**: a conscious strategy to avoid responsibility.

In 1984, the California legislature passed a bill, known as the Katz Act, which mandated schools to establish earthquake emergency procedures and develop school building disaster plans. Hailed as an important first step towards safer schools, the bill is largely ineffective because it contains no on-going mechanism by which governing boards, school districts, or county superintendents are notified that they are required to comply with its mandates; no system to review compliance, and no funding for implementation. Five years after the Katz Act was enacted, many public and private schools are still unaware of their legal responsibilities and many more lack the staff, time and financial resources critical to its implementation.

Two years ago, California Governor Deukmejian declared that April would become Earthquake Preparedness Month. He then vetoed legislation that would have established earthquake safety courses for school children - one day before the October, 1987 Whittier Narrows quake.

Public agencies are no better. According to a recent review of current status and recommendations compiled by a California Department of Education task force, no state agency has the lead responsibility for assuring school emergency preparedness. The Office of Emergency Services indicates the State Department of Education should have the lead; conversely, the State Department of Education indicates the lead should be the office of Emergency Services. There is no consensus on a standard by which to evaluate school site or district emergency plans, nor any approval authority. There is no enforcement mechanism for requiring schools or districts to develop these plans.

In other words, it's not my fault.

Overcoming Defenses

I know of several very well-prepared schools. As you might expect, many are wealthy private schools with virtually unlimited resources and trustees who are sensitive to their personal liabilities. But one of the best prepared schools I've seen is South Gate Junior High School, with a largely Hispanic population of nearly 4000, and a rambling site in the midst of an urban industrial area. So it isn't simply a matter of time and money. Usually, it's a commitment from the top - the site administrator - coupled with strong support from other segments of the school population.

In South Gate's case, that commitment was sparked by the Whittier Narrows quake. The school, which operates year-round, was in session at 7:50 that morning. The district plan did not work. This prompted the teachers and administrators, in partnership with the parents (many of whom lost relatives in the 1985 Mexico City quake), to make earthquake preparedness a high priority.

Those of us in the field know that a moderate quake is our best motivational tool. But I believe that there are at least six carrots and sticks which can provide the incentive to prepare:

1. **Awareness** We must convince all concerned that a damaging earthquake is a highly probable event, and that it can adversely affect even the most "earthquake safe" buildings.

2. **Education** We must inform administrators of the specific risks and hazards they will face. For example, most disaster plans direct those in charge to send the injured to the nearest emergency facility. Once school planners learn that the Coalinga hospital - located 50 yards from the high school - was incapacitated by their quake, they begin to realize that they must train staff in mass medical care.

3. **Benefits** School boards in particular can be encouraged to realize that a fairly modest investment can reduce property losses. For example, putting lips on chemistry lab shelves can lessen the risk of a toxic spill.

4. **Liability** The cost of after-the-fact repairs and legal settlements can be enormous - and members of public boards of education are not protected from personal lawsuits; if it can be demonstrated that they were negligent in inadequately preparing for a highly probably seismic event.

5. **Guilt** Years ago, in Chicago, a Catholic school collected newspapers for a funding drive. Papers were placed temporarily under a fire escape. A fire broke out, and two children died while evacuating the building. The nun who had directed the newspaper drive suffered severe

psychosomatic illnesses as a result of her guilt, and eventually left her order. Could you live with yourself if you chose to ignore the earthquake threat, and children died as a result?

6. **Flattery** If **you** - with all your knowledge, compassion, organization skills and power - don't take the lead, who will? This argument applies equally to parents, teachers, principals, and local and state officials.

"BEFORE IT'S TOO LATE"

In January, 1988, I began raising funds to produce a videotape which would promote greater school preparedness. Two days ago in Los Angeles, my producer handed me the finished product. I will see it in its final form for the first time this afternoon. As you will see, we shamelessly incorporated all six motivational tools in order to strip away the emotional defenses of those who can make a difference. We at UCLA Education Extension fervently hope that this video, titled "Before it's Too Late," convinces everyone - from the parents of school children to the governor - to begin to take responsibility for our faults.

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THE PROCESS OF DISSEMINATION

Phyllis Marcuccio
Editor
Science and Children Magazine

Reaching an audience in the teaching community with information about earthquake preparedness can be a frustrating task. How can you increase the chances that your materials and message are seen and heard by the classroom teacher? What channels are best to use for communication directly to the teacher? Which ones work best for dissemination? For communication with administrators? For response? For support? How can and will the teacher fit your materials into the existing curriculum?

What options exist for materials distribution and communication through the science education profession beyond the direct routes within a school or school system, e.g., mailing lists, meetings, conventions, conferences, workshops, organizations, newsletters? For example, the NSTA Membership Office notes that there are 45,000+ (P-C) members. This group includes approximately 15,000 high school teachers and 8,000 elementary school teachers. Knowing professional membership information can guide dissemination decisions.

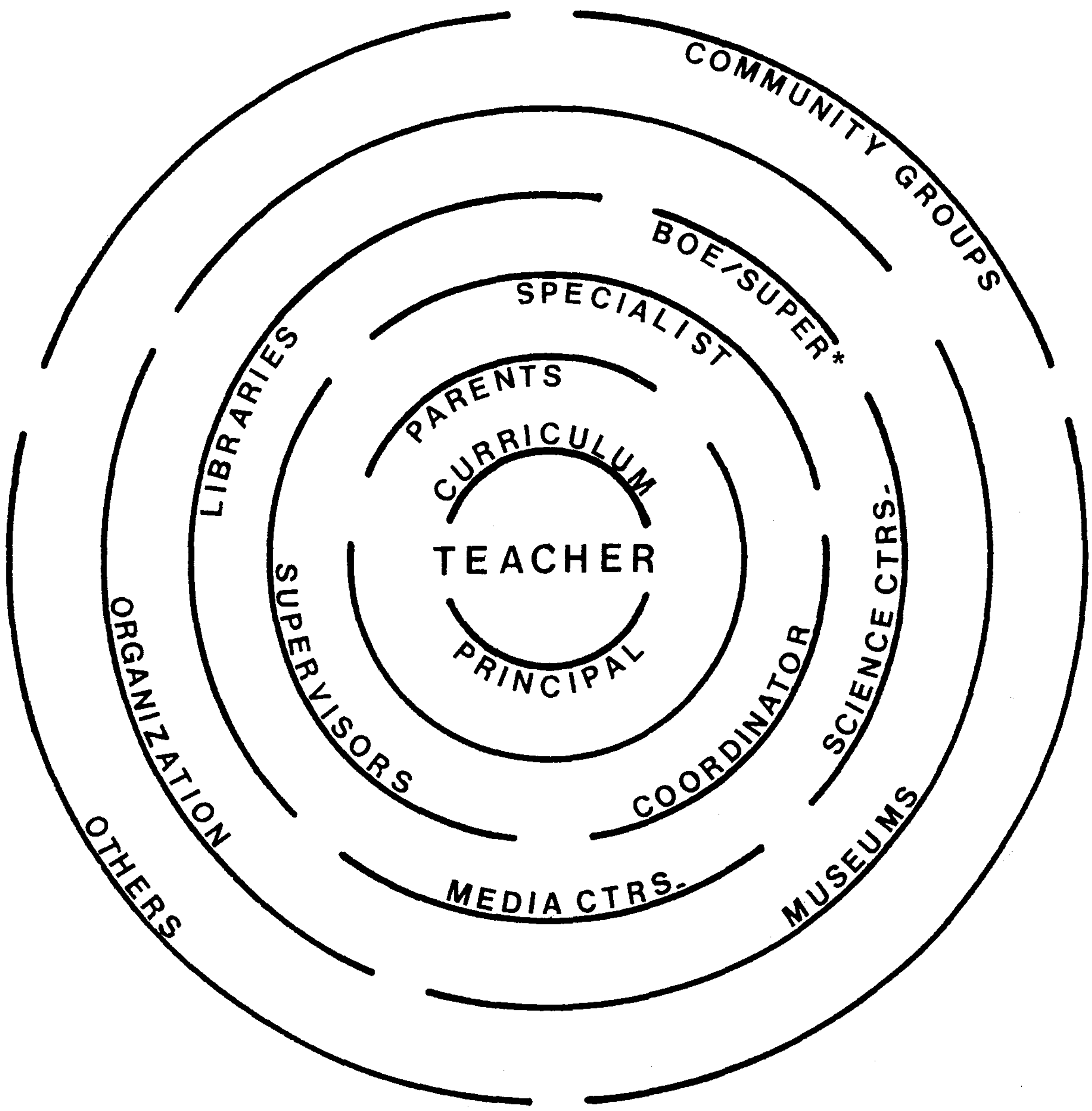
There are practical do's and don'ts for many of these questions. Several suggestions and techniques will be mentioned that may stimulate ideas and channels for you to try as you strive to encourage the implementation and use of classroom materials you prepare.

It's important to know about your audience and what technique will work best for the dissemination of information to that particular group. It's also important to know which channels work best for communication (see Figure 1) with administrators (legislative), for response, and for support (PTA). It is also important to know your audience in order to see how the teacher will fit the new materials into the existing curriculum (see Table 1). Teachers learn in a variety of ways (see Table 2). Locally they do it at workshops, at professional organization meetings, through newsletters, on field trips, at the library, and in various centers, i.e. science centers. Nationally they learn about new materials and curricular information through meetings, various professional organizations, journals, newsletters, directories of information, and networks such as ERIC. Another source is through computer bulletin board systems and networks. It's important to know what computer bulletin board systems and networks exist that science teachers frequent for information. The NSTA bulletin board system is one computer bulletin board system that is used by science teachers: (202) 328-5853.

PHYLLIS MARCUCCIO

Ms. Phyllis Marcuccio is Director of Publications at the National Science Teachers Association and Editor of Science and Children. The publication program of NSTA includes 4 journals, a newsletter, several special publications, in-house typesetting, and a publication sales/fulfillment operation. She is the author and editor of numerous publications and was Project Director for the K-6 Earthquake Curriculum, under a Federal Emergency Management Agency Grant in 1987.

SUPPORT SYSTEMS SURROUNDING A TEACHER



Workshops
Conferences
Publications/Periodicals
Suppliers
Electronic bulletin boards
Community members

Figure 1

* Board of Education/Superintendent

Table 1*

TABLE 17.
SUBJECTS TAUGHT BY DEPARTMENTALIZED ELEMENTARY (1976-1986) AND SECONDARY TEACHERS (1961-1986)

Subject	Elementary[a]			Secondary					
	1976	1981	1986	1961	1966	1971	1976	1981	1986
Agriculture	0.0%	0.0%	0.0%	2.6%	1.6%	0.6%	0.6%	1.1%	0.6%
Art	4.6	8.4	4.5	2.2	2.0	3.7	2.4	3.1	1.5
Business education	0.0	0.0	0.0	7.6	7.0	5.9	4.6	6.2	6.5
Driver education	0.0	1.2	0.0	0.4	...[c]	0.7	0.7	1.3	0.6
English	32.1	28.9	31.8	19.0	18.1	20.4	19.9	23.8	21.8
Foreign languages	0.0	2.4	0.0	4.1	6.4	4.8	4.2	2.8	3.7
Health and physical education	10.7	9.6	15.9	8.2	6.9	8.3	7.9	6.5	5.6
Home economics	0.0	0.0	0.0	5.1	5.9	5.1	2.8	3.6	2.6
Industrial arts	0.8	0.0	0.0	5.5[b]	5.1	4.1	3.9	5.2	2.2
Mathematics	15.3	15.7	11.4	11.4	13.1	14.4	18.2	15.3	19.2
Music	6.9	15.7	9.1	1.7	4.7	3.8	3.0	3.7	4.9
Science	7.6	7.2	4.5	11.7	10.8	10.6	13.1	12.1	11.0
Social studies	8.4	6.0	4.5	12.9	15.3	14.0	12.4	11.2	13.6
Special education	13.0	4.8	13.6	...[c]	0.4	1.1	3.0	2.1	3.5
Vocational education	0.8	0.0	0.0	...[d]	...[c]	2.1	3.3	1.3	2.2
Other	0.0	0.0	4.5	0.6	0.0	0.3	0.0	0.7	0.6
(Number responding)	(131)	(83)	(44)	(778)	(1,088)	(707)	(670)	(619)	(463)

[a]Elementary teachers not tabulated separately in 1961, 1966, and 1971.
[b]Includes vocational education.
[c]Data not available.
[d]See industrial arts.

*From: Status of the American Public School Teacher, 1985-1986 (p.28), 1987, Washington, DC: National Education Association. Copyright 1987 by the National Education Association. Reprinted by permission.

Table 2*

TABLE 44.
PERCENTAGES OF ALL TEACHERS PARTICIPATING IN PROFESSIONAL GROWTH ACTIVITIES, 1971-1986

Activities	1971	1976	1981	1986
Workshops sponsored by school system during school year	58.6%	68.3%	67.4%	72.7%
Workshops sponsored by school system during summer	20.5	21.9	13.4	15.1
College courses in education during school year	40.1	45.4	21.3	21.1
College courses in education during summer	30.4	33.8	13.3	12.4
College courses in fields other than education during school year	26.1	25.9	12.7	9.2
College courses in fields other than education during summer	21.5	16.2	5.7	4.3
University extension courses	32.6	33.8	18.7	15.0
Association-sponsored activities	24.5	23.3	27.1	31.5
Curriculum committees	40.8	44.7	34.2	30.5
Committees other than curriculum	35.3	38.6	32.6	33.9
Educational TV	11.3	12.2	13.4	12.9
Educational travel, not sabbatical	26.4	23.0	14.7	9.6
Sabbatical leave—travel	3.8	7.2	2.4	17.6
Sabbatical leave—full-time college	2.4	3.7	0.6	0.6

*From: Status of the American Public School Teacher, 1985-86 (p. 49), 1987, Washington, DC: National Education Association. Copyright 1987 by the National Education Association. Reprinted by permission.

IMPLEMENTATION OF EARTHQUAKE EDUCATION IN THE UNITED STATES: AN OVERVIEW

Katharyn E.K. Ross

Education Specialist
National Center for Earthquake Engineering Research

ABSTRACT

In May 1988, the National Center for Earthquake Engineering Research initiated an earthquake education project which focused on earthquake awareness and safety education in school programs for grades K-12. A primary focus of this program was surveying state education departments, individual school districts, and schools in the United States and the Territories to see who was offering earthquake education. A survey of the state education departments has been completed with fifty states and two Territories responding. Results of this survey will be presented, and difficulties with general implementation of earthquake and other hazard awareness curricula at the state education level will be highlighted. A need to find other dissemination and implementation mechanisms exists, especially in those states where the state education department cannot mandate curriculum.

KATHARYN E.K. ROSS

Ms. Katharyn E.K. Ross joined the National Center for Earthquake Engineering Research (NCEER) at the State University of New York at Buffalo after many years as a teacher and developer of programs for children, primarily for those who are developmentally disabled. Educated at the State University of New York College at Buffalo, she is currently Education Specialist at NCEER where she is responsible for the development and oversight of earthquake education programs created by the Center.

INTRODUCTION

The National Center for Earthquake Engineering Research initiated an earthquake education project in May, 1988. The program focused on earthquake awareness and safety education in school programs for grades K-12, with a special emphasis on grades K-6. The initial goals of this project were to determine what has been done elsewhere in the field, develop a package of materials with an appropriate amount of detail for students at varying intellectual and interest levels, and test those materials in an elementary level program.

The primary emphasis during the first six months of the project was on surveying state education departments, individual school districts, and schools in the United States and the Territories to see who was offering earthquake education. Earthquake education was defined as having a science and a safety component.

In addition to asking whether a state or particular school was offering earthquake education, the survey also asked whether the Federal Emergency Management Agency's (FEMA) Guidebook for Developing a School Earthquake Safety Program (December, 1985) was being used, what natural hazards curricula was being implemented, and if there was a school or classroom with a model natural hazards program.

STATE EDUCATION DEPARTMENT SURVEY

The first survey to be completed was directed to the state education departments. All fifty states and two Territories responded to the survey. Results of this survey indicated three states, Arkansas, California, and Kentucky, included earthquake education in their state education department guidelines (see Figure 1).

In Arkansas, there is a requirement for earthquake awareness and safety education in the state course outline starting in Junior High School. In addition, on May 26, 1989, the Arkansas Department of Education sent a memo to all superintendents noting the earthquake risk in Arkansas and stating, "...earthquake preparedness programs are essential and should be initiated, for those who have not done so, as soon as possible."[1] To assist with these programs, the following are offered: Guidebook for Developing a School Earthquake Safety Program (on request), lectures and video presentations for students in K-12, and optional scheduling of on-site inspections and recommendations for schools. The earthquake preparedness programs will be monitored by the K-12 area supervisors during annual visits.

In the California Science Framework Field Review Draft and Addendum (1984), there are several learner outcomes that deal with earthquake education. Information about earthquakes and plate tectonics is emphasized in the three themes of Energy, Evolution, and Patterns of Change, and integrated throughout various grades. Other materials used in the state include the

[1] Director's Memo No. 89-18, May 26, 1989, from Ruth S. Steele, Director, General Education Division, and Emma Boss, Associate Director, Instructional Services.

earthquake education materials developed by the California Earthquake Education Project (CALEEP); the "Hands-On Earthquake Learning Package" (HELP), from Environmental Volunteers; the Earthquake Awareness and Preparedness Project curriculum, which is a joint effort between the Audubon Nature Training Society and the Junior League of Oakland-East Bay; and "The Plate Tectonic Cycle," from Math/Science Nucleus. These materials address both earthquake science and preparedness.

In Kentucky, teachers are trained to use earthquake materials in elementary grades, and to integrate the materials in science and social studies. Materials from FEMA have been used for training sessions.

Information from the survey indicated that thirty-one states and the District of Columbia do not mandate earthquake awareness or safety education, although information about earthquakes might be included in general science or earth science (see Figure 2). For example, in Alabama, earthquakes are discussed in eighth grade earth science classes. Fifteen states could not mandate any curriculum and one other state could only give recommended guidelines to the school districts (see Figures 3 and 4).

The two territories that responded were American Samoa and Puerto Rico. American Samoa does not include earthquake education in their guidelines although earthquakes are discussed in Level 8 General Science. In addition, the government in American Samoa has a Disaster Planning Office and disseminates information and drill materials to the schools. In Puerto Rico, earthquake information is included in the ninth grade earth science curriculum. Earthquakes, plate tectonics theory, and landforms are discussed in a unit about subterranean processes.

Some state education departments provided additional information (see Figure 6). For example, six states, Hawaii, Illinois, Indiana, Missouri, South Dakota, and Utah, noted that either earthquake safety information is distributed to the schools and/or earthquakes are included in the disaster plans. Oregon includes earthquake safety in the school bus driver training program. Washington state indicated they had temporarily inherited a partially completed curriculum, "Project Quake," which is "...an interdisciplinary, supplementary environmental and safety program emphasizing the impact of earthquakes on the human physical, social, and emotional environments"[2] (p. 1). Currently, this exists as a preliminary curriculum which will be reviewed by the Pacific Science Center for a trainer's workshop along with other earthquake materials.

In Idaho, a project to develop seismic safety standards for Idaho schools has been completed and submitted to the Idaho State Board of Education. This study incorporated three aspects: the evaluation of the seismic hazard in the state from a geological viewpoint; seismic vulnerability of school buildings in the state; and the establishment of a school-based disaster preparedness program. The Idaho Department of Education has given school districts packets of pertinent information including the NSTA/FEMA curriculum, Earthquakes (FEMA 159).

[2] Project Quake is a K-6 curriculum initially undertaken by the School Earthquake Safety and Education Project (SESEP), under the direction of Linda Noson.

This survey provided some general information about what was occurring in some states, particularly highlighting the difficulties with general implementation of earthquake and other hazard awareness curricula at the state education level. There is a need to find other dissemination and implementation mechanisms, especially in those states where the state education department cannot mandate any curriculum.

INFORMATION FROM OTHER SOURCES

In over 30% of the states, the state education department does not mandate curricula. As a result, these departments do not keep data on what is occurring. For example, the Alaska Department of Education can only give minimal details of any earthquake education programs in the schools. They do not know the extent to which districts provide earthquake education. However, this information can be obtained from the Alaska Division of Emergency Services, which completed a survey of Alaskan School districts in Spring, 1988,[3] with 45 out of 55 districts providing information.

The Alaskan survey queried school districts on the following: emergency operations plans, the number of earthquake drills during a year, awareness programs requested, and new school construction in the next five years. The survey indicated that of the schools located in Seismic Zone Four, 25% had no earthquake drills; 25% had one earthquake drill per year; 33% had 2-4 earthquake drills per year; 8% had 6-12 earthquake drills a year; and 9% had "some" drills. Information such as this is invaluable to those actively working in earthquake education.

Because more information was needed than could be provided by state education departments, information about earthquake education programs was also collected from other sources such as FEMA; other preparedness organizations; Earthquake Information Centers; college and university faculty that have written articles about earth science and/or earthquake education programs or that have advised other programs; U.S. Geological Survey; Red Cross; professional teacher organizations such as the Earth Science Teachers Association; and the Krause Guide. Information from these sources is being compiled and analyzed.

Letters from state representatives of the National Earth Science Teachers Association provide additional information:

- From Florida, "Florida children do not need earthquake drills."

- From Iowa, "I must report that very little earthquake education is being taught in our school district. Even though we are fairly close to the New Madrid area, there is nothing in terms of hazard awareness mandated by our school district. Were there to be a damaging quake, I am sure few would have any idea how to react."

[3] "Earthquake/Tsunami Survey of Alaska School Districts," Spring 1988, Alaska Division of Emergency Services, Mike Webb, Earthquake Program Manager.

- From Ohio, "People in the state of Ohio do not seem to be worried about earthquakes because they do not seem to be important except as a news item. It happens other places but not here."

- From Pennsylvania, "...our District does not feel that earthquakes pose much of a danger to our students."

- From Texas, formerly from Missouri, "When I was at Bowling Green High School, they did not have earthquake drills. While I taught about earthquakes and reviewed what to do in case of an earthquake, the school did not think it was important enough to have a drill. One of the reasons was that it was not required by the state of Missouri...I have found that if the state does not require it, they will not have them...The same is true with the school district I am now in. It is located just north of Houston, Texas. They have had fire drills this fall only. I checked with the principal and he said, 'why?' when I asked about earthquake drills. In checking with the other science teachers, they teach earthquakes, but do not teach what to do if you are ever in one."

- From Wisconsin, "In the midwest we have little concern of earthquakes. The only natural hazard that we are concerned with is the tornado."

OTHER IMPLEMENTATION ISSUES

There are multiple issues involved in earthquake education, many of which hinder its effective implementation in school systems. Primary among these issues is raising the level of awareness of school systems to the need for earthquake education. Along with this, the focus of, and ultimately the place of, earthquake education in the curriculum becomes a major issue. The following are some questions that need to be addressed:

What constitutes earthquake education for children?
Where does earthquake and other natural hazard education fit into the curriculum?
Should earthquake education and preparedness information be presented in isolation or in the context of an established science program in the schools? Should it solely be a part of the school safety plan?
Should earthquake education be presented in areas with little seismic risk?
Should all materials be state specific?
Should school materials be used as bridges to the public?
Who should be responsible for earthquake awareness and safety education? At the state education department level? At the school district level? At the local school level?

There is a need for coordinated dissemination of information to minimize duplication of efforts and maximize distribution of usable information, as well as a forum to discuss pertinent issues. Available information needs to be specifically tailored for various populations and shared simultaneously with state education administrators, district superintendents, professional organizations, and teachers. In those states where the state education department cannot mandate curricula, the emergency preparedness, professional, and national organizations can be used to spearhead earthquake education efforts.

CONCLUSION

Earthquakes have left schools damaged in the past and will probably do so in the future. Administrators, teachers, and staff need to be informed about earthquake hazards (see Figure 7) so they can be active agents in making the school safer. Earthquake education needs to be clearly defined and avenues for its implementation into the school system need to be aggressively pursued.

Figure 1

EARTHQUAKE EDUCATION

Included in the Guidelines of the State Education Department

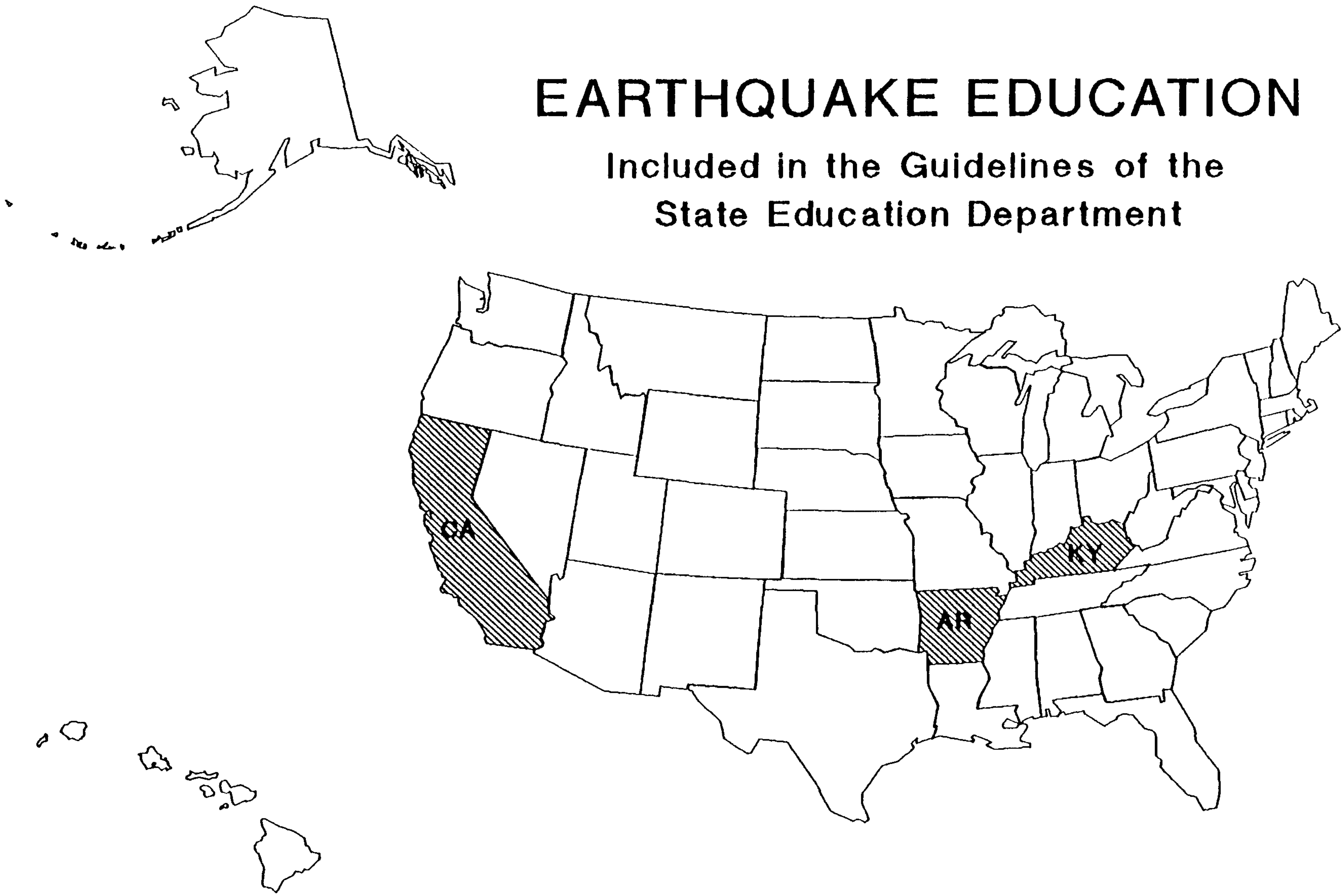
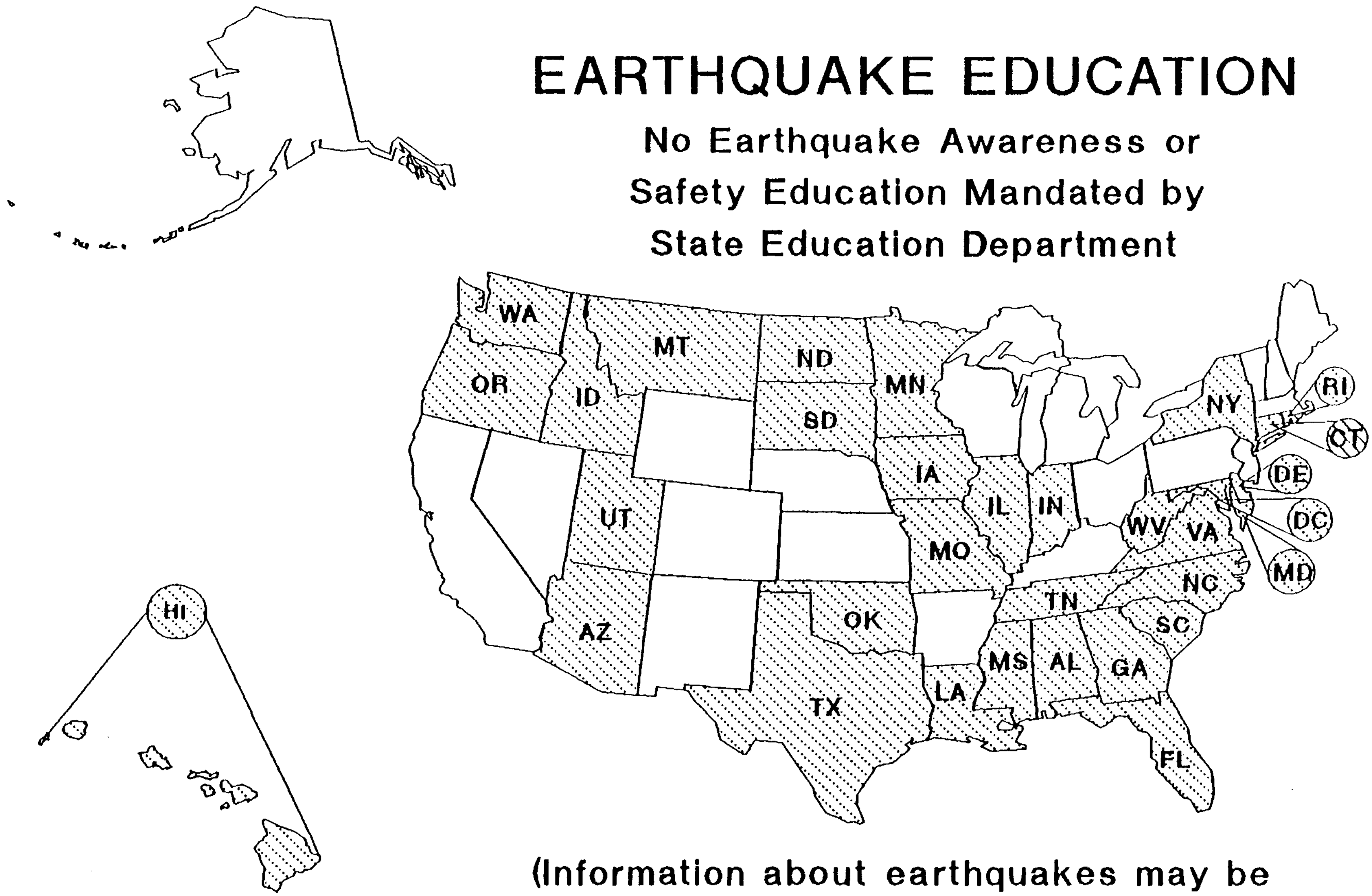


Figure 2

EARTHQUAKE EDUCATION

No Earthquake Awareness or Safety Education Mandated by State Education Department



(Information about earthquakes may be included in general science or earth science)

Figure 3

EARTHQUAKE EDUCATION

No Curriculum Mandated by State Education Department

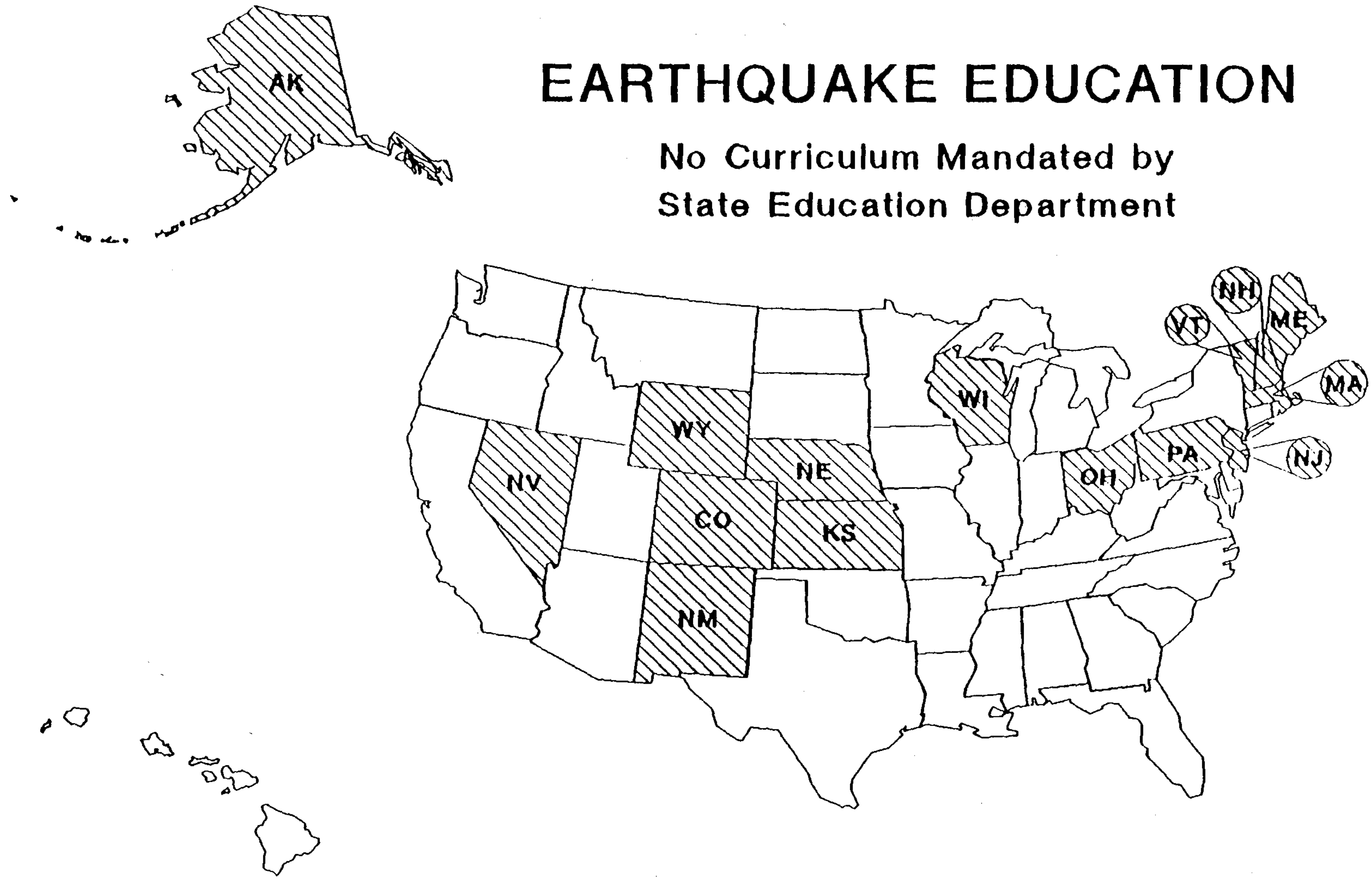


Figure 4

EARTHQUAKE EDUCATION

State Education Department Only Gives Recommended Guidelines to Districts

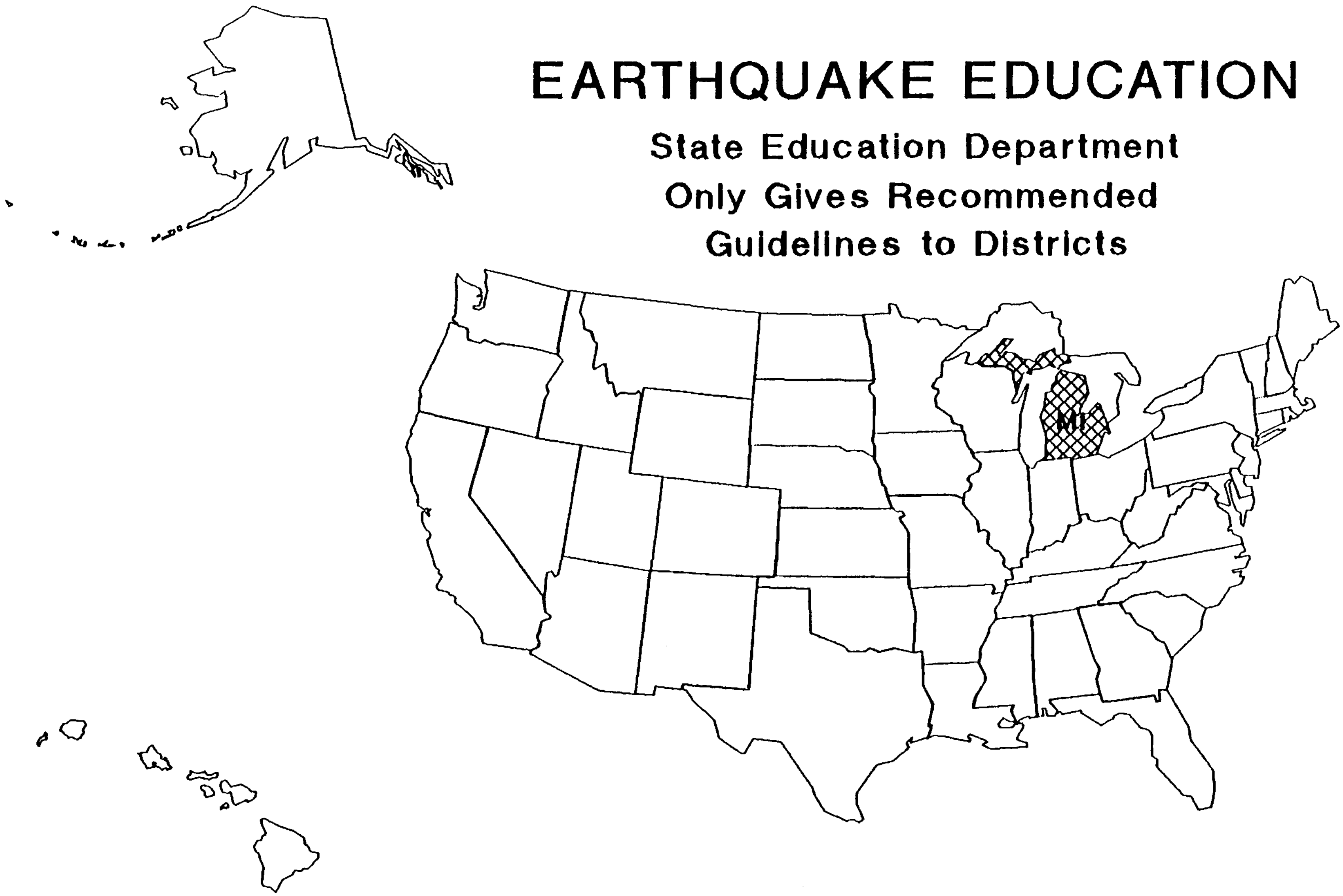


Figure 5

EARTHQUAKE EDUCATION

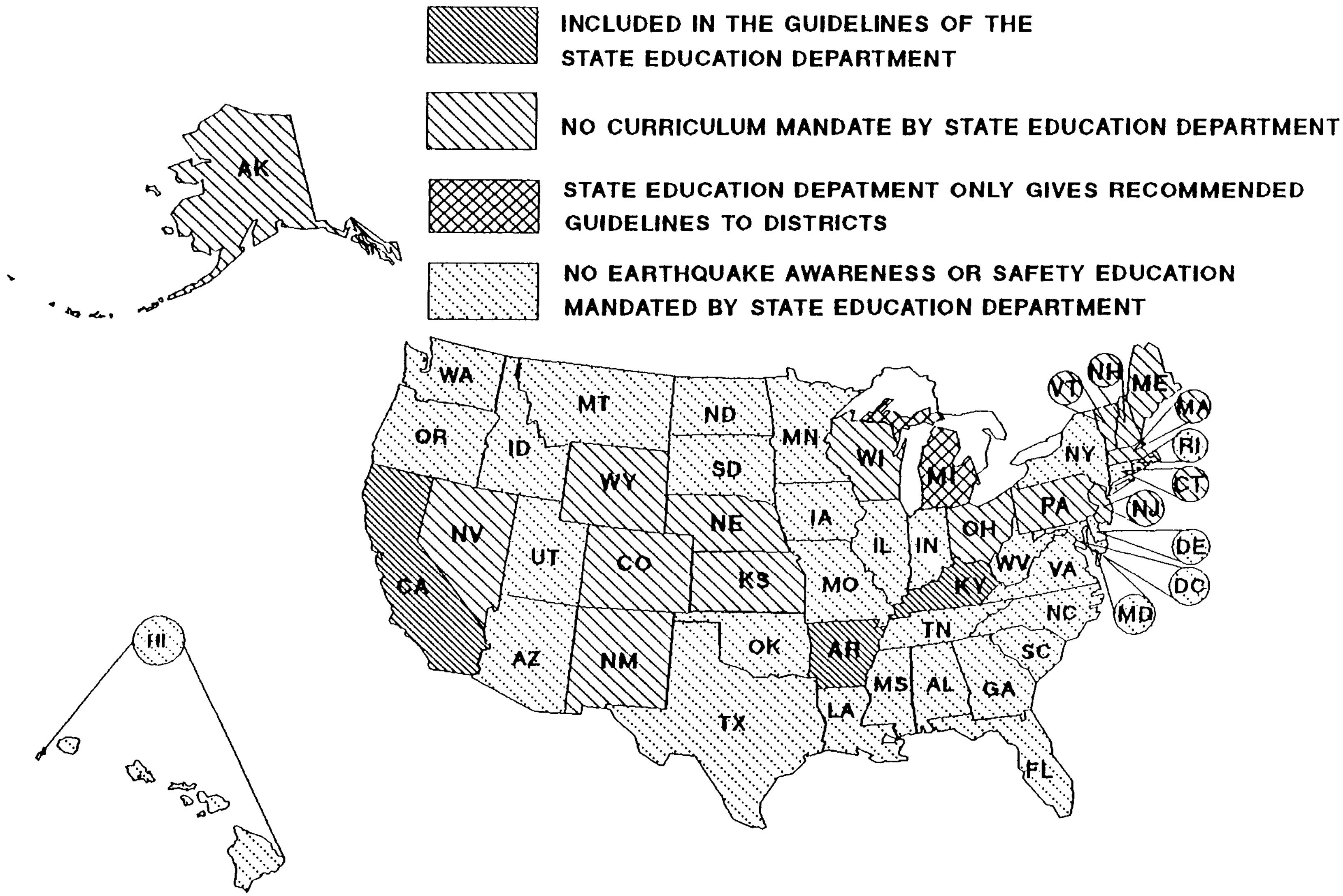
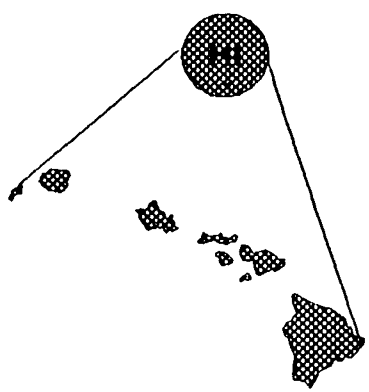


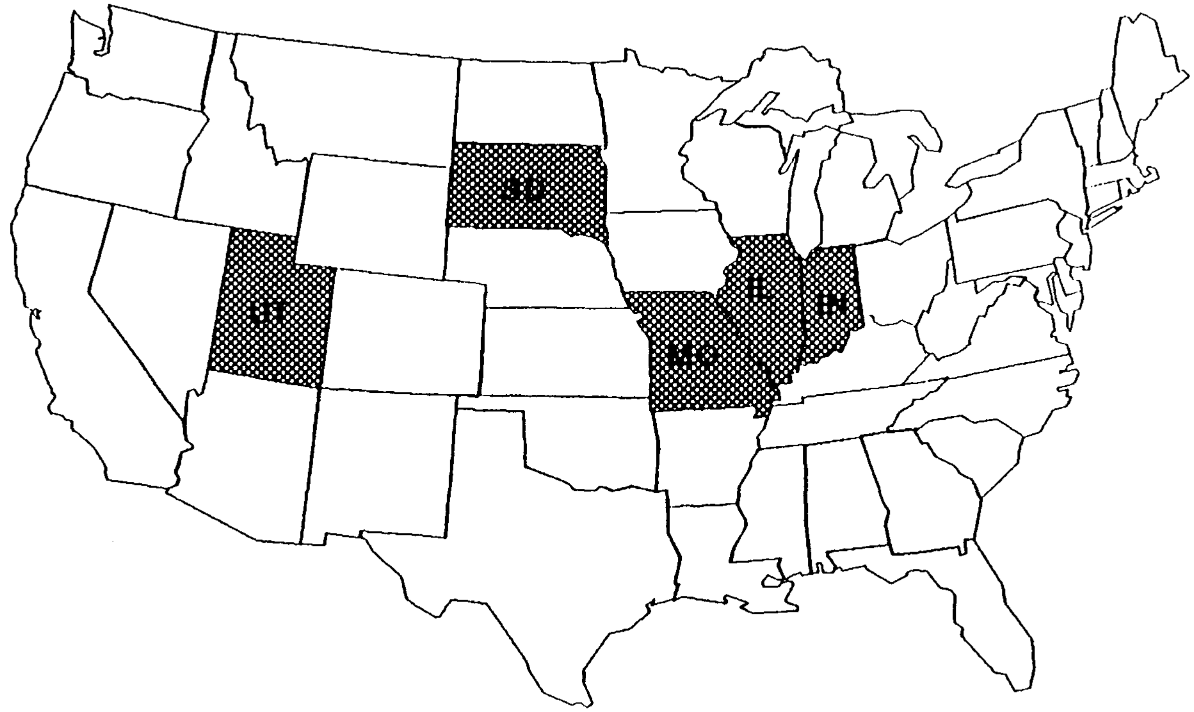
Figure 6

EARTHQUAKE EDUCATION

Earthquake Safety Information Distributed to Schools

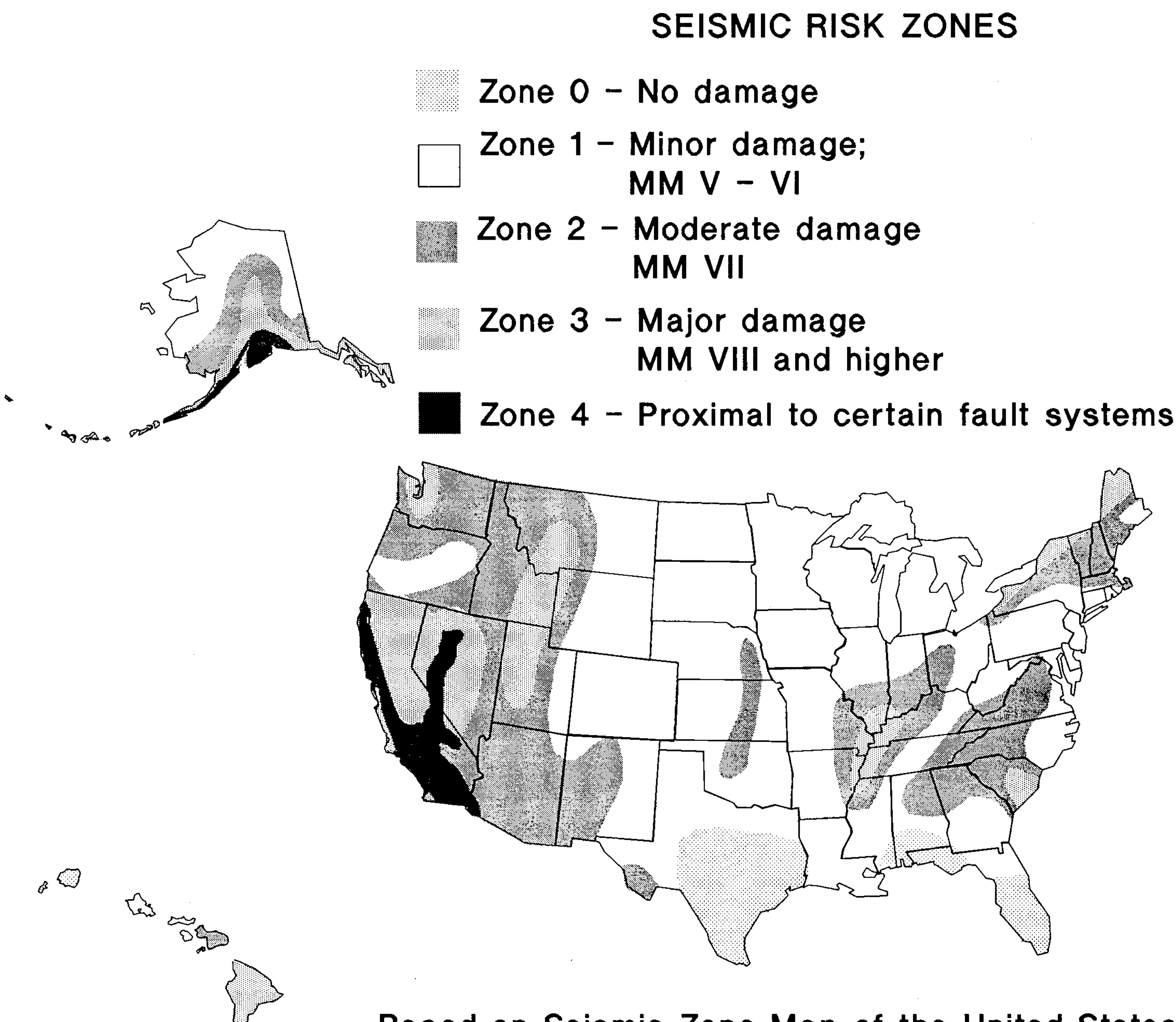
Earthquakes Included Disaster Plans *





* Information Volunteered by these States; this not meant to be an all inclusive list

Figure 7



Based on Seismic Zone Map of the United States, Uniform Building Code, 1979

Table 1

RESPONSE TO EARTHQUAKE AND NATURAL HAZARDS CURRICULUM INQUIRY

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Alabama	10/13/88	No earthquake education or safety instruction in schools. Do talk about earthquakes in earth science classes in 8th grade. Alabama has a course of study for districts to follow which delineates minimum standards only. Do provide tornado and hurricane safety information in the schools.
Alaska	9/14/88, 2/27/89	No curriculum mandated. Earthquake education is done by individual teachers in some districts, i.e. Anchorage. A seismograph was installed in Petersburg High School (southeastern Alaska) under a federal NEDA grant in 1976. This instrument continues to operate. It is maintained by students under the supervision of Mr. Paul Bowen, science teacher, and serviced by personnel from NOAA's Tsunami Warning Center at Palmer, Alaska.
American Samoa	3/21/89	No earthquake education. Do talk about earthquakes in Level 8 general science. American Samoa Government has a Disaster Planning Office and

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
American Samoa (Cont'd)	3/21/89	disseminates information and drill materials to the schools.
Arizona	10/27/88	No earthquake education. Information about earthquakes included in earth science but not safety aspects.
Arkansas	10/20/88	There is a requirement for earthquake awareness and safety education in the state course outline starting in Junior High School. EARTHQUAKE EDUCATION.
	5/26/89	Arkansas Department of Education sent a memo to all superintendents noting the earthquake risk in Arkansas and stating, "...earthquake preparedness programs are essential and should be initiated, for those who have not done so, as soon as possible."
California	9/27/88	Several earthquake programs in the state, i.e., CALEEP, sent Science Framework Addendum, 1984 which includes several learner outcomes dealing with earthquake education. Have used FEMA Guidebook. EARTHQUAKE EDUCATION.
Colorado	10/31/88	No curriculum mandated.

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Connecticut	10/13/88	No earthquake education or safety in schools; no state earth science curriculum. Class on geology of region taught in Moodus.
Delaware	8/24/88	No earthquake education programs/natural hazard curricula in the schools.
Florida	5/20/88	"Minimum Student Performance Standards for Florida Schools," Enclosure 1 - Curriculum Frameworks -Grades 6-8 Florida Department of Education, Enclosure 2; no earthquake education.
Georgia	5/20/88	Process of being revised; no earthquake education.
	8/25/88	"K-8 Science Curriculum" approved; request a copy when it becomes available 10/88.
Guam		No response.
Hawaii	11/1/88	There is no earthquake education in the curriculum. Earthquakes, tsunami included in emergency preparedness plans for schools. Tsunami drills recommended once a year.
Idaho	4/20/88	"Secondary Earth Science Course of Study."

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Idaho (Cont'd)	7/11/88	There is no formal mention about earthquake education in The State Science Curriculum Guide or in health and safety education. Earthquake education and safety is sometimes integrated into other subject matter areas, i.e. current events. Have no figures on how many teachers are teaching earthquake education to students in grades K-6.
Illinois	6/10/88	Information & instruction sheet for teachers and school administrators in the event of an earthquake, and a poster for the classroom bulletin board.
	6/17/88	"School Emergency Planning Guide," provided by The Illinois Emergency Services and Disaster Agency; includes chapters on earthquakes, tornadoes, severe thunderstorms, floods, blizzards. No earthquake education in curriculum.
Indiana	5/3/88	FEMA "Guidebook for Developing a School Earthquake Safety Program." No earthquake education in curriculum.
Iowa	4/20/88	"A Guide to Curriculum Development in Science;"

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Iowa (Cont'd)	4/20/88	no earthquake education.
Kansas	4/28/88	No curriculum mandated.
Kentucky	5/11/88	Brochure - "Earthquakes;" also have manuals developed and printed by Federal Emergency Management Agency used for training sessions.
	6/28/88	In response to followup letter - Received FEMA's Emergency Management Instructions Draft IG 1.2, April 1981, K-3. Teachers in Kentucky are trained to use earthquake materials in elementary grades and integrate the materials in science and social studies. EARTHQUAKE EDUCATION.
Louisiana	9/13/88	No earthquake education in schools though earthquake information incorporated into earth science curriculum; earthquakes not included in school disaster plans.
Maine	5/12/88	No curriculum mandated.
Maryland	3/13/89	"Science - A Maryland Curricular Framework," earthquakes included as part of the regular earth science curriculum. No specific earthquake education.

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Massachusetts	9/22/88	Department of Education does not have statutory authority to establish curriculum guidelines generally. Individual districts may offer training about earthquakes and natural hazards; but they don't collect that information.
Michigan	10/18/88	No earthquake education; no other natural hazards education. State education department gives recommended guidelines only to the district.
Minnesota	5/5/88	No curriculum distributed to schools - in process of developing a document which addresses this issue; no earthquake education.
Mississippi	5/16/88	"Curriculum Structure - Science" (Philosophy, Goals, Skills & Concepts); no earthquake education.
Missouri	5/9/88	"Administrative Guidelines for School Safety" and FEMA "Guidebook for Developing a School
	6/20/88	Earthquake Safety Program" FEMA K-6 Guidebook and lesson plans field tested by schools in Poplar Bluff and Excelsior Springs, Missouri. "Guidebook" has been distributed to over 500 locations in Missouri;

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Missouri (Cont'd)	6/20/88	have received no feedback. State Emergency Management Agency developed a "Ready Teddy," talking bear designed for use in K-3, and also has "hands on" Earthquake learning package used in many schools. S.E.M.A. has, in conjunction with the University of Missouri, developed an Earthquake Education course for teachers. No earthquake education mandated in curriculum.
Montana	1/30/89	No earthquake education.
Nebraska	5/2/88	No curriculum mandated.
Nevada	4/28/88	No curriculum mandated.
New Hampshire	10/6/88	No state mandated curriculum. Earthquakes would be covered only as a part of regular science curriculum.
New Jersey	5/20/88	No curriculum mandated.
New Mexico	11/1/88	There is no earthquake education; no particular course is mandated by the state.
New York	5/5/88, 3/6/89	MS/JHS Syllabus, Block D - "The Earth's Changing Surface;" "Earth Science Syllabus;" "Earth Science - Supplement to to the Syllabus." Contains objectives related to earthquakes, eg. "The Earth's Changing

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
New York (Cont'd)	3/6/89	Surface" II.B.Constructional forces 1. Earth movements pg. 25-26 "Earth Science Syllabus" - Section B-1 "What are some properties of earthquake waves?" pg. 39-41 "Supplement to the syllabus" - LT1 2. "Earthquake Longterm Investigation" pg. 29-30. No earthquake education mandated in curriculum.
North Carolina	4/28/88	"Standard Course of Study and Introduction to Competency - Based Curriculum." No earthquake education mandated in curriculum.
North Dakota	11/1/88	There is no earthquake education. Tornadoes are included in the disaster plan.
Ohio	6/13/88	No curriculum mandated.
Oklahoma	10/6/88	Earthquake education not mandated; covered as part of regular science curriculum. Concentrate on tornado safety.
Oregon	9/13/88	No earthquake education in schools. Earthquakes are included as part of hazard training given to school bus drivers; windstorms and earthquakes are grouped together.
Pennsylvania	4/29/88	No curriculum mandated.
Puerto Rico	3/29/89	Earthquake instruction included in ninth grade earth science curriculum. In a unit about subterranean processes, the following are

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Puerto Rico (Cont'd)	3/29/89	discussed: Earthquakes, Plate Tectonics Theory, and Land forms.
Rhode Island	8/19/88	No formal earthquake awareness activities designated by state education department; science teachers would talk about it as part of their curriculum when appropriate.
South Carolina	5/16/88	Course outline for Earth Science. Chapter outline on natural hazards and earthquakes, p.2. No earthquake education mandated in curriculum.
South Dakota	8/22/88	No formal earthquake instruction in schools. School disaster plans do include earthquake directions. Fire and tornado drills held by law.
Tennessee	9/2/88	"A Guide for Preparing a School Disaster Plan" which will be revised to include earthquakes. No earthquake education mandated in curriculum.
Texas	5/17/88, 3/24/89	"Science Framework, Kindergarten-Grade 12;" earthquake information is incorporated into the required eighth grade Earth Science course and the elective high school Geology course.

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Utah	11/1/88	There is no earthquake education however, every school is required to have an emergency plan and this plan includes earthquakes.
Vermont	9/12/88	No state mandated curriculum; no earthquake education and earthquakes not included in disaster plans for schools.
Virgin Islands		No response.
Virginia	5/4/88, 2/13/89	No earthquake education mandated. State framework for science includes objectives related to Plate Tectonics theory (9th grade) and utilizing research skills to investigate scientific, environmental or individually selected problems (8th grade).
Washington	6/22/88	Have inherited partially completed "Project Quake" from Linda Noson; looking for money and legislative authority to complete it. (Legislature meets January, 1989; if it passes, soonest they'd start completion work would be July, 1989.) Currently, no earthquake education mandated in curriculum.
	7/89	Currently "Project Quake" exists as a preliminary curriculum and will be reviewed by the Pacific Science Center along with other earthquake materials to develop a trainer's workshop.

LIST OF STATES	DATE RECEIVED	INFORMATION RECEIVED
Washington, DC	8/30/88	Earthquake education not taught in elementary schools though earthquakes are included in a minor way in a science unit for grades 4-6. Earth science is an elective taught in senior high school and includes a unit on plate tectonics. A seismograph was installed by the students in basement of Ballou High School under leadership of Mr. John Thayer, (Physics Teacher).
West Virginia	5/16/88	Science program of study; no earthquake education.
Wisconsin	5/2/88	No curriculum mandated.
Wyoming	4/20/88	No curriculum mandated.

CRISIS MANAGEMENT AND EARTHQUAKE PREPAREDNESS - A REGIONAL PERSPECTIVE

Larry D. Pearce
Assistant Regional Director
Emergency Preparedness Canada
British Columbia & Yukon

ABSTRACT

It's a natural human reaction that when disaster strikes somewhere in the world, we suddenly scramble to see what the chances are of the same type of disaster happening in our own locale.

The vast variety of potential disasters creates a nightmare for our leaders and planners. How do we make the public aware of the problems? How do we analyze the hazards and risks and take steps to mitigate effects? How do you overcome the "Oh, it can't happen here" syndrome? How can you plan unless you know what hazards exist and who and what is a risk?

The public in Canada has become more and more concerned with man-made hazards but in the past three and one half years British Columbians have become more concerned with the earthquake hazard. This is largely as a result of major earthquakes around the world. The probabilities for disasters such as earthquakes are high and the risks are great. There are environmental, political and social impacts following any major incident. If you believe these risks exist, then what do you do about it?

This paper will outline for you some of the initiatives taken in Canada and in particular British Columbia to make the public aware of the risks and to educate planners, politicians and responders as to what can be done to mitigate the effects of disasters.

LARRY PEARCE

Mr. Larry Pearce received his education at the Canadian Army Staff College in Kingston, Ontario and Sir George William and Carleton Universities in Montreal and Ottawa. Mr. Pearce retired from the Canadian forces with 28 years of combined service including being posted to the Canadian Embassy in Washington, D.C. as Community Liason Officer to the U.S. Army. He is currently Assistant Regional Director of Emergency Preparedness Canada in Victoria which covers the areas of British Columbia and the Yukon.

CRISIS MANAGEMENT AND EARTHQUAKE PREPAREDNESS - A REGIONAL PERSPECTIVE

It's a natural human reaction that when disaster strikes somewhere in the world, we suddenly scramble to see what the chances are of the same type of disaster happening in our own locale. Chances are that there is nothing new under the sun and all along you have had these potential disasters right there under your noses, so to speak. In fact, we have identified over sixty natural and man-made disasters which could strike Canadians at anytime-everything from tornadoes to earthquakes and even nuclear war.

This vast variety of potential disasters creates a nightmare for our leaders and planners. How do we make the public aware of the problems? How do we educate the "Guy on the street?" How do we analyze the hazards and risks and take steps to mitigate effects? How do you overcome the "Oh, it can't happen here, eh!" syndrome.

Disaster planning theory dictates that Emergency Planners keep three principles in mind. For example, planning must take place with, not for, the community; planning must not occur in isolation but involve communication at the intra/inter-agency level; and plans, once developed, must be tested and/or exercised.

Having said that, I would like to outline for you some of the initiatives we have taken in Canada to make the public aware of the risks and to educate planners, politicians and responders as to what can be done to mitigate the effects of disasters.

HAZARDS AND RISKS

How can you plan unless you know what hazards exist and what and who is at risk? We don't do this very well. For example: What are the probabilities of the following:

a. a major oil spill off the Pacific West Coast?
b. a major industrial accident in large metropolitan areas?
c. a catastrophic earthquake off the Pacific West Coast?

The probabilities are high and the risks are great. There are environmental, political and social impacts following any major incident. If you believe these risks exist, then what do you do about it? You...

TELL THE PEOPLE
TO
TELL THE POLITICIANS
TO
TELL THE PLANNERS

HOW DO WE DO THIS

Well, here's what we're doing to answer the BIG question:

UNIVERSITIES

Through the academic community we have put in place programs and initiatives. For example:

UNIVERSITY OF BRITISH COLUMBIA

- A public seminar on earthquake preparedness was conducted through the department of continuing education;
- An emergency response workshop was conducted for municipal employees and elected officials;
- EPC Fellowships - four Fellows are currently funded by EPC to study doctoral programs in Emergency Preparedness;
- Disaster Preparedness Study (DPS) centre has been created.

SIMON FRASER UNIVERSITY (Vancouver, B.C.)

Emergency Communications course:

> A unique undergraduate course believed to be the first offered at a Canadian University. The course is designed to provide an overview of Emergency Communications for government and other agencies. The course looks at policy and regulations, government emergency communications, and risk assessment and how it affects the provision of communications.

Emergency Preparedness Information Exchange (EPIX):

> A one year pilot project developed by SFU; Department of Communications and Continuing Studies under the sponsorship of EPC. It is a computer based bulletin board system designed to stimulate networking and regular exchange of ideas and information. It puts members of the Canadian Emergency Preparedness Community in direct contact with each other providing disaster related information.

CARLETON UNIVERSITY (Ottawa, Ont.)

Emergency Communications Research Unit (ECRU):

This is a standby research unit which as been in existence since 1973. It consists of two faculty, under the direction of Professor Joe Scanlon, and a group of volunteer students. The main thrust of ECRU has been to examine patterns of communication and response to unexpected events (i.e.) disasters. These have ranged from windstorms, fires, hostage incidents, spills, and mud slides to air crashes. They have occurred in communities across the country from coast to coast. Some of the incidents studied were:

-	Miramichi Earthquake	1982
-	Toxic Spills	1983
-	Newfoundland Air Crash	1986

Plus many others.

PUBLIC AWARENESS

The public in Canada has become more and more concerned with man-made hazards but in particular in the past three and one half years British Columbians have become more concerned with the earthquake hazard. This is largely as a result of major earthquakes around the world and the 1985 Mexican Earthquake, the 1988 Armenian Earthquake and their concomitant media coverage. However, there has also been an increased sense of risk generated by the scientific community.

Seismologists with the Geological Survey of Canada at the Pacific Geoscience Centre of Sidney, B.C., a part of the Department of Energy, Mines, and Resources Canada, have come out strongly regarding the increased threat of a great subduction earthquake in B.C. and the accompanying tsunami.

The consequences of such a catastrophic earthquake are tremendous and would affect almost 10% of Canada's population which resides in southwest British Columbia. In particular, a large number of the schools would be seriously affected or might even collapse. If such a subduction earthquake occurred, undoubtedly it would be the largest economic and social catastrophe due to nature, ever to hit Canada.

Emergency Preparedness Canada and, in particular, Fred Cooper and myself in British Columbia have recognized this potential high risk for many years. In fact, we have been preaching earthquake mitigation for the past eight years but up until recently our pleas had largely fallen on deaf ears.

OK; What have Fred and I been doing to spread the gospel? What has EPC done to make folks aware of the earthquake threat?

- Our office has given over 150 earthquake briefings in the past two years to a wide variety of groups including schools, private agencies, government offices, service clubs, corporations, etc., all over B.C. and the Yukon.
- Fred and I have participated in over twenty different seminars and workshops on earthquake preparedness in both Canada and the United States.
- We have both provided interviews to the press, radio and TV and assisted in the development of articles on the earthquake risks.
- We have assisted all levels of government in the preparation of earthquake plans.

- Fred has written and published "Quake: The Prediction No One Wants To Hear." A copy of his article has been provided for you.
- We are constantly providing advice and assistance to communities on earthquake planning.
- We have worked with the Ministry of Education on an earthquake plan for B.C. Schools. You will hear more about this from Neil Jackson.

What about EPC and our Directorate of Public Information? The Director of Public Information, Ms. Lesley Lynn, has not been idle. For example:

- They have produced Earthquake Posters that have been distributed all over the world and, in fact, are producing a new 3 panel earthquake poster which provides information on what to do during and after the "Quake." Hopefully, this will soon be available.
- A 15 minute International Award winning video entitled "Earthquakes In Canada" has been produced in concert with Energy, Mines, and Resources. This video won a gold medal in Houston, Texas during 1987 as the best documentary on advice to the public.
- EPC has produced and distributed literally hundreds of thousands earthquake brochures over the past decade.
- EPC in support of the Victoria Capital Regional District Earthquake Week arranged to place earthquake brochures in 84 supermarkets across B.C. to help stress earthquake awareness.
- EPC in conjunction with the Province of Ontario has provided a School Multi-Media Material Kit to be slotted into the curriculum. This project is now being tested in 15 different schools in Canada in both languages with a view to including it, nation wide, as part of the curriculum. If we can change public attitude towards emergencies through the school system we can change their response.
- EPC in conjunction with the Province of British Columbia's Provincial Emergency Program (PEP) have funded an earthquake information page in the B.C. telephone directories.
- EPC has produced two new 30 second public service announcement videos to stress earthquake awareness;
- EPC has produced a variety of radio tapes stressing the earthquake message; and
- We continue to produce and publish articles in our quarterly Digest on earthquake preparedness.

WHAT HAS THE GOVERNMENT DONE

Remember I said we have to "tell the people" to "tell the politicians" to "tell the planners?" Well, it must have worked because, here is what has happened:

NATIONAL EARTHQUAKE SYMPOSIUM

As a result of media and people pressure and strong requests from the Province of B.C. to the Federal Government, a National Earthquake Symposium was held at Arnprior, Ontario in September 1988. The aim was to involve federal departments and ministries of the Province of B.C. at the working level, in drafting a National Earthquake Response Plan to support B.C. in the event of a catastrophic earthquake. This meeting of minds was successful for two reasons:

a. It produced a draft concept national support plan; and
b. It forced the Province of B.C. to come to grips with the earthquake threat and to start to produce their own plan of response.

While this was ongoing, Energy, Mines and Resources (EMR) had put forward a Memorandum to Cabinet (MC) asking for money and person years to do more investigation along the Cascadia subduction zone in an attempt to further define and provide solid geological evidence to support the large thrust earthquake hypothesis. This is still being considered but in the interim the Geological Survey of Canada has increased the Pacific Geoscience Centre's earthquake research budget for the FY 1989/90.

As these events were unfolding in November on 1988, the town of Chicoutimi, Quebec, was hit with a 5.6 earthquake. This earthquake literally and figuratively shook the establishment and perked the interest of not only the scientists but also governments and politicians across Canada. No one was killed but it served to warn Canadians that the earthquake hazard is real and we must get on with our planning.

Meanwhile, momentum was building in the Province of B.C. as a result of the earthquake in Quebec. The media had seized the initiative. Articles appeared in the local press, TV was bulging with earthquake information and then, suddenly, the Armenian earthquake struck with a bang! We all know what a terrible tragedy ensued. The politicians were now very, very interested. A flurry of activity was apparent. The Province established the Seismic Safety Subcommittee with a mandate to report to the Solicitor General, Minister responsible for the B.C. Provincial Emergency Program on the state of earthquake preparedness in B.C. and what had to be done to provide a modicum of safety for the populace.

At this point I should mention that not all of the government ministries in B.C. were sitting on their hands. The B.C. Ministry of Education had for the past three years been involved in earthquake planning and seismic engineering evaluations of schools. Neil Jackson will speak at length on its programs.

B.C. Hydro has spent over 60 million dollars hardening their dams throughout the risk zones over the past ten years and as a result have probably the safest dams in Canada if not North America.

As a result of all this activity and as promised by EPC, the Federal Government conducted a follow-up workshop held in Vancouver to produce the second draft of the National Earthquake Response Plan. This took place in March of 1989.

The Provincial Emergency Program, as a result of this workshop, its need to have a Provincial Earthquake Plan, and the pressure from the Minister, held a crisis management seminar in Vancouver in April 1989. The aim of the seminar was to develop a strategy for the provision of a B.C. Earthquake Response Plan. The Seminar was a great success and hopefully the Province will by the end of 1989, have an Earthquake Response Plan which will dovetail with the federal National Earthquake Plan.

Many other initiatives by a myriad of agencies both government, corporate and volunteers, have been undertaken as a result of the earthquake hazard and its accompanying risks. However, I will not take anymore of your time to provide further examples of the work that has taken place in British Columbia and across Canada. I sincerely hope I have given you a sufficient overview of our programs and the progress that has been made in a comparatively short time--progress, I might add that came as a result of people and media power.

Earthquake preparedness in British Columbia is in full gear and is steadily moving forward.

Finally, I wish to leave you with this thought: **"Civilization exists by geological consent subject to change without notice"** so anticipate and mitigate.

POLICIES AND PROJECTS IN THE BRITISH COLUMBIA MINISTRY OF EDUCATION

Neil Jackson

Senior Architect
Ministry of Education
British Columbia, Canada

ABSTRACT

The entire 900 km long western seaboard of British Columbia plus large areas in the northeast are defined as zones of high seismic risk. The development of earthquake-preparedness programs, however, was not begun until 1986. This paper describes the difficulties experienced in starting such programs, the developments to date and plans for the future. The intention of this paper is to share experiences with other education authorities and perhaps initiate future dialogue to mutual benefit.

NEIL JACKSON

Mr. Neil Jackson, educated in London, England, has had an architectural practice in London, England; Lagos, Nigeria; Devon, England; and in Calgary, Alberta and Victoria, B.C., Canada. He has served as Chief Architect for the British Columbia Ministry of Housing and is currently senior architect with the British Columbia Ministry of Education.

INTRODUCTION

School-based earthquake preparedness programs only began in British Columbia in early 1986. This paper records out experiences since that date so that those who are more advanced can advise us while others perhaps can learn from our successes and failures. It is hoped that a regular exchange of information can be continued in the future to mutual benefit.

BACKGROUND

The Province of British Columbia is approximately 1,400 kms long north/south and 600 - 800 kms east/west. It contains 75 school districts with almost half a million students in 1600 schools.

Along its 900 km western seaboard are a series of mountain ranges and offshore in the Pacific Ocean there are major geophysical faults where earthquakes occur regularly.

The population is concentrated mainly in the southwest corner. On the mainland is Greater Vancouver with 800,000 population, while nearby is Vancouver Island where the provincial capital Victoria has a population of 300,000.

In 1988, the Association of Professional Engineers of British Columbia presented a brief to the Provincial Government in which they pointed out that our west coast is one of the most seismically active areas in the world; also that several M7 to M8 earthquakes have occurred in the past and certainly will again.

In 1946 on Vancouver Island, an earthquake of 7.3 magnitude seriously damaged 30 schools around the town of Courtenay; fortunately it occurred on a Sunday when the buildings were empty. Nearby, across the U.S. boarder, Seattle in 1965 experienced a 6.5 magnitude earthquake which caused damage to eight schools and death to seven people in the community.

PROGRAM DEVELOPMENT

One of the major restraints on the development of earthquake programs in B.C. has been the low level of public awareness.

In 1985, one of the benefits of television was demonstrated vividly when the results of the Mexico City earthquake were brought into the homes of our local population. Public awareness of our own exposed position was heightened as never before by that disaster. Scientists and Emergency Planning personnel who had been trying for years to sound an alarm suddenly became headline news. As a result, a few government people took up the cause and began to initiate programs which received political support.

The lead in our school system was taken at first by the Greater Victoria School Board. In 1986, they established an ad-hoc committee to investigate their situation and make recommendations for action. Included on that committee were representatives from other sectors of the community including the Facilities Branch of the Ministry of Education.

The primary purpose of our Facilities Branch is to allocate and monitor funding for school construction. We also set standards and provide guidelines. The actual design and construction of schools is undertaken by the 75 school districts and their consultants.

In 1986, it was decided that the Ministry should develop school, earthquake preparedness programs for school districts. Implementation of that decision however has often been surprisingly difficult. At first, there seemed to be no shortage of useful guideline material, but as we began to develop programs, we realized that very little of that material addressed some critical realities.

Firstly, the cost implications of earthquake preparedness programs are huge. Senior decision-makers are hesitant in committing themselves to this potentially major demand on resources, particularly during a period of financial restraint.

To that problem must be added the uncertainty of earthquakes. As we know, nobody can forecast how large they will be or when, where, and how often they will occur. Procrastination, therefore, tends to occur at every level from the senior policy maker to the junior staff person, both of whom have many other calls on their time.

Pressure for action seems to have come from the "grass roots." Without that, it is difficult for the few dedicated realists to gain political support and acquire sufficient resources.

We began our programs by establishing an advisory committee and in that we were fortunate in having representatives from both the Federal and Provincial Emergency Planning programs, both of whom had offices in Victoria. We also obtained the services of a geophysicist from the nearby Pacific Geoscience Centre, a base for several of Canada's most knowledgeable scientists on the subject. The committee recommended that we address earthquake preparedness on two fronts, EDUCATION and PROTECTION. The following is a description of what has been accomplished to date under those headings.

Education

One of the most useful documents we were given when we began to develop Ministry programs was the Guidebook for Developing a School Earthquake Safety Program, published by the U.S. Federal Emergency Management Agency (FEMA). At first, our committee proposed to issue that Guidebook complete to all schools in British Columbia. However, it was eventually decided that for ready acceptance, we needed a shorter document that was easier to use and more specifically addressed the B.C. situation.

Our document was entitled School Earthquake Safety Guidebook and it amalgamated the best material available from several sources into 24 pages and five sections.

1) How to set up an Earthquake Safety Program.
2) Recommended earthquake drill procedures.
3) How to identify and eliminate non-structural hazards in schools.
4) A typical Response Plan.
5) Checklists for students, teachers, parents and others on what to do before, during and after an earthquake.

Four hundred copies of the Guidebook were printed and copies were sent to every school district. A loose-leaf version was included and permission granted to duplicate as many copies as required.

We have since been swamped with additional requests for copies. It is therefore planned to reprint 4 - 5000 and give it wider distribution.

A demand on our resources that we did not anticipate was the time required simply to respond to requests for the guidebook. We have now arranged for the Ministry Information Services Branch to handle that task for the reprinted issue. That is an example of how demands on time can come from unexpected sources.

It is Ministry policy that earthquake preparedness programs are a school district responsibility. One problem with that policy is that some districts act and others do not. There has been some pressure for the Ministry to make the preparation of an earthquake preparedness plan mandatory, a step that so far has not been taken. In B.C. there is a tradition of local autonomy that the Ministry will depart from only with reluctance. Government policy tends to follow and not lead popular opinion; therefore when trying to start something new, public education is a vital facet. At present in B.C. there is probably insufficient popular support for a mandatory, government-directed program for earthquake preparedness.

Another facet of education concerns the actual school curriculum. Our branch has been encouraging the Ministry Curriculum Branch to introduce disaster-planning material into regular programs. The reaction so far has not been encouraging, possibly because nobody in Curriculum has the necessary commitment. However, education must be undertaken on the broadest possible front; not only the student curriculum but teachers, parents, community leaders and - most effectively - the politicians and senior bureaucrats who make the decisions that allow us to do what seems to be needed.

Protection

The second front on which we addressed earthquake preparedness concerned protection. Though protection of the occupants was primarily addressed, we also addressed protection of the structural and non-structural elements of school buildings.

One program we have introduced which allows school districts to deal with non-structural hazards such as ceilings, windows, parapets and chimneys is termed a "Shareable Capital Allowance." This is a formula-generated fund provided for minor capital works.

Funding for non-structural hazard correction can also be provided within an overall facility-upgrading project.

The Ministry has also commenced a province-wide structural upgrading program. Because the cost implications of such a program are huge, it was decided that to obtain some credible cost estimates, we needed more information on the scale of the problem. To obtain this, we issued a survey questionnaire to 27 school districts in the zones of highest seismic risk. Twenty-two districts completed and returned the questionnaires for all their schools. This gave us a data base of information about the age, size and type of construction of just under half of the schools in B.C.

Many schools comprise several segments built at different times and of different structures. Our data provides separate information for each segment.

From information obtained from elsewhere, notably California State and the Seattle School District, it seems clear that unreinforced masonry buildings are more vulnerable to earthquake damage than most other structural types. Seismic requirements were not introduced into the Canadian National Building Code until 1953 and have been made more stringent at regular intervals since then. From our survey, we ascertained that there are 109 masonry buildings in the 22 districts built prior to 1960 and therefore likely to be poorly reinforced or not at all.

Our consultant engineer estimated the 1988 cost of rebuilding those schools as $307 million or alternatively $58 million to upgrade. Those figures are so large that before making policy recommendations, we decided to obtain some supporting information on actual projects. Five different districts were asked to obtain upgrading recommendations and cost estimates.

Fees for the actual studies were only $5 - 10,000 each. We asked the districts to pay, which in retrospect, was a mistake. Two districts objected and at first were not cooperative. As a result, completion of the studies was delayed.

The past six months has been a particularly active period in the Ministry for a variety of reasons, and unfortunately earthquake programs have tended to become a low priority in the demands on time. This points out the need for staff people whose specific responsibility is for earthquake programs rather than relying on personnel with other major responsibilities.

Two encouraging events have occurred recently. One of the pilot project engineers has introduced us to a new system for evaluating and upgrading the seismic resistance of buildings, developed recently in the U.S. and termed ATC 14. It provides an approach to seismic upgrading that focuses primarily on life-safety but also on limiting damage in a way that post-quake repairs are feasible.

Until recently, we had been uncertain what approach to take with the numerous old buildings that are either impossible or very expensive to upgrade to full code standards. To either carry out full upgrading or to demolish and rebuild them all would take decades and cost billions of dollars. It did not seem at first that reduced levels of seismic resistance are an acceptable alternative. We were concerned about the question of liability if a building is upgraded to reduced standards but is subsequently damaged and causes injury. By focusing on life safety, ATC 14 seems to provide a practical answer on which to base a funding program.

The second encouraging event is this present workshop. We hope to be able to learn from and exchange ideas with many of those present and then go home with sufficient knowledge to move into our next phase. That phase is currently planned to be a program in which each school district is allocated an amount of seismic upgrading funding calculated from a formula based on the age, type, and size of the district's existing school buildings. This decentralized approach seems the only practical answer in our present administrative organization.

It will also be necessary to publish structural guidelines for which we think ATC 14 will probably be the basis. In addition, some monitoring will be necessary, and we hope initially that this can be accomplished with our present staff.

CONCLUSION

We are intrigued and challenged by the unique task of preparing against a hazard that might happen today but perhaps not for decades; a hazard that may strike the centre of Greater Vancouver in the middle of a busy winter's day or (let us hope) hundreds of miles from any community.

It seems to be a natural human defense mechanism that people tend to believe nothing bad can happen to them personally until it is imminent. Earthquakes, of course, happen usually without warning. Perhaps we need a few minor ones to literally shake the populace out of its apathy but let us hope not. We must accept that it will be many years before all our schools are made reasonably safe from seismic shock. But that is only one aspect of earthquake preparedness. Perhaps ultimately the single most important task we face is described in the title of this conference. Educate well - in the broadest sense - and the rest will follow.

STRATEGIES FOR THE IMPLEMENTATION OF EARTHQUAKE PREPAREDNESS IN THE ARKANSAS SCHOOLS

John C. Gill, Ed. D.

Educational Administrative Supervisor
Arkansas Department of Education

ABSTRACT

In an effort to coordinate the activities of the Office of Emergency Services and the Department of Education in earthquake preparedness for schools within the twenty-four counties on or in close proximity to the New Madrid Fault, the following responsibilities and duties will be discussed: the science section, Instructional Services, may function as the contact for communications. To effectively utilize the extensive earthquake educational materials available from the Office of Emergency Services, the Division of Instructional Services may facilitate the dissemination of materials and monitor their use during annual visits. Other divisions and agencies may assist in the implementation of this program.

JOHN GILL

Dr. John Gill, educated at San Antonio College, University of Southern Mississippi, University of Minnesota, and the University of Arkansas, has had various academic appointments. He has been a Professor and Department Chair of Aerospace Studies at the University of Minnesota, a lecturer at a NATO school in West Germany, a department head and administrator at a highschool, and, from 1980 to the present he has been Educational Administration Supervisor, Division of Instructional Services, Arkansas Department of Education.

INTRODUCTION

In order to provide the most effective earthquake mitigation, preparation and response, and to enhance recovery capabilities, the 77th General Assembly, Regular Session, 1989, State of Arkansas, passed Act 247. This Act was to establish a State Earthquake Preparedness Program within the Arkansas Office of Emergency Services. The Department of Education was contacted in April, 1989, to establish a liaison person in the department. This person was to attend and participate in the National Center for Earthquake Engineering Research Seminar, entitled "Disaster Preparedness - The Place of Earthquake Education in Our Schools," during July of 1989. Two preliminary planning and coordination meetings were held between Dan Cicirello, Supervisor, Earthquake Preparedness (OES), and John Gill, Supervisor, Educational Administration, Department of Education (ADE). Further discussions will address the earthquake preparedness training status and plans for the future in Arkansas schools.

EARTHQUAKE PREPAREDNESS TRAINING STATUS AND PLANS FOR THE FUTURE

There are three unique training programs for the public schools in Arkansas that include the following: A Ready-Teddy program for K-4; a VCR presentation about earthquakes in the central area of the United States, approximately 45 minutes in length for the 5th and 6th grades; and a 45 minute presentation designed for the older students in the 7-12 grade groups. A description of the Ready-Teddy program is contained in the Appendices.

Approximately 63 schools have received training during the past two years. Training may be scheduled on a first come - first served basis by contacting the Arkansas Office of Emergency Services. Two people are currently conducting all of the in-school seminars, which presents somewhat of a limiting factor in the time required to accomplish training in the remaining schools (227). Some of the schools have received the training or training materials in the years prior to 1987. Director's Memo No. 89-18, May 26, 1989 (Appendices), has increased the interest from the schools in the 24-county area, and the materials requested may soon deplete the funds allocated for earthquake training materials from the Office of Emergency Services.

Plans for the Future

Time, materials, and the number of schools involved indicate that both short and long range plans must be promulgated.

Short Range Plans

The short range plans will include:

1. Close cooperative efforts continuing between OES, ADE, and the Governor's Earthquake Advisory Committee.

2. The science supervisor, ADE, serving as the contact person for OES.

3. Requesting assistance from the Educational Cooperatives in disseminating materials and assisting with earthquake preparedness training when possible.

4. Requesting that the 8th grade earth science teachers emphasize the sections on earthquakes and prepare student peer instructors as class projects in science.

5. Providing earthquake preparedness information to K-12 supervisors serving the twenty-four counties concerned.

Long Range Plans

The long range plans will include:

1. Monitoring the earthquake preparedness programs at the appropriate schools by K-12 supervisors, ADE, during their visits.

2. Assisting in obtaining data from schools in the endangered areas concerning training completed and training required (ADE).

3. Assisting OES to ensure that earthquake preparedness training is available to universities and colleges within the endangered counties (ADE).

CONCLUSIONS

Training materials and trainers well versed in earthquake preparedness seminars are available through the offices of the Arkansas Office of Emergency Services. The number of schools (277), some of which had previous training prior to 1987, and some of which have received earthquake preparedness materials, will require a survey instrument to determine their individual level of preparedness. This survey report will be formulated by the Department of Education and the Offices of Emergency Services and will be disseminated by the Department of Education. The number of schools (277) also dictates that some training take place at the educational cooperatives to responsible school personnel in large numbers, if schedules and time permit.

The educational cooperatives may also disseminate earthquake preparedness materials after proper coordination and approval from the Cooperative directors. Earth science and general science teachers will be encouraged to augment their textbooks with earthquake preparedness materials from the Office of Emergency Services. These teachers will also be asked to encourage students to be peer instructors for the lower grades in earthquake preparedness as science projects.

The Arkansas Department of Education will continue to work closely with the Office of Emergency Services and the Governor's Earthquake Advisory Committee to ensure that the schools in the twenty-four county endangered areas receive earthquake preparedness training in order that the most effective earthquake mitigation, preparation, response, and recovery capabilities may be accomplished.

ACKNOWLEDGEMENTS

The assistance and cooperation of Mr. Dan Cicerello, Supervisor, Office of Emergency Services, State of Arkansas, is gratefully acknowledged. The NCEER's major part in formulating, coordinating, and financing this inaugural conference on earthquake education is also gratefully acknowledged.

REFERENCES

ACT 247, State of Arkansas, 77th General Assembly Regular Session, 1989, entitled "An Act to Establish a State Earthquake Preparedness Program Within the Arkansas Office of Emergency Services; and for Other Purposes," is included as an appendix.

Director's Memo No. 89-18, May 26, 1989, Department of Education, State of Arkansas, entitled, "The Arkansas Earthquake Preparedness Act of 1989," is also included in the Appendix.

Arkansas
DEPARTMENT OF EDUCATION
4 STATE CAPITOL MALL • LITTLE ROCK, ARKANSAS 72201-1071 • (501) 682-4475
RUTH S. STEELE, Director, General Education Division

Director's Memo No. 89-18
May 26, 1989

REGULATORY

TO: Superintendents, ESC Directors, and Persons Interested in Earthquake Preparedness Programs

FROM: Ruth S. Steele, Director, General Education Division
Emma Bass, Associate Director, Instructional Services

SUBJECT: "The Arkansas Earthquake Preparedness Act of 1989"

Act 247 of 1989, effective February 24, 1989, charges the Office of Emergency Services, Earthquake Preparedness Program, with the responsibility of carrying out such programs and requires the full cooperation of state agencies, offices and personnel to the end that the most effective earthquake mitigation, preparation, response and recovery capabilities may be accomplished.

Twenty-four counties in Arkansas (from Randolph in the northeast to Chicot in the southeast, and affecting approximately 650,000 citizens) are on or in close proximity to the New Madrid Fault. Therefore, the purpose of this memo is to notify all school districts, cooperatives, and interested parties that earthquake preparedness programs are essential and should be initiated, for those who have not done so, as soon as possible. To assist with these programs the following information is provided:

1. School Earthquake Safety Program Guidebooks are available upon request.

2. Lectures and video presentations are also available for students K-12.

3. On-site inspections and recommendations for schools and districts may be scheduled.

4. All of these services are provided by the State Office of Emergency Services, P.O. Box 758, Conway, AR 72032-0758, contact person, Dan Cicirello, Supervisor, 501-374-1201.

The K-12 area supervisors will monitor these programs during their annual visits.

ACT 247 1989

A Bill

State of Arkansas
77th General Assembly
Regular Session, 1989 HOUSE BILL 1154
By: Representative O. Miller

For An Act To Be Entitled

"AN ACT TO ESTABLISH A STATE EARTHQUAKE PREPAREDNESS PROGRAM WITHIN THE ARKANSAS OFFICE OF EMERGENCY SERVICES; AND FOR OTHER PURPOSES."

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF ARKANSAS:

SECTION 1. Short Title. This act may be cited as the "Arkansas Earthquake Preparedness Act of 1989."

SECTION 2. PURPOSE. It is hereby found and determined by the General Assembly that: there exists a history of violent seismic activity within the Central United States Seismic Zone which includes the New Madrid Fault; the southern branch of the New Madrid Fault being at or about Marked Tree, Arkansas, and extends northeast into Missouri and Tennessee; that a recurrence of the 1811-1812 earthquake swarm, whereby 55 of the approximate 2,010 earthquakes occurring during a three month period that had surface wave magnitudes of 6.0 - 8.7 (Richter) estimated to have affected in excess of 800,000 square miles, is again possible; that it is essential for the protection of life and limb of the citizens of this State, and particularly those approximately 650,000 citizens on and in close proximity of the fault, that a program be initiated to provide for continuous mitigation, preparedness, response and recovery capability for violent seismic activity. The General Assembly further determines that it be appropriate to amend the "Interstate Civil Defense and Disaster Compact," to be in concert with the Central United States Earthquake Consortium efforts to develop an "Interstate Earthquake Emergency Compact." Therefore, it is the purpose and intent of this Act to initiate a program to deal with this matter and to charge the Office of Emergency Services, Earthquake Preparedness Program, with the responsibility of carrying out the program requiring the full cooperation of

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all other state and local government agencies, departments, offices and personnel and requiring that all earthquake mitigation, preparedness, response and recovery related functions of Arkansas be coordinated to the maximum extent with comparable functions of the Federal government including its various departments and agencies with other states and localities, and with private agencies of every type, to the end that the most effective earthquake mitigation, preparation, response and recovery capabilities may be accomplished.

SECTION 3. ARTICLE II of Arkansas Code 12-76-102 is hereby amended to read as follows:

"ARTICLE II

It shall be the duty of each party state to formulate civil defense plans and programs for application within such state. There shall be frequent consultation between the representatives of the states and with the United States Government and the free exchange of information and plans, including inventories of any materials and equipment available for civil defense. In carrying out such civil defense plans and programs, the party states shall, so far as possible, provide and follow uniform standards, practices and rules and regulations including:

(a) insignia and any other distinctive articles to designate and distinguish the different civil defense services;

(b) mobilization of civil defense forces and other tests and exercises;

(c) warnings and signals for drills or attacks and the mechanical devices to be used in connection therewith;

(d) shutting off water mains, gas mains, electric power connections and the suspension of all other utility services;

(e) all materials or equipment used or to be used for civil defense purposes in order to assure that such materials and equipment will be easily and freely interchangeable when used in or by any other party state;

(f) the conduct of civilians and the movement and cessation of movement of pedestrians and vehicular traffic, prior, during and subsequent to drills or attacks or disasters;

(g) the safety of public meetings or gatherings;

SPEAKER OF THE HOUSE

(h) standardized data bank of response and recovery resources; and

(i) disaster forecasts and reports."

SECTION 4. ARTICLE VIII of Arkansas Code 12-76-102 is hereby amended to read as follows:

"ARTICLE VIII

Any party state rendering aid in another state pursuant to this compact shall be reimbursed by the party state receiving such aid for any loss or damage to, or expense incurred in the operation of any equipment answering a request for aid, and for the cost incurred in connection with such requests, including amounts paid under ARTICLE VII; provided, that any aiding party state may assume in whole or in part such loss, damage, expense, or other cost, or may loan such equipment or donate such services to the receiving party state without charge or cost; and provided further that any two or more party states may enter into supplementary agreements establishing a different allocation of costs as among those states. The United States Government may relieve the party state receiving aid from any liability and reimburse the party state supplying civil defense forces for compensation paid to and the transportation, subsistence, and maintenance expenses of such forces during the time of the rendition of such aid or assistance outside the state and may also pay fair and reasonable compensation for the use or utilization of the supplies, materials, equipment, or facilities so utilized or consumed. The State of Arkansas will only honor reimbursement claims from other states rendering aid to Arkansas to the same level of reimbursement and for the same items or areas of cost as each of those states' interstate compact laws provide to requesting states."

SECTION 5. ARTICLES XI and XII of Arkansas Code 12-76-102 are hereby amended to read as follows:

"ARTICLE XI

The committee established pursuant to Article I of this compact may request the Federal Emergency Management Agency (or its successor) of the

United States Government to act as an informational and coordinating body under this compact, and representatives of such agency of the United States Government may attend meetings of such committee.

ARTICLE XII

This compact shall become operative immediately upon its ratification by any state as between it and any other state or states so ratifying and shall be subject to approval by Congress unless prior congressional approval has been given. Duly authenticated copies of this compact and of supplementary agreements as may be entered into shall, at the time of their approval, be deposited with each of the party states and the Federal Emergency Management Agency (or its successor) and other appropriate agencies of the United States Government."

SECTION 6. Arkansas Code 12-76-102 is hereby amended to add the following at the end thereof:

"ARTICLE XVI

DEFINITIONS:

(1) "Civil Defense" shall be used here to be synonymous with emergency services, emergency management or future terms denoting an emergency or disaster response organization or capability with the chief goal of protecting life, limb and/or property of citizens that could be lost because of a disaster agent.

(2) "Civil Defense Forces" mean all state, county and local government agencies, departments, offices, and personnel, qualified emergency service workers as defined by Arkansas Code 12-75-103 and all private volunteer citizens called upon by state officials to provide emergency service in response to a disaster agent or to one that is pending.

(3) "State Employees" include all persons paid wages or salaries by the State of Arkansas, all qualified emergency service workers as defined by Arkansas Code 12-75-103 and all private volunteer Arkansas citizens called upon by state officials to provide emergency services."

SECTION 7. ARKANSAS EARTHQUAKE PROGRAM.

(a) The Office of Emergency Services, Earthquake Preparedness Program, shall coordinate an earthquake program designed to protect the lives and property of persons of this State, to the fullest possible extent, from the direct effects of seismic activity affecting Arkansas as well as from secondary effects created by such occurrence. The program shall coordinate all activities involved in mitigation and preparedness regarding seismic events. Toward that end, the earthquake program shall include but not be limited to: continued assessment from proper scientific authorities of the seismic risk to the state; training and education of state and local government officials, employees and citizens of Arkansas regarding preparation and protective measures that can be taken before, during and after an earthquake; planning coordination, guidance and assistance to all state and local government officials in preparation for, response to and recovery from earthquakes; coordination of earthquake program activities with comparable agencies of the Federal government and other states; the dissemination of information to the public pertaining to earthquake hazards, protective measures, seismic resistance in building construction, and appropriate actions to be taken before, during and after an earthquake, and other matters the Office of Emergency Services shall determine to be necessary or appropriate to educate, inform and equip citizens in this State to deal with any earthquake.

(b) In order to carry out the responsibilities provided for herein, the Office of Emergency Services, Earthquake Preparedness Program, is authorized to employ such personnel as deemed necessary to the extent that funds are appropriated therefor by the General Assembly.

SECTION 8. COMPLIANCE WITH THE "ARKANSAS EMERGENCY SERVICES ACT." It is the intention of the General Assembly that this Act shall be in compliance with Arkansas Code 12-75-101 et seq., "Arkansas Emergency Services Act of 1973" to the extent that if this Act or any provision of it or application thereof to any person or circumstance is held in opposition or out of compliance with the "Arkansas Emergency Services Act of 1973" then such provisions of this Act are invalid. But such invalidity of a provision or provisions of this Act shall not affect other provisions or application of this Act which can be given effect without the invalid provision, provisions or its/their applications.

SECTION 9. All provisions of this Act of a general and permanent nature are amendatory to the Arkansas Code of 1987 Annotated and the Arkansas Code Revision Commission shall incorporate the same in the Code.

SECTION 10. EMERGENCY CLAUSE. It is hereby found and determined by the General Assembly that this Act is designed to charge the Office of Emergency Services with full responsibility of administering the Earthquake Preparedness Program and should be given effect immediately. Therefore, an emergency is hereby declared to exist and this Act being necessary for the immediate preservation of the public peace, health and safety shall be in full force and effect from and after its passage and approval.

APPROVED BY

GOVERNOR

2-24-89

CALIFORNIA EARTHQUAKE PREPAREDNESS EDUCATION

Thomas P. Sachse
Manager
Math/Science/Environmental Education Unit
California State Department of Education

Bill Andrews
Education Programs Consultant
Math/Science/Environmental Education Unit
California State Department of Education

ABSTRACT

Californians are increasingly aware of the threat of a major earthquake, yet few are prepared to adequately respond should the disaster strike today. This paper focuses on the action of the California State Department of Education in response to the efforts of State Legislature to address this problem. It surveys the extensive variety of curricula developed by state, public, and private agencies that are aimed at enhancing earthquake awareness and preparedness, both in the schools and in the community. The reader will notice the interconnections of earthquakes and tectonics integrated with several thematic strands that are described in the draft of the new *California Science Framework.*

THOMAS SACHSE

Mr. Thomas P. Sachse, educated at both the University of Illinois and Stanford, has been an education specialist and consultant. Author and co-author of numerous publications, he is presently manager of the Mathematics/Science Education Unit of the California State Department of Education.

INTRODUCTION

Scientists agree that California has better than a 50% chance to experience a major earthquake sometime in the nest ten years.[1] The Federal Emergency management Agency (FEMA) estimates that a catastrophic earthquake of more than 8.0 on the Richter scale could leave 3,000 to 14,000 people dead and another 12,000 to 52,000 seriously injured[1].

Experts agree that many Californians are unprepared to cope with the damage that will occur if such an event should occur. Even earthquakes with less intensity have caused widespread destruction. In October, 1987, the 5.9 Whittier-Narrows earthquake caused an estimated $358 million damage with over 27,000 residents and business owners registering for disaster assistance[1]. In the 6.5 Coalinga earthquake, 75% of the downtown area was totally destroyed[1]. Studies show that Californians are increasingly aware of the threat of a major earthquake, yet only a few of the residents are doing something to prepare their homes, schools, or businesses. California still has an urgent need for continued educational efforts in Earthquake Preparedness Education.

LEGISLATIVE ACTION

In order to give the California State Legislature some direction to address the aforementioned threat, the California State Department of Education (CSDE), has recently compiled a "Report of the Earthquake Preparedness Taskforce in compliance with Assembly Bill 3730, Chapter 1352, Statues of 1988, authored by Assemblywoman Roybal-Allard." This document will provide school districts with specific "quake-safe" actions for their schools and surrounding community. The Office of the State Architect, who is responsible for enforcing the strict California building codes, assisted with this draft.

For many years, the CSDE has worked closely with the California Seismic Safety Commission to develop guidelines and policy for insuring earthquake-safe school programs. Funding has been supplied by the CSDE to districts and individual schools to encourage individualized response plans.

For several years, California schools have been striving to comply with the Katz bill (Chapter 1659, Statues of 1984) which requires all public schools, and private schools with over 50 students, or more than one classroom, to establish an earthquake emergency system. Two federal publications have assisted school districts in achieving this goal. In 1986, FEMA provided schools with a guide and workbook for developing individual earthquake safety programs that go beyond "response plans." This publication, The Guidebook for Developing a School Earthquake Safety Program, aided schools by including strategies for hazard assessment, earthquake drills, community-wide coordination plans, training exercises, and classroom discussion topics and activities.

[1]Governor's Office of Emergency Services, *California Earthquake Preparedness Month (1988 Campaign Activities Guide)*, 1988.

Another very helpful publication produced by National Science Teachers Association (NSTA) and supported by FEMA, Earthquakes: A Teacher's Package for K-6 is a hands-on K-6 curriculum which not only delivers excellent background information, but also, well planned, integrated classroom activities. This resource was created by a special writing team from six states and then field tested in 11 states. The activities are contained within six units, each divided into three learning levels: Grades K-2, 3-4, and 5-6. The first five of the six units develop a thorough understanding of "what," "why," "where," and "when" earthquakes occur, while the last unit focuses on protective survival strategies that should be done before, during, and after an earthquake. The activities use cooperative learning and other creative approaches throughout to encourage student involvement and to enhance student comprehension. Teachers will have little problem in obtaining the materials and supplies utilized in the activities as the majority are commonly found on school campuses.

Lastly, the entire month of April was designated as Earthquake Preparedness Month by Governor Dukemejian. To that end, the California Earthquake Education Project (CALEEP) created a classroom packet for Grades 5-9, "Earthquake Preparedness Materials" (1987), for the Southern California Association of Science Supervisors (SCASS) and Los Angeles County Office of Education to accomplish the following goals:

- Create preparedness before and after an earthquake;
- Participate in hypothetical situations involving earthquakes;
- Apply scientific processes to infer results from collected data;
- Experience an earthquake drill; and
- Identify non-structural hazards in schools, homes and neighborhoods.

NEW FRAMEWORK IDEAS

Throughout the new California *Science Framework Field Review Draft* information about earthquakes and tectonics are integrated with several major thematic strands. The interconnections of earthquakes and tectonics are highlighted within the following three themes of energy, evolution, and patterns of change.

Energy is a central concept of the physical sciences that is well illustrated by the flow of energy within the earth. Naturally, the *Framework* guides educators to discuss the origin of earthquakes and other related geophysical processes such as mountain building, continental drift, and volcanic activity.

Taught within the context that evolution is represented by "change trough time," the *Framework* encourages districts to study the changes in the earth's crustal formations caused by earthquakes and other tectonic activity.

Though "change through time" is one pattern of change, cyclical patterns are also evident in geophysical tectonic cycles of mountain building, plate movement, and subduction. Students will learn that earthquakes are the result of interaction of the aforementioned geophysical processes.

Earthquake-Related Themes

A thematic approach helps students learn about earthquakes within the paradigm of plate tectonics. Students will develop deeper understanding of complex geologic processes such as plate tectonics because they study the lines of evidence derived from a variety of science disciplines, including rocks that show reversals in the earth's magnetic field, geophysical data of matching mountains ranges, continued monitoring of crustal "hotspots," underwater topographic features revealed by sonar, and the paleontological evidence of ancient distributions of plants and animals. Within the various content sections of the *Framework*, this evidence is integrated and reinforced throughout all grade levels. The following content areas contain examples of multi-grade integration on the subject of earthquakes and tectonics:

Sound: An earthquake is always felt as at least two shocks separated by some time. Both p-waves (for pressure) and s-waves (for shear) are used to calculate the distance of the observer from the epicenter.

Geology and Natural Resources: This section of the *Framework* presents detailed explanations of plate tectonics and its role shaping the evolution of the earth. In grades K-3, students learn that changes beneath the earth's surface (along with the movement of the earth) cause great stress and strain on the crustal rock. This "pressure" is periodically relieved by earthquakes and volcanoes. Moreover, students learn the mechanisms responsible for mountain building. In grades 3-6, the general composition of the earth is taught in order to show both the relative thickness of the crust at the plate boundaries and the energy release, through earthquakes, that occurs along associated faults. The students also learn that many landforms have risen and subsided due to cyclical processes of uplift and erosion. In grades 6-9, several lines of evidence are explored to aide in understanding plate tectonics including structural evidence (e.g. faults), geophysical evidence (e.g. earthquakes and earthquake waves), and paleontological data (e.g. continental drift). The principle driving force of tectonics is slow convection in the earth's mantle. The resultant geological processes, such as earthquakes and landslides, affect how people now plan cities, dams, bridges, landfills, aqueducts, and the uses of these resources. In grades 9-12, students explore manifestations of tectonic processes including earthquakes, volcanoes, plate-plate boundaries, continental drift and seafloor spreading. Tectonic processes and metamorphism are also responsible for altering sedimentary rock (e.g. compressed, fractured, etc.). Through time, the movements of plates and the changes in the configurations of bodies of water have had profound effects on the evolution of the life on earth and dramatic changes in climates of marine and continental areas.

Meteorology and Oceanography: the discipline of seismology is intimately interconnected with oceanography and meteorology as evidenced by the water on the earth's surface which resulted from tectonic processes that released and combined hydrogyn and oxygen within the earth to form the original oceans and atmosphere. Students in grades 3-6, learn that there is evidence that a giant supercontinent (Pangea) comprised nearly all the continents, but continental drift separated them, allowing new oceans to form and new species to fill them. In grades 6-9, students focus on the continental margins to study subduction and focus on the mid-oceanic rises to study sea-floor spreading. In grades 9-12, subduction is shown to be the cause of difficulty in reconstructing the ocean histories before 200 million years despite the fact that the marine life of the past is the best represented sector of the fossil record.

CURRICULUM DEVELOPMENT

A wide variety of earthquake education materials has been developed by California Earthquake Education Project (CALEEP) as a major activity of the Lawrence Hall of Science (LHS), University of California, Berkeley. CALEEP is a cooperative effort between the LHS and the California Seismic Safety Commission whose goals were focused on the development of educational materials for school and community groups on earthquake science and earthquake preparedness. In 1987, the "CALEEP Sampler" was published by LHS. This document was thoroughly field tested with upper-elementary and middle-junior high school students. The CALEEP teacher's manual has been organized for flexibility in approach and allows the instructor to quickly grasp the background, content, and extensions for each activity. LHS provides leadership institutes and training sessions in the use of their education and preparedness activities. A sample activity is the "Bedroom Hazard Hunt" developed by CALEEP to engage students in personal inspections of their own bedroom in order to make them safer in earthquakes. Another activity that encourages people to take preparedness action is the activity: "Improve Your E.Q. (Earthquake Quotient)." It helps students identify their level of preparedness after a simulated earthquake strikes.

The Governor's Office of Emergency Services (OES) supplies information about the effects of earthquakes in local communities and the steps needed to prepare for earthquakes. Brochures are available for distribution to parents and staff by calling (916) 427-6660. Speakers are sometimes available through regional OES offices whose phone numbers are listed in the front section of California public phone directories in the "State Government Offices" section under "Emergency Services Office."

The Bay Area Regional Earthquake Preparedness Project (BAREPP) is supported by the OES. BAREPP promotes comprehensive earthquake preparedness planning for local government agencies and other public and private organizations, including schools, within the greater San Francisco Bay area. BAREPP provides regional training and age appropriate informational materials for schools and community organizations. BAREPP has a large lending library of videos and slide/tape programs.

This past year, BAREPP compiled a series of earthquake preparedness activities designed to aid child care providers in developing their earthquake plans for their centers in the publication entitled: "Earthquake Planning and Preparedness Activities for Child Care Providers," by Sandra Cherkassky.

The Earthquake Awareness and Preparedness Project is a joint effort of the Audubon nature Training Society and the Junior League of Oakland-East Bay. This project presents to elementary schools (Grades 1-6) in Alameda and Contra Costa Counties, a program which increases public knowledge of and preparedness for earthquakes. The reference consists of curriculum materials, a detailed instructor's resource section and eight follow-up role play activities.

The Environmental Volunteers, a private, non-profit company, has developed the following school activities to meet the learning needs of different grade levels:

- "Global Plates:" An activity that discusses the division of the earth's "plates" and their dynamic movement on the mantle layer. By examining plate movement, students are able to predict where earthquakes are likely to occur.
- "Fault Features:" This activity presents the effects of earthquakes on the landscape over a period of time.
- "Stress Release:" This activity demonstrates the results of two plates grinding past each other (a transform fault like the San Andreas) to create friction, stress and strain.
- "Earthquake Drills:" This activity, co-developed by CALEEP, simulates an earthquake (or stages a surprise earthquake drill), so students discover their reactions and develop their ability to respond properly during an earthquake.
- The "HELP Curriculum" (Hands-on Earthquake Learning Package): This activity consists of an Instructor's Guide with student booklets, and lesson plans with teaching materials. A geophysicist with the U.S. Department of Interior found the information to be technically accurate, and a Master's thesis on the effectiveness of the HELP program showed a very significant increase in earthquake awareness and understanding.

The Los Angeles chapter of the American Red Cross developed an interactive computer "simulation game" which teaches students "quake-safe" action before, during, and after an earthquake. For several years, the American Red Cross (ARC) has provided a clear and concise booklet on personal, home and family earthquake preparedness, called "Safety and Survival in an Earthquake." Local chapters of the ARC provide assistance in planning an earthquake response.

Field trips to earthquake exhibits can provide excitement and unique experiences to all age groups. Both the California Academy of Science in San Francisco and the Museum of Science and Industry in Los Angeles have shake tables that can be mounted by observers in order to experience the motion of an earthquake. Though very popular, experts are worried this experience will give a false sense of security to the "survivors" of the exhibit because the motion is relatively tame compared to an actual quake.

The Southern California Earthquake Education Project (SCEEP) is a project funded by the OES. SCEEP has similar responsibilities to BAREPP but has independently developed the following educational materials:

- "Hands-on Earthquake Learning Package" (1983)
- "Guidelines for School Earthquake Safety Planning" (1982, New edition under revision)
- "Earthquake Preparedness Checklist for Schools" (1982)
- "Preschool Earthquake Preparedness Guidebook" (1988)

SCEEP uses the above materials as they consult with a school task force comprised of LAUSD, the L.A. County Office of Education, and the L.A. County School Board about their earthquake education programs and their school-site earthquake safety plans. SCEEP is currently conducting a teacher training program on earthquake safety through the U.C.L.A. extension service.

Following the Whittier, California earthquake, SCEEP worked with FEMA and the San Fernando Child guidance Clinic to develop and produce the publication, "Coping with Children's Reactions to Earthquakes and Other Disasters" (July, 1986).

To simulate earthquakes, an American version of Japan's earthquake simulators has been created in Southern California, dubbed the "Shaky-Quaky Van."

The California Division of Mines and Geology also provides a wide variety of booklets, magazines, articles, and fliers available for distribution, sometimes in large numbers. Speakers are also available.

CONCLUSIONS

To be truly effective, Earthquake Preparedness Education must involve rigorous participation by not only teachers, principals, and staff, but also students, parents and community leaders. Only then will the entire school neighborhood be prepared to be self sufficient for 72 hours or more. It is imperative that schools and community work together to develop action plans for emergency response and to raise the awareness of all its citizens.

Upon completion of the emergency response action plans, individual schools/districts must take the initiative to prepare to meet staff and student survival supply needs as well as provide training in the proper use of the emergency supplies and equipment. The Red Cross, fire departments, independent consultants, and County Offices of Emergency Services all offer courses which prepare non-medical professionals in schools for medical response in an earthquake[2]. The training should provide clear-cut divisions of authority and labor. Cross-training in more than one area will ensure sufficient staffing for unanticipated emergencies. All medical response team members should train bi-annually with other local emergency response agencies. Given the wide variety of in-depth earthquake education materials and the availability of expertise at the county, state, and federal levels, the responsibility of creating and implementing an earthquake preparedness plan lies ultimately with school districts. When the next great quake strikes, their training efforts will surely reduce the inevitable loss of life.

[2]California State Department of Education, School Facilities Planning Division, "Report of the Earthquake Preparedness Taskforce in compliance with Assembly Bill 3730, Chapter 1352, Statutes of 1988, authored by Assemblywoman Roybal-Allard."

SEISMIC SAFETY STANDARDS FOR IDAHO SCHOOLS

Eldon L. Nelson

Supervisor, Support Services
Idaho State Department of Education

ABSTRACT

A project to develop seismic safety standards for Idaho schools has been completed and submitted to the Idaho State Board of Education. The study has three components: evaluation of the seismic hazard in the state from the geological point of view; seismic vulnerability for approximately 670 public school buildings in the state; and, the establishment of a school-based disaster preparedness program. Findings and recommendations from the report cluster around four general areas: construction standards for new school buildings, retrofitting of existing school buildings, non-structural mitigation, and emergency preparedness training.

ELDON NELSON

Mr. Eldon Nelson was educated at Idaho State University and Brigham Young University. He has been an instructor in health, physical education, and traffic safety; an assistant principal; and consultant in the Driver Rehabilitation program and Coordinator of Safety Education - both for the Idaho State Department of Education. Currently he is the Supervisor of Support Services with the Idaho State Department of Education.

INTRODUCTION

On October 28, 1983, the largest earthquake in the western United States since 1959 occurred at Borah Peak in the central mountains of Idaho. This earthquake shattered windows, cracked walls, and killed two people. Five Idaho schools in the sparsely populated Borah Peak area suffered nearly ten million dollars in damage. While seismic safety may not be the number one priority on the minds of many school administrators in Idaho today, these disasters do happen from time to time in our state and in others.

On December 31, 1983, by Executive Order, Governor John Evans assigned the Idaho State Board of Education the responsibility to "investigate the establishment of seismic safety standards for school construction and schools occupancy in the State of Idaho." The leadership for this undertaking was shared by the Bureau of Disaster Services and the Department of Education. Also cooperating were the Department of Labor, Department of Administration, Idaho Geological Survey and the University of Idaho Departments of Geology, Civil Engineering and College of Education.

SEISMIC SAFETY STANDARDS FOR IDAHO SCHOOLS

The result of the cooperative effort was a report entitled *Seismic Standards for Idaho Schools*. The findings and recommendations from the report cluster around four general areas:

(1) new construction standards
(2) retrofitting of existing buildings
(3) non-structural mitigation, and
(4) emergency preparedness training.

The proposed action in these four areas is as follows:

1. New construction standards - Additional standards are not needed at this time because the Uniform Building Code, adopted by the State Board of Education for new construction, has all the regulations needed for safe building construction. Therefore, to ensure enforcement of existing standards, the following action is proposed:

   In addition to the school building plan check for compliance with State Board of Education regulations performed by the Department of Education, that all school building plans be examined and approved by the Idaho Department of Labor & Industrial Services. This procedure would ensure compliance with the Uniform Building Code, the Life Safety Code, and ANSI 117.1 Handicapped Access.

   This action requires a change in Idaho Code.

2. Retrofitting of existing buildings - Since many Idaho schools are over 30 years old, there is a need to look at retrofitting them. The following recommendation is proposed to be included in the school building manual:

   That any existing school building categorized as building class 3 or 4 that is located in or near Seismic Zone 3 or 4 on the Uniform Building Code Seismic Map should have a structural engineer do a study to determine the need for retrofitting.

3. Non-structural mitigation (movement of building contents and attachments) - This area can best be addressed by cooperation between the Bureau of Disaster Services and the Department of Education. The effort will include providing written material to help school districts survey their buildings and secure items in the building that might shake loose or fall causing injury to occupants. This activity has an added benefit since students can be used to survey the schools.

4. Emergency preparedness training - This activity can best be served by the Department of Education in cooperation with the Bureau of Disaster Services to provide leadership to school districts in training students and staff on what to do in case of an earthquake. Curriculum materials and models for disaster plans will be a major part of this effort.

EARTHQUAKE EDUCATION IN IDAHO SCHOOLS

On May 18, 1989, by gubernatorial directive, an exercise entitled EQUIDEX 89, created a hypothetical potential disaster caused by an earthquake in the southeastern corner of Idaho. Seven counties were involved as well as several industries and utilities in the immediate area. In addition, 15 state agencies, as well as school officials in the area, were involved in a cooperative effort to assess the effectiveness of plans and procedures that had been set up to test people's competencies and increase the understanding of roles and responsibilities. From this activity a renewed awareness was created of the possibilities of disasters occurring in the area. Students were observed following proper procedures during a "scheduled earthquake" during EQUIDEX 89.

As part of the state commitment, the Idaho Department of Education has provided school districts with a packet of materials, one of them being a curriculum guide, *Earthquakes*. The strength of this document is that the materials are designed to be integrated into existing subjects instead of being another "new" subject in the curriculum. For instance, in the guide there are several concepts in science and physics that enrich existing curriculum materials.

Let me take a moment now to share with you an example of an activity on disasters that took place in one of our public schools. I am referring to a report made by a third grade student named Kim. Although Kim's spelling is not good, he has a basic understanding of survival. He reports rather well on what to do and the dangers of disasters that might affect him. He also gives credit to the fact that someone got together and came up with a plan. He makes the statement that "he's glad someone made the plan or we would all be killed." I bring this to your attention because one of the keys to success in earthquake education is planning and cooperation. If we are going to succeed in being prepared for the eventuality of earthquakes in our representative states, it is the responsibility of city, county and state level agencies to get involved and have a plan.

I have a representative plan from one of our school systems. It provides for earthquake drills and an annual review of earthquake programs to ensure preparedness for the safety of those for whom the schools are responsible. Most of the plan is common sense, but it does give specific information on student, staff, parent and community preparedness.

It is my hope that none of our school districts will be required to exercise their programs in an actual earthquake. However, if it happens, we do want to be prepared.

Kim

Disaster's are very disasterus, My story has good School disaster information Such as tornatos, earthquakes, and Volcano's.

My school is up on a hill, So when it comes to Floods I do not think it would be to harmful, but if it was to sereus I would edvise to have a lot of first aid suplys.

As you know, snow storms are bad, they get So bad the Schools have to close. The School's call the road mantrance and ask if it is to bad to gave if so, the school calls the raido Station, and they said it on the raido.

When it comes to tornato's we have some good things." We should" did you know tornato's go 3,000 mile's per hour? If one ocered We Would hide in the Jonyoir high hall, the dressing rooms for-ball games, and weite lifting room, so we have enuf firstaid suplies:co merd woonds.

Earth quakes happen recently if we got a big shake you would have to get undera desk or get in a door jam, you would have toget undera good strong thing.

Valcanos have very hamful even soot though it's just sand and dirt, it can blind youso I would be careful if I were you!

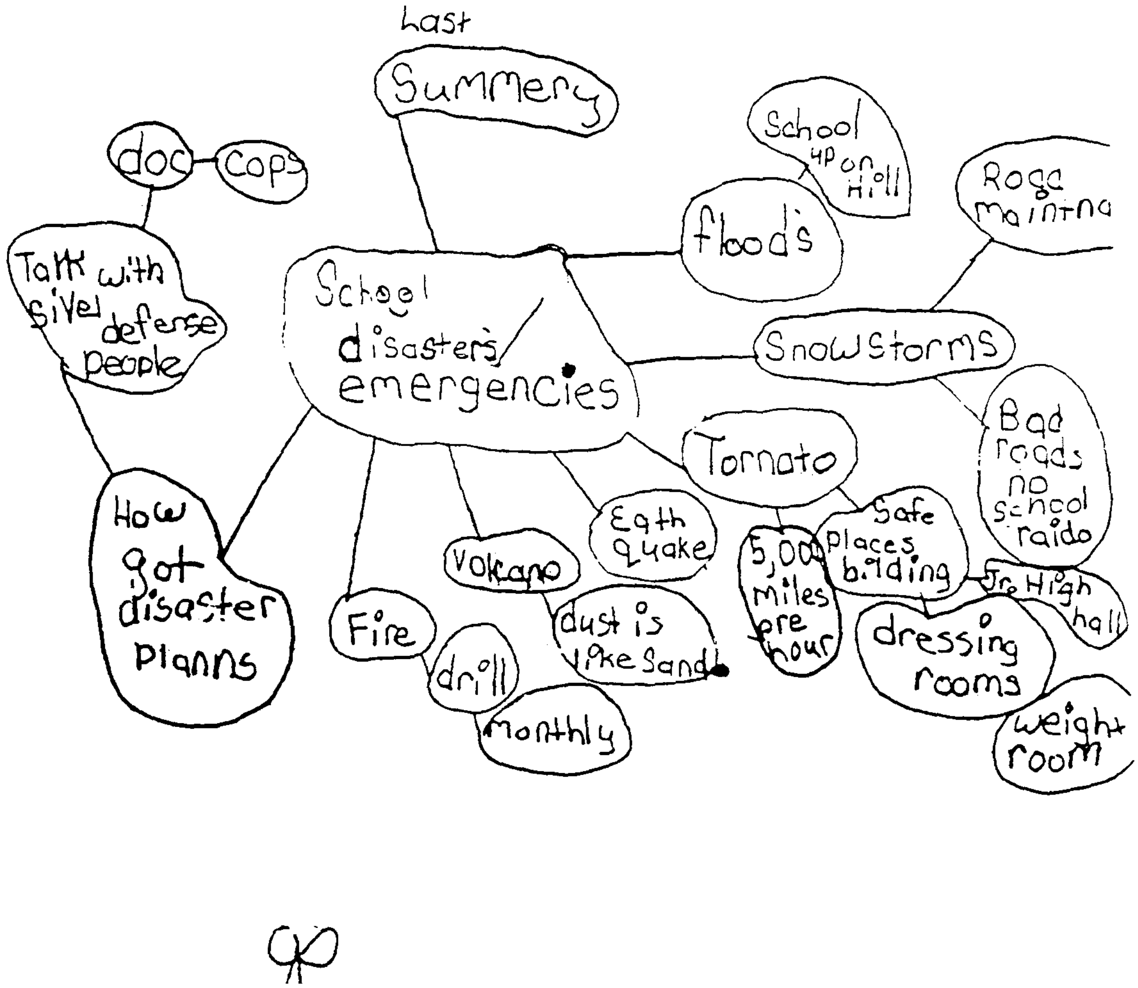
Fire is very Hot, it can kill you, so at my shchool we have Fire drill's every mounth so noone will get killed!

How we got all theses plan's is: Mr. Shrowder talk's to the sivel defence people, "like the police men and doctor's," and plan all this!

I'm glad they made the plan's or we would be killed!

name: K̆ II

School disaster's



SLOW SCHOLARS CONSIDER THE REALITIES OF SIGNIFICANT SEISMICITY

David A. Kennedy

Program Administrator for Curriculum
Office of the Superintendent of Public Instruction
Olympia, Washington 98504

ABSTRACT

Washington is a state that has a significant history of and potential for violent natural disaster from such events as fires, winds, volcanic eruptions, tsunamis, and earthquakes. The Kindergarten through grade twelve education system has not made this reality a component of their everyday educational practice. The system currently has other priorities that line up well ahead of earthquakes such as reading, mathematics, writing, HIV-AIDS, drugs, alcohol, violence, driver training, dropouts, school lunches, and money.

A recent significant national conference and subsequent report indicated that "large subduction earthquakes on the Cascadia subduction zone pose a potential seismic hazard, and the potential exists for a great earthquake being of magnitude 8 or 9." A growing effort among the scientific community to inform us about this probable seismicity and a resulting awareness on the part of a few educators is beginning to bring the reality of the earthquake problem to the attention of educational decision-makers.

A thorough knowledge of the structure of education programs and of key characteristics of the education community will play a large role in how well we can assist a significant percentage of our population to prepare for such an eventuality as significant seismic shock.

DAVID KENNEDY

Dr. David Kennedy is a biologist with degrees from Oregon College of Education and Oregon State University. He has taught science subjects at the elementary, junior, and senior high school levels, taught in teacher education programs at the college level, and has been a school district science coordinator. The author and co-author of numerous publications, he is currently Program Administrator for Curriculum in the office of the Superintendent of Public Instruction in the state of Washington.

INTRODUCTION

Successful design, development, and installation of an earthquake emergency planning and instruction program in all public and private schools will enable the school population to survive a significant seismic event. This task requires both up-to-date knowledge of the school system and some thoroughly considered strategic planning.

A knowledge of the structure of education programs and of key characteristics of the education community are the two most significant variables whose control will increase the probability of successful change within our education system on behalf of earthquake education.

THE STRUCTURE OF EDUCATIONAL PROGRAMS

An educational program such as one that might deal with seismic hazards does not/can not exist only as an instructional episode between teacher and student. Figure A shows the immediate suite of considerations that, at a minimum, make up any effective instructional effort. The elements of Figure A are noted as follows:

1. **Authority** is defined by the legal and policy statements at both the state and local level that permit and encourage an educational program.

2. **Planning and management** sets into motion the considerations necessary for each of the system elements to function successfully independently, and in relationship to each other.

3. **Curriculum and learning systems development** is largely concerned with developing, selecting or modifying program materials to meet the pre-stated instructional goals and objectives.

4. **Staff Development** provides new knowledge and skill through inservice education of the teachers and administrators who will provide direct instruction and supervision for the success of the program.

5. **Instruction** includes the conduct of the programs selected in the curriculum area, and should account for the critical interaction between the student, the teacher, and the content to be learned.

6. **Learning outcomes** is the realization of instruction and the achievement of the pre-stated goals and objectives of instruction.

7. **Delivery systems and supports** includes activities and resources that allow the program to be conducted successfully such as policy development, financial support, transportation, personnel, media, and management functions at the state, district, or building levels.

8. **Evaluation** is a continuing set of activities which includes gathering data about program functions and outcomes, analyzing them, and providing feedback for planning and management considerations.

A system with this many decision points is bound to be slow to change, and any proposed addition to the curriculum takes lots of consideration, and certainly takes lots of time.

KEY CHARACTERISTICS OF THE EDUCATION COMMUNITY

From the amazing variety of variables that one might consider in planning for the successful development and implementation of a new education program, three issues lead the list. First, the education system has well-established priorities at virtually every level. Legislatures and school boards have theirs, superintendents and principals have theirs, and teachers certainly have all of those to face, plus their own. Children, parents and the community have theirs, too, but those need to be discussed at another time. Sometimes the priorities all line up just right and consensus exists on a few of common interest that generate a coordinated response.

Second, teachers have a wide variety of demands for their instructional time. Proponents of virtually very hazardous social issue from substance abuse to AIDS want a piece of the instructional pie. Educators are usually reluctant to make room for things that are imposed from outside their jurisdiction, and it helps a lot if proponents of new initiatives have leverage in the form of the interest of the education community, legal authority, influence, and money. It helps too, if the issue attempting to crash the system is of undeniable personal and societal importance. Earthquakes may qualify on one or more of the leverage issues.

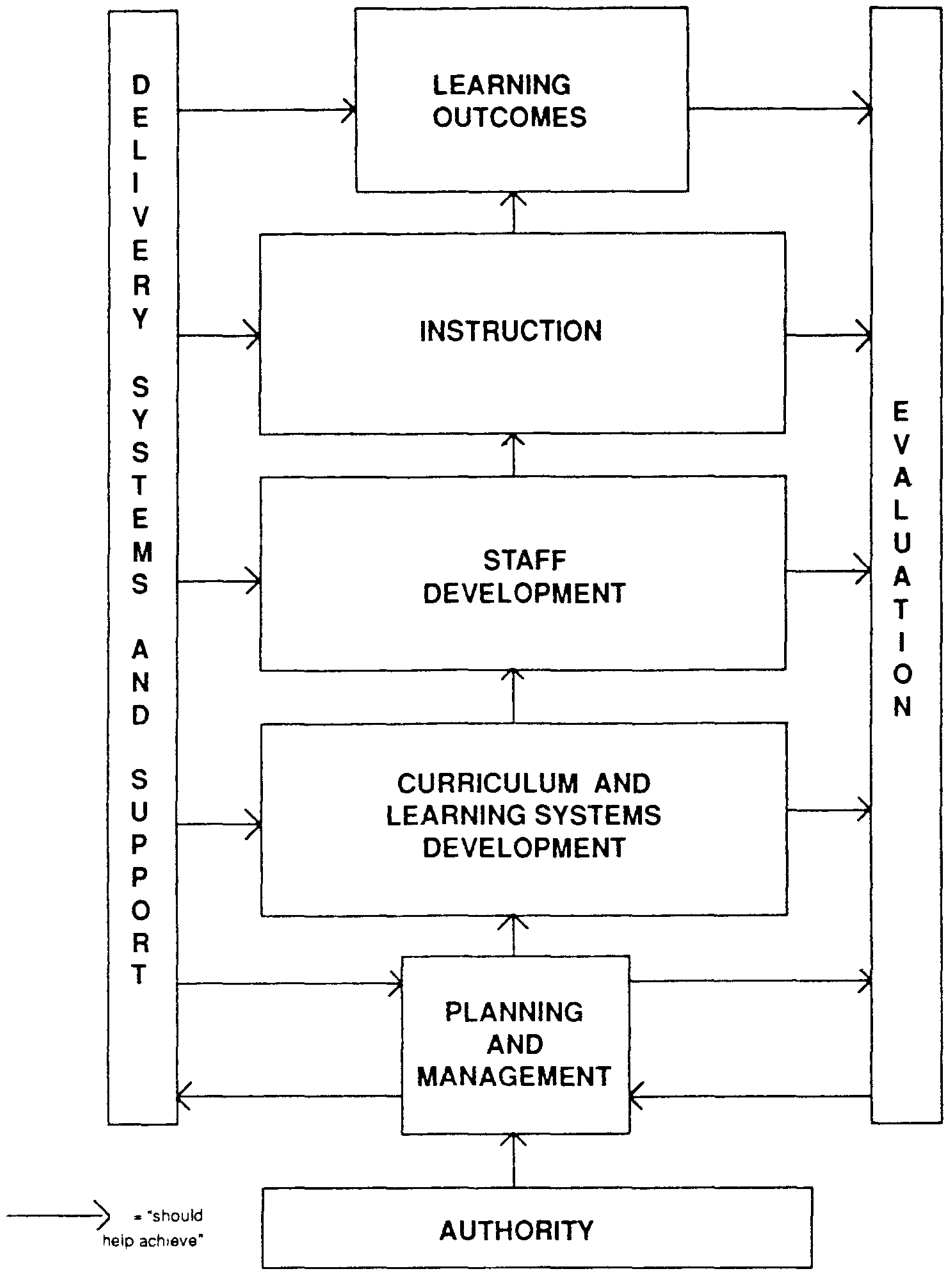
Third, teachers are naturally reluctant to dilute their instructional impact or to endanger their professional reputation. They will rarely teach about topics they know little or nothing about, and will avoid any teaching situation that seems beyond the scope of their perceived responsibility.

Teachers will respond to well organized, active advocates and leadership that is supportive of effective new ideas and programs. They will respond positively to well prepared instructional materials that promise to provide a significant return on the instructional investment. In short, teachers will probably try it if it has the potential to enhance their effectiveness.

CONCLUSION

The State of Washington provides an interesting and valuable model to consider when planning for statewide change as we attempt to educate about a significant seismic hazard. If left only to the education community, the response would be folded into the normal 5-15 year educational change cycle. It would be submerged in the ever burgeoning pile of priorities that society expects to be treated through formal education. Key insights into the education system can allow concerned citizens and responsible public officials access to the decision points and to the decision-makers. It can facilitate the probability of realistic and effective short-term solutions.

FIGURE A



Modified from **Designs for the Future of Environmental Education**, from the U.S. Department of Education

PLANNING FOR THE PSYCHOLOGICAL AFTERMATH OF SCHOOL TRAGEDY

Thomas T. Frantz

Associate Professor of Counseling and Education Psychology
State University of New York at Buffalo

ABSTRACT

Nineteen steps in a postvention plan for coping with the aftermath of a major earthquake that results in death are presented as a guide for the school to develop its own crisis procedures. The plan is designed to meet three goals: reduce fear, facilitate grieving, and promote education. Suggestion for class discussion of the tragedy are offered.

THOMAS FRANTZ

Dr. Thomas Frantz was educated at Grinnell College and the University of Iowa and is currently Associate Professor of Counseling Psychology at the State University of New York at Buffalo. Dr. Frantz, the author of numerous publications, is also the Founder of the Life and Death Transition Center, a United Way Agency to help grieving people and provide death education and professional inservice training. He is the founder of the Suicide Bereavement Group, founder of the Ravlin Clinic (a clinic to meet the psychological and social needs of people facing life-threatening illness), and the founder of 5 Compassionate Friends chapters in Western New York--a support group for bereaved parents.

PLANNING FOR THE PSYCHOLOGICAL AFTERMATH OF A SCHOOL TRAGEDY

Our purpose is to discuss a basic postvention plan that can be adopted for use in any school following a death or tragedy. The plan is designed to go into effect the first school day after the trauma has occurred.

To initiate thinking about postvention, consider the following specific questions that will usually arise: (questions modified from Dunne, et al. 1987, p. 247).

1. How and when should students and faculty be informed of the pertinent details surrounding it?
2. How, when, and where should students be allowed to express their reactions?
3. What should be done for victims' close friends?
4. What should be done for "high risk" students?
5. Should the school hold a special assembly or memorial service?
6. Should there be a symbolic expression of grief, such as lowering the flag to half mast?
7. Should the school close for the funeral?
8. Who should go to the funeral?
9. What kinds of commemorative activities or symbols - plaques, memorial funds, etc. - are appropriate?
10. Should the victims' parents be contacted and what help can be offered to them?
11. What should be done about the concerns of other parents?
12. How should the school deal with the media?
13. Should the school turn for outside consultation to help? To whom?
14. What reactions from students should be expected?
15. Should a regular school schedule be followed the day after?
16. How long should the school be concerned about student reaction?
17. How much grieving or "acting out" should be allowed?

18. Should students be involved in planning the school's response?

19. Who should organize and coordinate the school's response?

20. What about siblings or affected students in other schools?

21. What should teachers say to students in their classes?

Principles of Postvention

Before presenting a plan to respond to the issues raised by these questions interrelated principles of postvention are outlined. It is on the principles of fear reduction, grief facilitation and the promotion of education that the postvention plan is based.

Reduce Fear

Fear is the most overpowering and debilitating human emotion. Fear can cause us to flee in panic, act irrationally, become immobilized, say things we regret, and act in other ways that later are embarrassing to us. To deal with fear, we first recognize that fear breeds in the unknown. People are most afraid of what they don't understand, of mysterious, dark, different, unknown situations. The neighbor's German Shepherd running at you, riding the subway, driving to Toronto may each be scary the first time, but once you get to know the dog, have taken the subway a few times, or made the trip to Toronto often; you are much less afraid. Experience reduces the unknown and thereby reduces fear. An earthquake, especially resulting in death, produces so many unanswered questions, leaves so much unknown, and thus creates fear. What made it happen? Will it happen again? Is the school really safe? Am I safe at home? Will the next one get me? Why didn't God do something! Is there any place that's really safe?

As a result of so many unanswerable questions, the atmosphere in a school following an earthquake may be tinged with fear. Students and staff may feel unsure of themselves, confused, afraid of what else might happen, and not know how to behave or what to say.

Most of us grow up not thinking much about earthquakes. They only happen to other people, people we hear of or read about. It's hard to imagine that a major earthquake, especially one that kills people would ever happen to our friends, family, or community, and then when it does, many people feel insecure and afraid. Something that wasn't supposed to be part of God's plan, something that wasn't supposed to happen has happened and if that can happen then anything can happen.

An earthquake can pull the rug out from under basic beliefs about how the world is and leave us feeling unsure, unsafe, and wondering what we can count on with certainty. It's in this sense that an atmosphere of fear may prevail in a school the days following an earthquake. Of course, those friends and staff closest to those who may have died will be most affected; but the tragedy will effect everyone in the school to some extent.

It is very difficult for any constructive activity to take place when people are afraid. It's hard to concentrate, hard to take tests, write essays, or listen to lectures. It's even hard to feel sadness, remorse, or other normal grief feelings. Hence the reduction of fear is the first major goal for the school following a tragedy. We can't expect to eliminate it, but we can reduce it by reducing the unknowns.

While exercising sensitivity, we reduce fear by providing students and staff factual information about what happened, the deaths, and the grieving process to be expected in the days ahead by organizing the school day with as few changes as possible and by providing an open, accepting atmosphere allowing the "secret" fears, questions, and feelings of students and staff to come out.

Facilitate Grieving

Grief is the normal, healthy, appropriate response to death or loss. Anyone who knew those that were killed is going to experience grief, from the parents whose bereavement will normally last 2 to 3 years to tangential acquaintances whose grief will be measured in days. Students and staff don't get a choice of whether to feel grief, but they *do* get to choose how they'll respond to it.

People who deny their grief, pretend it's not a big deal, or insist they're not going to let it bother them, or try to cover it up with bravado, laughter, or stoicism usually have a much harder time resolving their grief than do people who are able to grieve more expressively.

Each person grieves in his or her own way; a way that has been learned by experience with loss over the years. A student or staff member's way of grieving or coping with loss can be predicted (based on past experience with loss) and is not likely to change in the midst of a crisis like the aftermath of an earthquake.

Accordingly, a wide range of grieving behavior needs to be tolerated, e.g., screaming in anguish, pounding the lockers in anger, sobbing in the hallway, stunned silence, inability to answer even simple questions, seeming totally unaffected as if nothing happened, or saying as one boy did upon being told of his friend's death, "Good, now I don't have to pay him the ten bucks I owe him." (This last remark was made in shock and he spent the next month being attacked for it and apologizing over and over for it.)

The initial response of most people to learning that someone they know has died is shock. Shock is usually a numbness, feeling like in a fog or spacey during which the full impact of what's happened may not have sunk in. People in shock usually don't talk a lot and mostly need friends to be patient and not assume that they're unaffected just because they're not emotional.

Other reactions to be expected for some people following death are anxiety over what else might happen; anger at the person that died, e.g., for not heeding warnings; blame at someone for not doing something to save her; and perhaps guilt for surviving when he didn't. Naturally a sadness and feeling the loss will usually replace shock, anxiety and anger and remain as the major result of the death for a long time.

While each person's way of grieving needs to be accepted, people who can get their grief out by talking, crying, expressing anger or guilt, writing, reading, exercise, painting, music, etc. are usually better able to resolve their grief and in less time than those who can't or are not allowed to grieve. Thus, the school's postvention program needs to allow and encourage the natural expression of grief especially immediately after the tragedy, but also, for some students, in the weeks and months ahead.

In this vein, one of the most predictable and significant consequences of a tragedy is that it will unlock and trigger unresolved grief in many students and staff. That is, there will be a sadness in the school not only because a student has died, but because grief over people's previous losses will be activated. For example, the girl whose father drowned last year, the teacher whose miscarriage at 6 months no one would talk about, the boy whose mother has breast cancer, the custodian whose dad is deteriorating with Alzheimer's disease at a nursing home, the freshman whose parents are fighting out a bitter divorce all will be feeling both the effects of the tragedy and now even more intensely, the pain of their own life.

The school's postvention program must take into consideration both grief over previously unresolved losses and give high priority to facilitating the grieving process of students and staff.

Promote Education

The purpose of a school is to educate its students and, (if Anna who says in The King and I, "by our students we'll be taught" is right) staff. Since we learn more from problems, crises, and tragedies than on average days; an earthquake will be an intense time of learning - not of reading and arithmetic, but of things perhaps more important.

The postvention program must be developed to promote constructive and useful learning in the aftermath of tragedy. Students and staff can be helped to learn how they react in a crisis, what people do that help most, how to help other people, what they really believe about death, that people can cry and still be strong, and, measured against the criterion of death, what's really important in life.

Obviously, no one wants a student to die; however, given the death has happened, learning is inevitably going to take place. The only question is, is the school going to allow it to occur haphazardly or will a postvention program be developed to promote constructive grieving, ways of helping others, and understanding of death and people in crisis?

POSTVENTION PLAN

What follows is intended to be a practical step by step outline of the tasks to be accomplished in planning a school's response to tragedy. The planning process should begin, of course, long before the event occurs. It may be initiated by anyone recognizing the need for a postvention plan; however, the cooperation, support, and hopefully, leadership of key school personnel must be obtained before meaningful planning can take place. That is, the principal, superintendent, and guidance staff clearly need to be involved and preferably also key teachers, coaches, school psychologists and social workers, nurses, and administrative assistants. Some involvement of an outside expert or consultant may be helpful at varying stages of the planning process. At times, in the process it is extremely important to consider the roles that custodians, secretaries, cafeteria workers, substitute teachers, bus drivers and student leaders may plan in the planning and/or implementation of the postvention program.

Each school needs to plan how it will carry out the 19 tasks outlined below. A report containing plans for how each task will be accomplished constitutes the postvention plan and should be available to all school personnel. It should be periodically reviewed especially by the administrative and guidance staff to update it (key resource people and phone numbers may change) and to keep copies of it at home as that's where the initial call about the tragedy may come.

To provide a context for the specific aspects of the postvention plan, we'll assume that the school day after the earthquake would begin with an emergency staff meeting before school followed by each faculty facilitating a short discussion of what has happened in the homeroom or first period class. Discussion of feelings about what's happened should be allowed to take as much class time as seems appropriate. A regular school schedule should be followed, but with great flexibility in allowing students to talk in the hallways, go to various individual and group counseling rooms provided, sit quietly in pairs on the stairway, be excused from tests and homework, etc. The structure of a regular school day provides some security and routine in a suddenly topsy turvy world while the wide latitude given students allows grief to be expressed. A variety of school and community personnel will be available to help students during the day. After school, a second general staff meeting is held to review the day and prepare for tomorrow.

1. **Selection of the Crisis Response Team**. A crisis response team of perhaps three to five members with authority to make decisions in the time of crisis needs to be chosen. The team is responsible for both planning and implementation of postvention. Among its members should be a staff who have some respect in the school, are sensitive to student and faculty needs, are committed to personal involvement in a crisis response, are able to be decisive, and who are relatively calm under fire. The crisis response team would conduct planning for the remaining tasks and, along with the building principal if he or she is not on the team, be responsible for carrying out the school's response to a suicidal death on the days succeeding it.

2. **Identification of Media Liaison Person**. One person within the school district should be designated to handle all contact with newspaper, television, radio, and magazine reporters and shield school personnel from media intrusion. Media personnel should not be allowed in school. All school students and staff should be firmly instructed to refer any phone or personal contact, whether in school or at home, to the media liaison person whose phone number should be readily available and who should receive instructions on what information to release from the crisis response team. A press release should be prepared to serve as a basis for talking with the media. In general, the less publicity death receives, the better.

3. **Identification of Family Liaison Person.** The crisis response team should designate a representative of the school to initiate immediate and appropriate contact with the family of the dead student, to express the empathy and concern of the school, to answer parents questions regarding school plans, to ascertain family wishes and plans regarding funeral, wake and memorials, to discretely obtain the information about the death and the circumstances surrounding it, and to offer to help the family with support, contact with community resources, or perhaps tangible help like driving, food, babysitting, or talking with siblings. The family liaison person should be educated about helpful and unhelpful responses to grieving people, be sensitive to family privacy, and use intuition about maintaining some contact with the family during the weeks ahead. The crisis response team may choose one family liaison person for all situations or a different one may be designated for each crisis based on the person's relationship to the deceased student or his/her family.

4. **Organization of Staff/Telephone Network.** A telephone network or tree should be developed wherein each school staff member is called as soon as possible after the incident has occurred, given the brief basic facts, and notified of the time and place of the emergency staff meeting to be held usually before the next school day. Care should be taken to reach not only faculty, but all auxiliary and related personnel as well. Furthermore, selected staff members in schools throughout the district should be notified particularly in schools attended by siblings or schools from which support staff may be borrowed to help during the crisis.

5. **Identification of Crisis Consultant.** Despite the expertise and capabilities of school staff, it is recommended that a consultant from outside the school be chosen with whom an agreement is developed to offer assistance to the school in the event of a tragedy. The principal, guidance counselor, or most experienced member of the crisis response team may know the student who has died and thus be personally affected by the death making it difficult for him or her to play their usual leadership role. Additionally, trained experts in grief or trauma are probably more experienced in coping with tragedy and knowing what helps in time of crisis than most school staff. The role of the consultant should be to assist with or review the postvention plan with the crisis response team, address the emergency staff meeting, generally be available for intervention or feedback during postvention, and to support school staff during the crisis.

6. **Identification of Community Response People.** Experienced counselors, psychiatrists, clergymen, psychologists, or social workers from the community should be identified and contacted ahead of time to ascertain their availability and willingness to help in one or both of two ways: first, to come to the school on the day after the tragedy and be available to talk with students needing support or counseling; and second, to agree to see professionally and immediately or as appropriate, students or staff referred by the school. Lists of these professionals should be clearly posted in school on the days following the death.

7. **Develop Suggestions for Classroom Discussion.** During either the homeroom or first class period, whichever is longer, each teacher should announce to the students what has happened, give the pertinent facts about the tragedy in a low key, unsensational manner, describe the schedule for the day and mention the people and places in school where help is available. The purpose is to ground the students in reality, reduce rumors and gossip, provide an accurate basis for discussion and grieving, and assure the students that help is here if they need it. Once the students are informed, the teacher should allow for and facilitate a discussion encouraging students to share their reactions, thoughts and feelings to what's happened recognizing that, while many students will have heard about the death before, others may not have known until the teacher announced it.

   Some schools prefer the equally acceptable plan of having the principal make a brief announcement of the death at the time of morning announcements after which the teachers will add some information and lead class discussion. Tragic news is usually best delivered by the person with most authority.

   Since following the announcement of the death, however it is made, the classroom teacher will facilitate student discussion which will be a new and difficult experience for most teachers; the crisis response team should develop and distribute guidelines for conducting such a discussion. An in-service training session should be devoted to explaining the postvention plan and suggestions for facilitating class discussion ought to be the main focus of that training. Some guidelines for such a discussion are offered at the end of this paper.

8. **Identification of Crisis Center and Counseling Room.** One room with a telephone needs to be set up as a general headquarters and information center. Someone, perhaps the principal's secretary, the media liaison person, or a member of the crisis response team, should be designated to be in that room at all times during the day after the tragedy to relay information and answer questions on how to locate the principal, superintendent, school nurse, school psychologist, crisis response team, etc.

   Additionally, rooms should be set aside and their existence clearly publicized the day after the earthquake for individual and small group counseling or where students can go to talk and not be alone. Each room should be manned by a school or community resource person. One of these rooms, though loosely supervised by a staff member, may be designated as a quiet or respite room where a student can go to be alone and silent.

9. **Formulation of School Policy on Funerals.** Wakes, funerals, and other rituals around death usually serve a useful purpose in acknowledging and accepting the death, beginning the grieving process and letting people know they're not alone. The crisis response team needs to formulate a school policy on funerals which addresses questions like: Will the school be closed for the funeral? Will staff and/or students be given permission to attend the funeral? Will notes from parents be required for students to attend the funeral or

memorial service? Will the school provide bus transportation to the funeral? Will students the funeral be handled? Will any in-school memorial services be held?

Each school needs to answer these questions for themselves. Our general suggestions are to allow or even encourage students and staff to attend the funeral - the students, preferably, with parental permission. It is best, nonetheless, to run a "regular school schedule" and not usually offer special transportation to the service. Penalties to students in the days after the death should be few and, in most cases, the school is better off not setting up its own memorial service.

Special arrangements may need to be made in the hopefully rare, but very troublesome, instance when the family has no wake, a closed funeral, or no funeral at all. In such cases, the school may need to organize or at least allow some special memorial service to take place.

10. **Formulation of Policy on School Memorial.** The crisis response team, perhaps in conjunction with student leaders, needs to formulate a policy on what sort of memorial is appropriate to pay tribute to the person who has died. Will the flag be flown at half mast? Will a special page be set aside in the yearbook and who will write it? Will parents be consulted about a memorial? Does the class of the student who died want to establish a scholarship in the student's memory? Will a special event like a swim meet, school play, or class day be dedicated to the deceased student? Will a plaque be placed in the school? Will a tree be planted in the student's name?

    The implementation of this policy on memorials is an excellent place to involve students and can provide a task which helps them channel their grief into a constructive goal while giving them a reason to come together which may allow them to share with and support each other. It is often best to invite those students closest to the deceased student to plan the memorial to that student.

11. **Interface with Student Leaders.** Postvention is best handled by the school staff and community people, but the crisis response team should consider what role student leaders could play. Should there be a student member of the crisis response team? If there is a peer counseling program established, how will peer counselors be involved in the after-math? This is not to say that student leaders should have a role in postvention; rather it is to ask the crisis response team to consider whether they should, and if so, in what way.

12. **Availability of Readings on Death.** Many people affected by death find great comfort or help in reading about the grieving process, other people's experience with death, death itself, or suggestions on how to be helpful to their friends in a time of crisis. Accordingly, the school librarian should be prepared to place on an easily accessed table or counter, a number of books or pamphlets on death, grief, and earthquakes to be readily available for those students and staff who may find them helpful.

13. **Plan for Calling in Substitute Teachers.** Owing to their own grief or personal difficulties with death, some teachers may be unable to function normally, let alone help with student reaction. This, coupled with the difficulty in predicting the extent of student needs, leads to the suggestion that the crisis response team develop a plan for calling in a number of substitute teachers who will be available to fill in, in whatever ways the day's events dictate. Perhaps they won't be needed, but their presence will allow flexibility in use of school resources to meet student needs.

14. **Plan for Morning After Staff Meeting.** The school day following the tragedy should begin with an emergency meeting of *all* school staff, teachers, custodians, nurses, counselors, administrators, substitute teachers, cafeteria workers, resource room volunteers, etc. and including the community resource people. A half-hour to 45 minutes should be allowed for this meeting which should take place before the normal start of the school day. The meeting has two purposes, the first handled by the building principal, the second by the crisis consultant.

    The principal should begin the meeting by announcing what has happened, giving as much information about damage, death, funerals, and family wishes as possible. Staff will function best if they're well informed. Succinct staff questions should be answered and the plan for the day should be spelled out including introduction of community resource people, media and family liaison people, and crisis response team, location of the crisis center room and counseling rooms, and plans for the after school staff meeting.

    The crisis consultant will then address the group on what to expect from and how to respond to students, what to say in the homeroom or first class, special issues raised by the earthquake, and the importance of paying attention to the staff members own feelings and reactions about the death.

15. **Identification and Contact with At-Risk Students.** Through the telephone networking and other channels, the crisis response team should make an intense effort to identify two kinds of at-risk kids: boyfriends, girlfriends, and close friends of the dead student and students who are known to be very depressed, under great stress, or readily set off for other reasons.

    Each identified student should be contacted sensitively and privately by a school staff member to assess his/her current state, let the student know someone cares, and offer individual counseling or support at any point in the day and days that follow. If serious cause for concern is detected, the student's parents may be notified to hopefully insure their support. In certain instances, the at-risk student's closest friend or friends may be notified for the same reason.

    Additionally, those close friends of the deceased student may be invited and encouraged to meet as a group with a trained counselor to share their feelings, facilitate their grief, and feel their mutual support.

16. **Drafting a Letter for Parents**. During the school day, a letter to parents should be drafted so it can be sent home with the students. The letter should sensitively and succinctly state what has happened, how the school has responded thus far, plans the school has for the coming days, suggestions on being especially aware of and supportive to their child, names and phone numbers of community resources to call for information or help and contain an announcement of the parent/community meeting.

17. **Plan for After School Staff Meeting**. At the close of the first school day after the tragedy, a second staff meeting should be held for *all* school staff. The meeting may be led by the principal or the crisis response team. The purpose is to review the day's events attending to what went well and what didn't, identify which students/staff are most worried about and how to help them, make any needed adjustments in the postvention plan, enunciate continuing postvention plans, and allow staff to raise questions for the crisis consultant or response team.

18. **Plan for Evening Parent/Community Meeting**. Plans for a parent/community meeting to be held a day or two after the funeral should be formed by the crisis response team. Experience shows that such a meeting may be more important in a small or isolated community. The principal, crisis response team, and crisis consultant should speak at the meeting with the crisis consultant bearing the brunt of the load and emphasizing what to expect during the grieving process and how to be helpful to students and adults affected by the earthquake. While such a meeting is not essential, it usually is helpful to community people even if not directly affected by the tragedy and allows the school to perform a constructive community service.

19. **Plan for Postvention Evaluation**. After the crisis is over, usually a few weeks following the tragedy, there will still be some students and perhaps staff who will be grieving deeply and need support or counseling for some time to come. However, for most of the school, life will be more or less back to normal. During the time after the crisis, the crisis response team needs to organize a meeting of those staff most directly involved in postvention to discuss and evaluate the postvention process. Prior to the meeting, feedback should be solicited from other people who were involved in postvention. This information can be fed into the postvention evaluation meeting. Of course, the purpose of the meeting is to ascertain what worked well and what didn't, what modifications in the postvention plan are needed, and to thank or give feedback to those who helped the school cope with the crisis.

THE ISSUE OF STAFF GRIEF

Responsibility for carrying out the postvention plan is on the shoulders of various school staff members some of whom will have known, perhaps been close to, the student who died. Other key staff may be experiencing painful turmoil in their own lives. A student's death will cast grief over the school. The staff will be trying to help students cope with grief. The first principle of grief work is to be aware of and pay attention to one's own grieving process. The nature and strength of a teacher's feelings will effect, perhaps to help, perhaps to interfere with, student's grief.

Therefore, to best prepare for postvention following a death, the crisis response team, cognizant of staff being (intended or not) role models for student grief, should organize an in-service training day focusing on the losses, grieving styles, coping mechanisms, and feelings about death experienced by staff members. The in-service should contain two sessions, one didactic and the other experiential, and be conducted by the crisis consultant.

The didactic portion should consist of an explanation of grief and the process people go through when a loved one dies. Issues such as how long the grieving process may take, phases one goes through, feelings of going crazy as a normal part of grief, what helps and what to say to people in grief, and especially the influence of coping with past losses or current reaction to death should be discussed.

Experientially, the session should help people become aware of their own grieving process; their own unique ways of coping with loss and death. In pairs, triads or small groups each person may be asked to think back over his/her life about the losses he/she suffered (to death or otherwise), to describe one or two of these losses, share how he/she reacted, coped and grieved at those times, and recall what helped or didn't help.

There are two reasons for this exercise. First, people grieve a current death in much the way they've grieved other losses in their lives. When death occurs, people don't leisurely decide how they're going to grieve; they react immediately and begin to respond the only way they know how, the way they've learned over years of coping with losses. People don't change their style of grieving in a crisis; so focusing on one's grieving style will provide a good indication of how that person will react when a student death occurs. Thus, staff can know what to expect from themselves and what they'll need in the crisis.

Second, people have a tendency to judge others through their own eyes and, hence, assume that other people will or should react to and grieve the death the way they do. This tendency is nearly always unhelpful and interferes with a staff member's ability to respond to student or other staff needs following the earthquake. Awareness of one's own grieving tendency makes it more likely that he/she can set that tendency aside for a time and be open to helping other people cope in their own way.

Knowledge about grief in general and one's own grief in particular, will increase the self-confidence of staff members, thus enabling them to talk with, listen to, and help students in the aftermath of an earthquake.

SUGGESTIONS ON LEADING CLASS DISCUSSION OF DEATH

One or more of three paths can be followed in leading a class discussion following the death of a student. First, mention in a kind and sensitive way what has happened and then simply open the floor for whatever anyone wants to say by saying something like: "This has come as such a shock to all of us. It's so hard to believe. Do any of you have any reactions or feelings or thoughts about _____________'s death?" If it's a vocal group or emotions are high, this simple offer may be all that's needed for students to begin sharing their reactions.

Second, reference can be made to some aspect of the crisis and specific questions can be directed to the class about the concern. For example, the teacher can mention that the funeral will be at 1:00 p.m. tomorrow and that any student who wishes to, may attend; then follow this by asking, "How many of you have ever been to a funeral?" and asking some of those with their hands up whose funeral they went to and what it was like, was the casket open, what did people say at he funeral, etc. This more direct cognitive approach may be easier for some students to respond to. The teacher may choose to share his or her funeral experience with the class as well.

Third, depending on the teacher's own state of mind or his/her assessment of the mood of the class, the teacher may express his/her own emotional reaction in a very feeling way to the class and perhaps be silent for a moment afterwards to see if it triggers any student response. For example, a teacher may say something like, "I was 12 years old when my dad died. I was so scared I could hardly talk, but all I could think of was 'I better not cry because my mother's going to need me to take care of my little sister,'" etc. or "Last night when Mr. _____________ called to tell me what had happened, I thought he was joking and said 'If you think this is funny, you're wrong!' When I realized he was serious, I hung up the phone, slammed my fist on the table, and thought, 'What a rotten thing to happen.' I couldn't get to sleep wondering all night what was going through her mind as she died and I kept getting sadder and sadder."

Emotion begets emotion. A genuine, honest heartfelt response by a teacher will be more likely to elicit an emotional response in a student than will a cognitive or light response. Death is a great leveler. Neither teacher nor student fully understands it, has an answer for it, nor knows how to make it better. Though used to being cast in the role of expert, few teachers are expert on death; so it's phony to try and play that role. It's far better to be human with your students, showing your feelings if you can, and modeling that it's "OK" to be upset or grieve when someone dies.

Being only human, some teachers may know themselves well enough to realize they are simply unable to lead a class discussion on death, in which case, they may ask a counselor or someone to come to their class and take over the discussion.

WHAT DO WE DO NEXT?
THE NEXT STEP IN EARTHQUAKE EDUCATION

Joyce B. Bagwell

Director, Earthquake Education Center
Baptist College at Charleston

ABSTRACT

"Do I have to teach this earthquake drill to my students? I simply do not have the time!" said the frustrated first-year fourth grade teacher to her assistant principal at Newington Elementary School in Summervihis paper is to address the future approach for earthquake education to a specific audience, schools. There is no one formula for successfully integrating a program in our educational system. There are the usual barriers for integrating any program or anything different in the educational system. In taking the next step, make use of the knowledge that has put us at this point of the process. Be aware that, without question, problems will emerge. Let the problems be stepping stones rather than stumbling blocks. The steps for implementing earthquake education to the school population is to (a) commit, (b) consult, (c) channel, (d) communicate, and (e) charge. Respond to these steps which I call the five C's in light of where you are. Your presence at this meeting indicates your serious intent to educate our school population in earthquake preparedness.

JOYCE BAGWELL

Ms. Joyce Bagwell has been both a high school science teacher and college professor as well as a frequent lecturer at civic and professional groups in South Carolina on the subject of earthquake history, causes, effects, and preparedness. The author of numerous publications, she is currently Assistant Professor of Chemistry-Geology at Baptist College at Charleston, Principle Investigator for Seismic Activity in lower South Carolina, and Director of the Earthquake Center at Baptist College.

INTRODUCTION

In constructing an earthquake education program for a vulnerable audience, our school children, it is logical that the next step in planning should be to examine the goals and objectives set at this conference. Refine them. Determine your commitment, and take proactive steps to educate school administrators and teachers to integrate earthquake safety in the curriculum. The methods by which to accomplish this task will be diverse, but the ultimate outcome should be to facilitate students' learning of life-saving behavior in the event of a damaging earthquake.

The purpose of this paper is to present five steps for implementing an earthquake education program to the school population. The steps I call the five C's are: (1) commit, (2) consult, (3) channel, (4) communicate, and (5) charge. Some of the methods I use to teach the concepts of earthquake history, causes, effects, and preparedness to school audiences will be demonstrated at the conclusion of my talk.

COMMIT

The advocates, individuals and agencies, instigating earthquake education will commit their energies to the continuance of upgrading the quality of the earthquake education materials that exist. The advocates will commit themselves to explore every possibility through which the material can be utilized. The materials will be applicable to the target audience addressed. Accurate and practical information must be made available to the user/learner.

Assign the task to carry on the work only to those who have the qualities of being a "champion" for the cause of earthquake education. Enthusiasm, interest, professional expertise, and understanding the subject of earthquakes are qualities that the "champion" will possess. The importance of possessing a contagious spirit about the need of earthquake education will attract the attention of policy/decision makers who are able to produce institutional changes locally, statewide, and nationally. Commitment to educating the school population will open doors of opportunities. The only limits that an earthquake educational program has is the limit of the imagination and commitment of the program's leaders.

CONSULT

The work of the past decade in earthquake education will become a basis upon which to build. Consult people like Marilyn MacCabe of the Federal Emergency Management Agency (FEMA) who put together pilot earthquake education programs. Learn the technique of providing the concepts and allowing individuals to build upon them. The 1983 pilot projects funded by FEMA at the Baptist College at Charleston, Memphis State, and Seattle, Washington modified the materials of the Environmental Volunteers of California and CHES of California (currently Lafferty and Associates, Inc.) to be applicable for Charleston, Memphis, and Seattle. The activities of the plans and programs that worked well and those that did not work well should enlighten anyone implementing earthquake education programs in other states. The success that the pilot programs in Charleston, South Carolina, Memphis, Tennessee, and Seattle, Washington, had in the schools has led to the emphasis of this conference.

It was the National Earthquake Hazard Reduction Plan (NEHRP) of 1977, that set in motion the tasks of government agencies planning ways to reduce the risk of earthquakes in the United States. The Federal Emergency Management Agency (FEMA), the U.S. Geological Survey (USGS), the Nuclear Regulatory Commission, the National Science Foundation, and the National Bureau of Standards and Technology involved the local private and public sectors in each section of the country to attend conferences throughout the U.S. and Puerto Rico to generate awareness of the risks of earthquakes in eastern United States as well as the known risk of damaging earthquakes in California. Consult the literature about the outcomes of the conferences. The Office of Earthquake Engineering and Research of the USGS in Reston, Virginia is an excellent resource to get the proceedings of the conferences to you. The earthquake education for the public was a very significant part of all the conferences.

All the scientific research, challenges for the engineers, vulnerability studies, mitigation plans for responders are vital, but the role of integrating earthquake education in the school population in order to plan and prepare themselves for a damaging earthquake is the important key to reducing the loss of lives in the event of a damaging earthquake in the United States.

California, being more active seismically than the eastern United States, is the leader in planning and educating their populace. Yet, there remains the task of involving *all* the schools to develop earthquake safety plans and practice earthquake drills. The difficulty which California and all other states will have is to "educate" the populace of *where* their closest resources lie, *what* materials are available, and *who* to get to act upon their knowledge.

Two outstanding earthquake educational resources at the present time are: <u>Earthquakes: A Teacher's Package for K-6</u> developed by the National Science Teachers Association under contract to FEMA and the <u>Guidebook for Developing a School Earthquake Safety Program</u> written by FEMA. These resource materials are written specifically for the school population and are excellent. The methods of disseminating the information will begin in July 1989, in St. Louis, Missouri, with a train-the-trainer workshop using the National Science Teachers Earthquake Curriculum.

As the educator, Robert Mager, made us aware, it is difficult to construct or map goals and objectives for where one wants to go unless one knows what has been done or accomplished in the past. Consulting with the beginning advocates in the field and researching the literature and programs are necessary beginning steps.

CHANNEL

Everyone has limited energy and resources. For a program to be successful, there must be continuous channeling of energies. The concept of channeling here means focusing, putting on blinders to avoid deviations or distraction. A magnifying glass concentrating the sun's rays in one spot upon paper can cause a fire. If the magnifying glass does not channel the sunlight to the one spot, there is no concentration of heat generated, no fire can be started. In the same analysis unless the focus of one's goals and objectives upon an audience is concentrated or channeled, no lasting earthquake education program will be generated.

Channeling can be interpreted by some as following a chain of command. The procedure of following a chain of command in the educational system can eliminate embarrassment and problems for a program. Recognize, however, that one does not abandon a school district or a school if the person in charge does not want to become involved with the earthquake education program. Successfully implementing a program in another school or district nearby can cause changes in the thinking of those who at first were reluctant to participate. This actually happened in our EEC program. A teacher from the reluctant school, not knowing how the principal felt, attended a teacher recertification course. She participated in the hands-on earthquake program that was taught as one of her classes. She returned to her school and integrated the earthquake program in her class. She shared her materials with the other teachers. The school as a whole has not initiated an earthquake safety committee, but the students have been exposed to earthquake drills in the classroom. Hopefully, in the near future, the principal who did not think his teachers would respond to the earthquake education program will be calling us for more information.

The approach used by the Baptist College Earthquake Education Center was successful, because the science coordinators for the counties involved were 100 percent in favor of the earthquake education program. The science coordinators invited the EEC staff to present the earthquake material in workshops. Teachers recognized the value of utilizing an interesting subject to enhance basic skills of the students. The interdisciplinary aspects of the subject stimulated ideas of ways to integrate earthquake safety for just about any discipline.

Teachers like the hands-on experience that students were afforded in learning the what and why's of earthquakes. Several teachers have expressed a feeling of reward when students appeared to be stretching their minds beyond the natural "what if" questions. "What if" questions always get in earthquake discussion sessions. Teachers "turned on" by the EEC programs presented during summer workshops, in-service workshops during the year, and various education courses offered for teachers never failed to write or call for brochures, material, film, slides, or borrow some of the models the EEC had to loan.

The proper channel to use for initiating an earthquake safety program can be through the teachers attending workshops, the principals or the district level staff. Only those exposed to an adequate presentation of the material and enabled to see the far reaching effects of improving safety within their own environment are the ones who have taken steps to utilize the program.

COMMUNICATE

Communicate with those who are interested in getting earthquake education into the schools. All participants at this conference are aware of the importance of networking. Make a deliberate list of those associates who share the same interest and communicate with them often. By attending workshops, symposiums, and conferences, the chance to enlarge the network is increased with the added bonus of obtaining added information.

In the communication step, be prepared to spend time on the telephone, make appointments with individuals, write notes to yourself so you will not forget or overlook anyone who is seeking information. There is a motivational book entitled Rhinoceros Success by Scott Alexander. The same concepts for a person to be successful as this book indicates, are applicable to a successful earthquake education program. In your communication, choose to be audacious. Alexander states that success, in itself, is audacious. Do not become obnoxious; but, to initiate a program where you live commands a daring feat to reach your goals. To convince educators that the possible threat of earthquakes requires initiating action plans for preparedness of an earthquake will be a major task anywhere because all Americans are convinced "It will not happen here." Your communication must be to convince others that you believe in the program.

CHARGE

You are a Niagara Falls of energy! With the power of the knowledge you possess on the importance of earthquake education in schools, you could easily light up New York City. You have the knowledge of what needs to be done. Think big! Go to the superintendents of education within your state with a plan for implementing earthquake safety in the schools. Use your energy wisely. The Niagara Falls are not used for taking a shower. Exercise your discipline. Changing people's attitudes from a "what will be, will be" to "what can I do to reduce the risk of getting hurt in an earthquake?" requires an impressive force from someone with a sound program ready to be executed.

The scientific principle of inertia confirms that all objects tend to stay still unless acted upon by some outside force. A baseball will not pick itself up off the ground and throw itself. An outside force is required to put the ball in motion. We must be the outside force to get an earthquake education program implemented in our schools. We must fine tune ourselves to a degree of excellence. Each of us here must take the information presented and apply it to our own situations. With singleness of purpose, we must CHARGE!

CONCLUSION

The next step in earthquake education is to leave this conference with the determination to exercise the five C's. **Commit** to upgrading and utilizing earthquake curriculum materials and enlisting enthusiastic "champions" for the integration of earthquake science and safety into the educational curricula. **Consult** the leaders of the earthquake education programs in progress. **Channel** your energy toward clearly defined goals and objectives for school earthquake safety programs. **Communicate** often with colleagues concerning methods to implement earthquake safety to the school population. Present a positive approach. **Charge** forward! As leaders in the earthquake education programs for the school population throughout the United States and other countries represented here, it is up to each of us to **take action.**

CONFERENCE WORKSHOPS

CONFERENCE WORKSHOPS

The Conference Workshops were designed as working sessions. Conference products were developed during these sessions and included goal statements, lists of recommendations, limitations for achieving listed goals, factors that would encourage the successful attainment of the goals and general position statements. The minutes from these workshops are on the following pages.

To avoid duplication and maximize discussion, each workshop had three sessions occurring simultaneously. One workshop session discussed the listed topic from the point of view of an administrator, another from the point of view of an educator, and the third from the point of view of a developer of science and/or safety curricula, inservice, and other related materials. These were not assigned groups. Attendees were encouraged to join the group with which they felt most comfortable and would best be able to contribute.

Workshop 1: Avenues of Dissemination

This workshop focused on available avenues for the dissemination of materials and how these avenues could be utilized more fully, and even expanded.

- Who should be responsible for dissemination?
- How do we get existing materials to students and teachers? What local, state and professional organization mechanisms are there?

Workshop 2: Barriers to Implementation

This workshop focused on regional, national, and political factors that interfere with the full implementation of earthquake education in the schools.

- Where does natural hazard education fit into the existing curriculum?
- Should existing materials be regionalized to meet the needs of particular areas of the country?

Workshop 3: Strategies - Getting Earthquake Education into Our Schools

This workshop focused on ways that earthquake education can be fully incorporated into the existing school curriculum at a variety of levels and across age groupings.

- How can parents and teachers be motivated to ask for the inclusion of earthquake education in the schools?
- In what ways can earthquake education in the schools be designed so that students internalize the concept of hazard mitigation and grow to become informed adults?

CONFERENCE WORKSHOPS

Point of view of administrators.

Leader: Marjorie Greene
BAREPP, Oakland, CA

Discussant: John Gill
Arkansas Department of Education

Recorder: Laurie Laughy
Emergency Preparedness Canada Fellow
Vancouver, B.C.

Workshop 1: AVENUES OF DISSEMINATION

The participants first examined the routes of dissemination of earthquake materials and information within the school system. Three main routes were identified:

1. TOP - DOWN: The information flow moves from the state school board, through to the local school board, the Superintendent, school principal, teachers and finally to the students.

2. BOTTOM - UP: Interested parties from lobby or advocacy groups either via the P.T.A. and then up to the school board or from interested local science teachers via the teachers association to school boards at the local or state level.

3. LEGISLATIVE: Legislative charges cause direct or indirect changes at the school level. It was stressed that unless the changes were deemed credible and were accompanied by funding and with policies of enforcement their effect was often negligible.

In order to better identify and utilize existing routes, the participants made three recommendations:

1. that existing data-base systems (e.g. ERIC) be identified and utilized as a National Clearing House of source materials and distribution networks;
2. that organization/agencies use the established data-base when producing or distributing materials or products; and
3. that proven known dissemination routes be identified and listed regarding earthquake safety and curriculum.

Four major principles were endorsed as a means of insuring that these routes of dissemination be used to their fullest.

1. Involve participants and recipients as part of the preparation of material.
2. Train the trainers--making use of in-house inservice training.
3. Encourage local authorities to establish an office of primary responsibility.
4. Insure that products are developed according to established routes of dissemination.

Workshop 2: BARRIERS TO DISSEMINATION

Five main barriers towards following these principles were identified. These were:

1. **Credibility**: because of denial or overdependence on government agencies, persons fail to "buy in" to the process.
2. **Resources**: financial, material, and personnel resources are often inadequate.
3. **Fragmentation**: government bureaucracy often dictates restricted scope and mandate and thus fragmentizes the response to the problem.
4. **Dissemination Routes**: there exists a lack of documented and proven routes for people to use.
5. **Research**: research is inadequate and at times contradictory.

Therefore, since it was noted that both public and school administrators control the financial resources and make the decisions regarding school earthquake safety and curriculum, the participants recommended that what was needed was a:

> "broad, integrated comprehensive approach that identifies and involves existing and potential players in terms of roles, mandate, responsibility and scope of influence and support and establishes the long and short-term goals and objectives."

Workshop 3: IMPLEMENTATION STRATEGIES

Eight specific strategies for overcoming barriers to using such an approach were identified:

1. **Sales**: there is a real need to develop a marketing plan and program to include both short-term benefits (i.e., what can you do to save yourself?) and long-term benefits (i.e., if you educate children now they will grow up to be concerned and aware parents).
2. **Developing a Quality Product**: existing materials needed to be demonstrated and displayed and become recognized. Research and development in the area of USAR needs to be redirected and made available to persons involved in damage assessment.
3. **Lobbying Politicians**: politicians must be made aware of the need for earthquake safety programs and that any such changes must be accompanied with programs for monitoring and with penalties for failure to comply.
4. **Developing a Model**: efforts need to be made to develop an integrated model of earthquake safety, mitigation and curriculum.

5. **Developing Dissemination Routes**: existing routes need to be identified so as to mitigate the effects of fragmentization and distribution problems. Existing corporate models regarding in-house training programs need to be identified and exploited.
6. **Education**: Development of earthquake curriculum is crucial in the education process. People need to be aware of the need for self-sufficiency. Children can be used to reach their parents and make them aware of the problems. More use of the electronic and print media needs to be made.
7. **Motivation**: People need to be motivated to make earthquake preparedness a priority. Research in the areas of motivating and reaching groups needs to be conducted. People have to be told that what's in place now won't work and decision-makers need to be made aware of the issues.
8. **Implementation**: Players have to be identified and then involved in the process of identifying the long and short-term goals of an integrated approach.

The discussion was considerable and spirited and it was the hope that these conclusions and recommendations would be of benefit in getting earthquake education into our schools.

CONFERENCE WORKSHOPS

Point of view of educators.

Leader: Deedee O'Brien
Utah Museum of Natural History
Salt Lake City, Utah

Discussant: Rodney Doran
State University of New York at Buffalo
Buffalo, New York

Recorder: Carole Martens
Washington State Community Development
Olympia, Washington

Workshop 1: AVENUES OF DISSEMINATION

Many different sections of the country and disciplines represented in group.

- Association, national, state, subject matter, local
  NSTA, STS, CESI - elementary, NAGT
- Parent groups/PTA's/School Boards/Community organizations/Principals/NASSP/ Council of State Supervisors
- Newsletters/Periodicals
- Television, media, public service: Discovery channels
- State Education office turnkey
- Colleges-Seminars-AETS; all teachers
- Teacher Centers/Local Resource Centers/Museums
- Electronic Bulletin Boards
- Educational Resource Information
- Catalogue of free and inexpensive materials $75
- Libraries
- Conferences/conventions
- Brochures
- Fire depts./Police depts.
- Staff development/In-Service/Pre-Ser.
- Textbook
- Governmental entities

Teacher resource centers located at different locations throughout states. Individuals feel these don't get broad usage. Create need. Information on availability can be disseminated through newsletters.

Key is to get information to teachers.

Number of publications available - science oriented. e.g.: Super Science.

Discover channel - was set up last April in Seattle.

Who has influence on textbook content? (Publishers easy to get to - comment from person in Mississippi.)

NSTA has a wealth of information
- Make things hands on.

SUMMARY:

Look at the audience. The dissemination avenue is determined by audience. Target specific groups: elementary teachers, principals, earth science teachers, state science supervisors. (Comment from participant - "don't separate entities.")

Can't do everything; - resources limited. Use Teacher centers and direct 5 groups to target. Choose where you want to focus energies. Year 1: which of 5 groups would we name priority 1?

Is there enough communication between levels of education to limit dissemination to one group and expect it to spread?

Use interdisciplinary groupings.

Are channels in various states similar? Not all states have Teacher Centers. Do we go through national organizations or the state level? (State education offices?)

What is it we are trying to disseminate? Awareness/safety? This should go out to the media - get parents involved - then they'd go to school and ask for earthquake education.

Another suggestion is a letter to school board asking "Would you be free from litigation if an earthquake occurred?"

We don't have a position paper. Needed!

If one were available it could be sent out to various outlets.

If State Board of Education is on record endorsing a position paper, can use it effectively to accomplish goals.

What can we use to communicate? Position paper good idea - select target group. Too many elementary teachers to get to all. Must be more focused.

Recommendations

1. Contact science periodical publishers and associate newsletters with suggested articles.

2. Create position paper. Use it as a tool to get endorsement and achieve goals.

3. Select target groups/resources limited.

Workshop 2: BARRIERS TO IMPLEMENTATION

Leader Summary:

-Focus on a target audience
-What to disseminate (a position paper)

What are Barriers -
Does anyone think there's not an appropriate channel? No one.

BARRIERS:

1. Teaching overload especially in elementary grades; interdisciplinary approach might be more effective
2. Lack of science/safety knowledge - In-service might be effective approach
3. Resistance: may need to mandate change
4. No support/resources
5. Some would say it's not necessary
6. Unsure which curriculum is best
7. No correlation with SLO's
8. Apathy
9. Presented as an extra; need to characterize it as a core part of the curriculum.
10. Independence
11. Money; insufficient funds for dissemination (mailing/contacting)
12. Personal overload
13. Lack of Principal support
14. Disorganization - separate teams
15. Multifaceted issue
16. Question of whether to isolate earthquakes or integrate
17. Uncooperative attitude
18. Will scare kids
19. Inability to have lasting impact
20. Secondary level may perceive safety as not an academic subject

21. Fragmented concepts on part of the persons disseminating the info.
22. No unified goal.
23. Improperly planned system of delivery or dissemination
24. Mind sets that consider only dissemination to a special interest or target populous; perception on the part of disseminators that there is only one basic way to approach the concept of dissemination.
25. Not enough personnel to handle the task of dissemination
26. Lack of cooperation or ignorance on the part of disseminators to use technology as a tool to assist in sending out information.
27. Lack of knowing how to positively disseminate information.
28. Personal or negative, selfish feelings and concerns override the goal of entire focus of earthquake education; hidden agendas on the part of disseminators.

Suggestions for Overcoming Barriers:

1. Overload: At elementary level, teachers can integrate but need guidance and hands-on help.

   Discussion included defining earthquake education.

   Questions: What should the in-service training include?
   Where should earthquake education be in the system?
   How much should be presented?
   Should there be a one time presentation? As what?

2. Lack of In-Service: Provide Inservice; Provide information, incorporate teachers, government, mentor-teacher; NSF Grant
   - Who should do it?
   If media focuses on school program, want to be involved.

3. Resistance to being told: time, persistence, ask them; education

4. Resources made available; information made available; team approach; identify "zealot", or local key contact. NCEER could take lead.

5. Awareness and emphasize mobility; link it with daily crises; link with other hazards.

6. Evaluate and analyze.

7. School wide plan; peer pressure.

8. Integrate.

9. Local business, service organizations, PTA's support to principals, workshops.

10. Establish consensus, guidelines.

11. Recognition; patience.

12. Local decision.

13. Education.

14. Science-technology-society.

15. Institutionalization needed.

SUMMARY:

Focus, Integrate, Support, Time (patience) - FIST.

Workshop 3: STRATEGIES

1. Process: State, local, regional process for getting quake education in schools

2. Institutionalization

What are the strategies?

-Mandates
- Framework and test
- Legislature
- Textbook: 90% of teachers depend on it
  What would textbooks include?
- Inservice
- Networking-effective to work with all possible groups and individuals on a continuing basis
- Dissemination: packets of information to provide what? Awareness or resources to implement programs and curricula and/or both?
- Exhibits at conferences
- Safety committee; mandate a school response plan. PTA can be a great help.

Framework

To continue, must be a renewal process - could be most successful if district or state mandate.

Peer sharing can occur and help but many advocates are not "peers".

Legislation

Difficult to get support. How can we attain it? Get advocates within the legislature and other decision-making bodies.

New York state science syllabus is just being rewritten. Process is on a 20-year cycle.

List of motivators. (Unable to do at this time).

Process

Awareness, position paper

Recommendation

NCEER give workshops to train teachers to go back to state. Contact: use marketing strategies on how to motivate: provide resources and directions on how to use curriculum. Participants could be earth science teachers, elementary teachers, administration.

SUMMARY:

Kinds of motivation we can use:

- Safety of the kids
- Legal issue
- Practical applications of science
- Science-technology

Children Legal Application Problem solving - CLAP

CONFERENCE WORKSHOPS

Point of view of developer of science and/or safety curricula, inservice, and other related materials.

Leader: Marilyn MacCabe
FEMA, Washington, DC

Discussant: Daniel Cicirello
Arkansas Office of Emergency Services

Recorder: Paul Spengler
Disaster and Emergency Services
Helena, Montana

Workshop 1: AVENUES OF DISSEMINATION

1. NSTA Bulletin Board: (202) 328-5853 (This connects directly to bulletin board service).
2. Unions: NEA and National Federation of Teachers - this is a good way to reach those not in professional organizations. Use their journals.
3. Serve most interested first. They will become the spokesmen.
4. Institutionalize - avoid temporarily incorporating earthquake education.
5. Train teachers.
6. Professional journal articles (NSTA - Science & Children is anxious to get material).
7. Package curriculum to make useful.
8. Aim at teachers. About 10% adopt innovative instruction early. Aim at the rest.
9. Aim at textbook companies. Preparedness information should be in math and reading books.
10. Identify and aim at support groups. Involve other people, grassroots.
11. Consider non-traditional ways to disseminate.
12. Make the curriculum part of the education system. Permanent, not temporary.
13. States need to mandate the education with policy statements.

To be a part of an on-going educational system, we need to be more systematic. Could couple dissemination with staff development.

Workshop 2: BARRIERS TO DISSEMINATION

1. Don't know how education works: access, instruction, legislation-legal.
2. Denial.
3. Decision making: state, local and personal.
4. Time/priorities.
5. Money: materials and training.
6. Lack of support from the public and professionals.

7. Don't know how to get resources.
8. Decision makers. Rigid bureaucracy.
9. Ill defined strategies and target audience. No agreed upon goals and objectives that can be evaluated.
10. Ignorance "Won't happen here;" risk perception low.
11. Dependence on outside resources.
12. Earth science not universally taught.
13. Can be locked in earth science which not all students study.
14. High turnover of teachers, especially in some areas.
15. Curriculum committees are swamped with requests.
16. Many textbooks do not change over the years.
17. Too specific for use as general curriculum material.
18. Lack of dissemination strategies.
19. No tested, proven model that's documented.
20. Different groups of students to be reached, i.e. special education, elementary, pre-school, etc.
21. Lack of teacher training. No team approach.

Workshop 3: IMPLEMENTATION STRATEGIES

1. Focus - don't confuse message.
2. Key agencies and personnel to lead identification and use.
3. Make positive messages.
4. Learn how education system works.
5. Identify funding and resources.
6. Use alternative dissemination methods.
7. Different states use different ways to implement curriculum; identify these ways.
8. Form coalition with other groups; team approach.
9. Document and evaluate programs to develop model.
10. Develop marketing strategy.
11. Public education: motivate the key people.
12. Develop a plan to implement.
13. Ownership of key players. Encourage their participation in implementation.
14. Central training sites. Train key people.
15. Mandate (federal, state, and local) implementation.
16. Become a part of textbook adoption strategies. Textbooks drive learning.
17. Followed by assessment. Evaluation of implementation techniques to learn if they work.
18. Get public support.
19. Use integrated approach, with other disciplines with earth science emphasis.
20. Talk to service groups for grassroots support. Teachers and administrators are often members of these groups.
21. Enlist the aid of local emergency managers (under various titles, e.g. disaster and emergency services coordinator or civil defense director).
22. Establish a partnership with volunteer agencies, such as the Red Cross.

23. Use the University Homemaker's Program and state office of disaster preparedness.
24. Informal approach will sometimes work. Just ask the right person.

IV. APPENDICES

A. Speakers List
B. Conference Planning Committee
C. Program and Schedule
D. Conference Evaluation

APPENDIX A
SPEAKERS LIST

Ms. Joyce Bagwell
Director, Earthquake Education Center
Baptist College at Charleston
P.O. Box 10087
Charleston, SC 29411

Dr. Joyce Blueford
Math/Science Nucleus
3710 Yale Way
Fremont, CA 94538

Dr. Ian Buckle
Deputy Director
National Center for Earthquake
Engineering Research
105 Red Jacket Quad
SUNY at Buffalo
Buffalo, NY 14261

Mr. Jeffrey Callister
Earth Science Teacher
Newburgh Free Academy
Newburgh, NY 12550

Mr. Daniel Cicirelllo
Arkansas Earthquake Preparedness
Program Supervisor
Arkansas Office of Emergency Services
P.O. Box 758
Conway, Arkansas 72032

Dr. Thomas Frantz
SUNY at Buffalo
Counseling and Educational Psychology
426 Baldy Hall
Buffalo, NY, 14260

Dr. John Gill
Education Administration Supervisor
Arkansas Department of Education
Rm. 305-B Education Building
Capitol Mall
Little Rock, AR 72201

Ms. Ferne Halgren
Director, Earthquake Project
UCLA Education Extension
10995 Le Cont Ave., Suite 514
Los Angeles, CA 90024

Mr. Neil Jackson
Architect of School Facilities Research
Ministry of Education
620 Superior St.
Victoria, BC, Canada V8V 2M4

Dr. David Kennedy
Program Administrator for Curriculum
Office of Superintendent of Public Instruction
Old Capitol Building, F-G11
Division of Instructional Programs and Services
Olympia, WA 98504-3211

Ms. Phyllis Marcuccio
Editor, Science and Children
National Science Teachers Association
1742 Connecticut Ave. NW
Washington, DC 20009

Mr. Karl Naugle
District Computer Coordinator
Dorchester School District Two
805 South Main Street
Summerville, SC 29483

Mr. Eldon Nelson
Supervisor of Support Services
Idaho State Department of Education
Len B. Jordan Office Building
Boise, ID 83720

Ms. Linda Noson
FEMA Region 10
130 228th St., SW
Bothell, WA 98021-9796

Mr. Kurt Othberg
Research Geologist and Director
Earth Science Education Programs
Idaho Geological Survey
Morrill Hall
University of Idaho
Moscow, ID 83843

Mr. Larry Pearce
Assistant Regional Director
Emergency Preparedness Canada
Box 10,000
Victoria, BC V8T 4Z8
Canada

Ms. Katharyn Ross
Education Specialist
National Center for Earthquake
Engineering Research
116 Red Jacket Quad
SUNY at Buffalo
Amherst, NY 14261

Mr. Thomas P. Sachse, Manager
Math/Science Education Unit
California State Department of Education
721 Capitol Mall
P.O. Box 944272
Sacramento, CA 94244-2720

Mr. James Tingey
Earthquake Preparedness Coordinator
Comprehensive Emergency Management
1534 Sunnyside Ave.
Salt Lake City, UT 84105

APPENDIX B
CONFERENCE PLANNING COMMITTEE

Ms. Joyce Bagwell
Earthquake Education Center
Baptist College at Charleston
P.O. Box 10087
Charleston, SC 29411

Dr. Joyce Blueford
Math/Science Nucleus
3710 Yale Way
Fremont, CA 94538

Mr. Daniel Cicirello
State of Arkansas
Office of Emergency Services
P.O. Box 758
Conway, AR 72032

Mr. Fred Cooper
Emergency Preparedness Canada
Box 10,000
Victoria, BC
Canada V8T 4Z8

Ms. Andrea Dargush
National Center for Earthquake
Engineering Research
106 Red Jacket Quad
Buffalo, NY 14261

Ms. Marjorie Greene
BAREPP
Metro Center, #152
101 8th Street
Oakland, CA 94607

Ms. Marilyn MacCabe
FEMA
228th St. SW
Bothell, WA 98021-9796

Ms. Linda Noson
FEMA Region 10
130 228th St., SW
Bothell, WA 98021-9796

Ms. Deedee O'Brien
Utah Museum of Natural History
University of Utah
Salt Lake City, UT 84112

Mr. Larry Pearce
Emergency Preparedness Canada
Box 10,000
Victoria, BC
Canada V8T 4Z8

Ms. Katharyn Ross
National Center for Earthquake
Engineering Research
116 Red Jacket Quad
Amherst, NY 14261

Dr. Herbert Thier
CALEEP
Lawrence Hall of Science
University of California at Berkeley
Berkeley, CA 94720

ADVISORS

Dr. Rodney Doran
SUNY at Buffalo
Learning and Instruction
563 Baldy Hall
Buffalo, NY 14260

Dr. Richard Foster
State University College at Buffalo
Room 131
Science Building
Buffalo, NY 14222

Dr. Thomas Frantz
SUNY at Buffalo
Counseling and Educational Psychology
426 Baldy Hall
Buffalo, NY 14260

APPENDIX C

Program and Schedule

Sunday, July 9:	3:30-4:30 pm	Conference Registration **Hilton Lobby**
	4:45 pm	Bus leaves Hilton for Amherst Campus
	5:30-7:00 pm	Tour of NCEER Seismic Simulator Laboratory Demonstration of NCEER Quakeline Poster and Exhibit Displays **Room 140 and Computer Lab, Ketter Hall, UB Amherst Campus**
	7:00-9:30 pm	Dinner Meeting - The Earthquake Risk in the Pacific Northwest Ms. Linda Noson, FEMA, Region 10 Mr. Larry Pearce, Emergency Preparedness Canada, British Columbia and Yukon **Center for Tomorrow, UB Amherst Campus**
Monday, July 10:	7:30-8:30 am	Conference Registration Continental Breakfast **Outside of Newport Room, Hilton**
	8:30-9:00 am	Welcome: Ms. Katharyn E.K. Ross, NCEER The Need for Earthquake Education Dr. Ian Buckle, NCEER **Newport Room, Hilton**
	9:00-9:20 am	Seismic Safety of Idaho Schools Mr. Kurt Othberg, Idaho Geological Survey **Newport Room, Hilton**
	9:20-9:40 am	The Benefits of Earthquake Education to the Schools Mr. James L. Tingey, Utah Comprehensive Emergency Management **Newport Room, Hilton**
	9:40-10:00 am	Internalizing Mitigation Education in the Schools Mr. Daniel Cicirello, Arkansas State Office of Emergency Services **Newport Room, Hilton**
	10:00-10:15 am	Break **Outside of Newport Room, Hilton**

Program and Schedule (Cont'd)

10:15-10:35 am	What Currently Exists in Earthquake Education: An Overview Ms. Katharyn E.K. Ross, NCEER **Newport Room, Hilton**
10:35-11:00 am	Plate Tectonics - Learning the Science to Understand the Hazard Dr. Joyce R. Blueford, Math/Science Nucleus, Fremont, California **Newport Room, Hilton**
11:00-11:25 am	Earthquake Preparedness From a School's Perspective Mr. Karl Naugle, Dorchester Two School District, Summerville, South Carolina **Newport Room, Hilton**
11:25-11:50 am	Teacher Participation in Earthquake Curricula Mr. Jeffrey Callister, Newburgh Free Academy, Newburgh, New York **Newport Room, Hilton**
11:50-Noon	Questions and Answers
Noon-1:30 pm	Lunch Presentation - It's Not My Fault: The Role of Denial in School Earthquake Preparedness Ms. Ferne Halgren, Education Extension, UCLA **Palo Alto Room, Hilton**
1:30-2:00 pm	The Process of Dissemination Ms. Phyllis Marcuccio, National Science Teachers Association **Newport Room, Hilton**
2:00-2:15 pm	Implementation of Earthquake Education in the United States: An Overview Ms. Katharyn E.K. Ross, NCEER **Newport Room, Hilton**
2:15-2:35 pm	Crisis Management and Earthquake Preparedness - A Regional Perspective Mr. Larry Pearce, Emergency Preparedness Canada, British Columbia and Yukon **Newport Room, Hilton**

Program and Schedule (Cont'd)

2:35-2:45 pm	Policies and Projects in the British Columbia Ministry of Education Mr. Neil Jackson, Ministry of Education, British Columbia **Newport Room, Hilton**
2:45-3:00 pm	Break **Outside Newport Room, Hilton**
3:00-3:10 pm	Strategies for the Implementation of Earthquake Preparedness in the Arkansas Schools Dr. John Gill, Arkansas Department of Education **Newport Room, Hilton**
3:10-3:20 pm	Implementation of Earthquake Education in California Public Schools Mr. Thomas Sachse, California State Department of Education **Newport Room, Hilton**
3:20-3:30 pm	Seismic Safety Standards for Idaho Schools Mr. Eldon Nelson, Idaho State Department of Education **Newport Room, Hilton**
3:30-3:40 pm	Slow Scholars Consider the Realities of Significant Seismicity Dr. David Kennedy, Washington State Department of Education **Newport Room, Hilton**
3:40-4:30 pm	Implementation Panel Discussion Dr. John Gill, Mr. Neil Jackson, Dr. David Kennedy, Mr. Eldon Nelson, Mr. Larry Pearce, Mr. Thomas Sachse, Ms. Katharyn Ross This time is provided to allow for optimal exchange between speakers and participants **Newport Room, Hilton**
4:30-5:00 pm	Summary of the Day; Identification of Key Issues and Workshops, July 11 Ms. Katharyn E.K. Ross, NCEER **Newport Room, Hilton**

Program and Schedule (Cont'd)

	5:00-6:00 pm	Poster and Exhibit Session Participants are encouraged to display materials and descriptions of their programs Cash Bar **Palo Alto Room, Hilton**
	7:30-8:30 pm	Optional Curricular Discussion This is designed for those who would like to further discuss available curricula and the future directions of earthquake education materials **Palo Alto Room, Hilton**
Tuesday, July 11:	7:30-8:30 am	Continental Breakfast **Outside Newport Room, Hilton**
	8:30-9:45 am	Workshop 1: Avenues of Dissemination Group A: Point of View of Administrators Ms. Marjorie Greene, BAREPP **Palo Alto Room, Hilton** Group B: Point of View of Educators Ms. Deedee O'Brien, Utah Museum of Natural History **Newport Room, Hilton** Group C: Point of View of Material and Curriculum Developers Ms. Marilyn MacCabe, FEMA **San Carlos Room, Hilton**
	9:45-10:00 am	Break **Outside Newport Room, Hilton**
	10:00-11:00 am	Psychological Aftermath of School Tragedy: Planning and Coping Dr. Thomas Frantz, Department of Counseling and Educational Psychology, State University of New York at Buffalo **Newport Room, Hilton**
	11:00-11:15 am	Break **Outside Newport Room, Hilton**
	11:15-12:30 pm	Workshop 2: Barriers to Implementation Group A: Point of View of Administrators Group B: Point of View of Educators Group C: Point of View of Material and Curriculum Developers
	12:30-1:30 pm	Lunch **Justine's, Hilton**

Program and Schedule (Cont'd)

1:30-2:45 pm	Workshop 3: Strategies: Getting Earthquake Education into the Schools Group A: Point of View of Administrators Group B: Point of View of Educators Group C: Point of View of Material and Curriculum Developers
2:45-3:00 pm	Break **Outside Newport Room, Hilton**
3:00-3:45 pm	What Do We Do Next? The Next Step in Earthquake Education Ms. Joyce Bagwell, Earthquake Education Center, Baptist College at Charleston **Newport Room, Hilton**
3:45-4:15 pm	Conclusions and Recommendations From Workshops; Reports From Workshop Leaders **Newport Room, Hilton**
4:15-4:45 pm	Closure Ms. Katharyn E.K. Ross, NCEER

APPENDIX D

DISASTER PREPAREDNESS - THE PLACE OF EARTHQUAKE EDUCATION IN OUR SCHOOLS
July 9-11, 1989

EVALUATION

Low				High
1	2	3	4	5

1. Did you find the conference to be useful for:
   a. defining the need for earthquake education? .... ______
   b. understanding the impact of earthquakes on children and schools? .... ______
   c. developing strategies to implement earthquake education in the school system? .... ______
   d. understanding the benefits of earthquake education to the schools? .... ______
   e. formulating ways to disseminate earthquake education materials? .... ______
   f. identifying currently available earthquake education materials .... ______

2. Did the conference benefit you or your organization by:
   a. providing new sources of information and expertise you might want to utilize in the future? .... ______
   b. establishing a better understanding of the issues involved in earthquake education? .... ______

3. Did you find the following activities/materials useful:
   a formal presentations? .... ______
   b. implementation panel? .... ______
   c. workshops? .... ______
   d. displays of materials and posters? .... ______
   e. tours of Seismic Simulator lab? .... ______
   f. demonstration of "Quakeline?" .... ______
   g. informal discussion during breaks, lunches, after hours? .... ______
   h. preliminary proceedings? .... ______
   i. handouts? .... ______

4. Prior to this conference, I would rate my awareness of earthquake education and the need for its inclusion in the schools as .... ______

5. Prior to this conference, I would rate my concern about earthquake education and its inclusion in the schools as .... ______

6. I now rate my awareness as .... ______

7. I now rate my concern as .... ______

8. Should future workshops be planned to continue the work initiated at this meeting? .... ______

COMMENTS:

DISASTER PREPAREDNESS--THE PLACE OF EARTHQUAKE EDUCATION IN OUR SCHOOLS
July 9-11, 1989

EVALUATIONS OF THE CONFERENCE BY PERCENTAGES OF RESPONDENTS
No. of evaluations received: 33

		Low 1 & 2	3	High 4 & 5
1. Did you find the conference to be useful for:	*			
a. defining the need for earthquake education?	(33)	3%	9%	88%
b. understanding the impact of earthquakes on children and schools?	(33)	6%	12%	82%
c. developing strategies to implement earthquake education in the school system?	(32)	9%	22%	69%
d. understanding the benefits of earthquake education to the schools?	(33)	3%	9%	88%
e. formulating ways to disseminate earthquake education materials?	(32)	3%	25%	72%
f. identifying currently available earthquake education materials?	(33)	3%	6%	91%
2. Did the conference benefit you or your organization by:				
a. providing new sources of information and expertise you might want to utilize in the future?	(33)	-	9%	91%
b. establishing a better understanding of the issues involved in earthquake education?	(33)	-	15%	85%
3. Did you find the following activities/materials useful:				
a. formal presentations?	(32)	3%	6%	91%
b. implementation panel?	(26)	12%	15%	73%
c. workshops?	(31)	6%	10%	84%
d. displays of materials and posters?	(32)	15%	38%	47%
e. tours of Seismic Simulator lab?	(29)	4%	41%	55%
f. demonstration of "Quakeline?"	(22)	19%	36%	45%
g. informal discussion during breaks, lunches, after hours?	(33)	-	3%	97%
h. preliminary proceedings?	(30)	-	13%	87%
i. handouts?	(32)	-	16%	84%
4. Prior to this conference, I would rate my <u>awareness</u> of earthquake education and the need for its inclusion in the schools as	(33)	9%	18%	73%
5. Prior to this conference, I would rate my <u>concern</u> about earthquake education and its inclusion in the schools as	(33)	6%	15%	79%
6. I now rate my awareness as	(33)	-	-	100%
7. I now rate my concern as	(33)	-	-	100%
8. Should future workshops be planned to continue the work initiated at this meeting?	(33)	-	-	100%

*Number of responses for each question listed in parentheses; percentages for each question are based on the number of respondents to that question.

NATIONAL CENTER FOR EARTHQUAKE ENGINEERING RESEARCH
LIST OF PUBLISHED TECHNICAL REPORTS

The National Center for Earthquake Engineering Research (NCEER) publishes technical reports on a variety of subjects related to earthquake engineering written by authors funded through NCEER. These reports are available from both NCEER's Publications Department and the National Technical Information Service (NTIS). Requests for reports should be directed to the Publications Department, National Center for Earthquake Engineering Research, State University of New York at Buffalo, Red Jacket Quadrangle, Buffalo, New York 14261. Reports can also be requested through NTIS, 5285 Port Royal Road, Springfield, Virginia 22161. NTIS accession numbers are shown in parenthesis, if available.

NCEER-87-0001 "First-Year Program in Research, Education and Technology Transfer," 3/5/87, (PB88-134275/AS).

NCEER-87-0002 "Experimental Evaluation of Instantaneous Optimal Algorithms for Structural Control," by R.C. Lin, T.T. Soong and A.M. Reinhorn, 4/20/87, (PB88-134341/AS).

NCEER-87-0003 "Experimentation Using the Earthquake Simulation Facilities at University at Buffalo," by A.M. Reinhorn and R.L. Ketter, to be published.

NCEER-87-0004 "The System Characteristics and Performance of a Shaking Table," by J.S. Hwang, K.C. Chang and G.C. Lee, 6/1/87, (PB88-134259/AS). This report is available only through NTIS (see address given above).

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