Impact of an Earthquake - Learning from Experience

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My interest in seismic safety is based on personal experience with earthquakes which have effected schools in California from 1978 to the present. The majority of information is based on the Santa Barbara Earthquake of 1978, and its effect on the University of California at Santa Barbara. Since the 1978 earthquake, I have also studied the Whittier/Narrows Earthquake in 1987 and its effects on the California State University in Los Angeles, and the 1989 Loma Prieta Earthquake and its effects on the University of California at Santa Cruz.

There are many things that can be done before an earthquake occurs that will reduce the chances of injury and property damage. It sounds simple enough. We had heard these words spoken over and over again, but unfortunately, in most cases, one must experience a disaster before the meaning sets in and action occurs. Earthquake preparation takes time, money and most of all, commitment. With tighter budgets and competing demands for the dollars spent in education, it will take a strong commitment on the part of school administrators to accomplish the goals of earthquake preparedness.

The University of California at Santa Barbara is located on the coast of California, approximately 100 miles north of Los Angeles, and has a population of 25,000 students, faculty and staff. Prior to the 1978 earthquake, the major buildings on campus were evaluated structurally for seismic integrity and rated from very poor to good. Although all of the buildings were built according to the Uniform Building Code in effect at the time of construction, two buildings were rated very poor, eight buildings were rated poor, and 37 buildings were rated fair to good. These ratings were based on brief observations of blueprints, a cursory look at the exterior of most buildings, and a judgmental opinion regarding the seismic performance of each building.

In 1978, I was working as a Safety Engineer in the Office of Environmental Health and Safety at the University of California in Santa Barbara. As a member of the safety staff, I was directly involved in the documentation and evaluation of the damage resulting from the 1978 earthquake.

The earthquake occurred on August 13, 1978, a Sunday afternoon, at 3:57 p.m. The Richter magnitude was 5.7 and the shaking lasted approximately 20 seconds. The timing of the earthquake was fortunate. Since school was not in session, very few people were on campus. Most offices were closed and the campus was virtually deserted. There were no serious injuries to anyone on campus, but the overall structural damage amounted to more than four million dollars. There is no doubt that had the University been in session at the time of the quake, numerous injuries and possible fatalities would have occurred.

The earthquake caused the derailment of a train north of the campus, damaged the main roadway overpass to the campus, and started a fire in a mobile home park. This left only the on-campus county fire engine to respond to emergencies on campus. As a result of the shaking, several fire alarms and security alarms went off immediately. The electrical power surged on and off and then went off for several hours. Major non-structural damage occurred throughout the campus. The following is a summary of the damage:

1. An eight inch water main broke.
2. Chemicals were thrown off of shelves in science buildings.
3. Compressed gas cylinders broke away from their supports.
4. Several research monkeys and rats were set free.
5. Light fixtures came loose and fell to the floor.
6. Ceiling tiles, and in some areas, entire suspended ceilings, collapsed.
7. Over 500 bookcases and vertical files fell over.
8. Plumbing leaks were numerous.
9. Windows shattered throughout campus.
10. Eighteen elevators were damaged.
11. Roads, walkways and bikeways were cracked.
12. Card catalogs in the library flipped over.
13. Heavy glass doors came off their hinges.
14. Several office doors were blocked by falling bookcases.
15. Television sets fell to the floor in the Student Health Center.
16. Tiles fell from the roofs of the buildings.
17. Ventilation systems and cooling systems on the roofs of many buildings were severely damaged.
18. Moderate structural damage occurred including cracked shear walls.
19. Seismic joints were damaged.
20. More than 280,000 books fell from library shelves.

The damage that occurred at Santa Barbara was, in varying degrees, similar to what I observed in Los Angeles in 1987 and Santa Cruz in 1989. Much of the non-structural damage, which is common in moderate to severe earthquakes, could have been reduced and in some cases eliminated with a very small expenditure of time and money.

After the 1978 earthquake, the University adopted a policy for Seismic Hazard Reduction that requires the securing of bookcases and cabinets over 42 inches in height (attachment 1). The Southern California Earthquake Preparedness Project (SCEPP) has developed a *Check List of Non-Structural Earthquake Hazards* which has been useful in providing guidelines for identifying non-structural hazards.

Other lessons learned were:

1. While it is important to evaluate the structural integrity of school buildings according to the latest information available, the buildings should not be given a verbal rating such as poor or satisfactory, but should be prioritized for seismic correction based on a review of their predicted performance in a creditable earthquake.
2. Administrative support and involvement from the highest level is necessary to create an effective seismic program
3. Non-structural damage can be significantly reduced by simple attachments and code compliance.
4. An Emergency Operations Plan stressing lines of communication should be written in a simple checklist format.
5. All planning should include coordination with local emergency response organizations such as police and fire departments and the local Red Cross.
6. Mutual aid agreements should be clear and in writing.
7. Control of information is critical, especially to the news media. Accuracy is essential and rumors and speculation should be avoided.
8. A policy on the retention of students in elementary schools is a mandatory part of disaster planning and should be thoroughly communicated to parents.

9. Staff and faculty should be aware of their responsibilities as State Disaster Service Workers in a declared emergency.
10. A system of identification of critical personnel, such as a picture I.D. card, should be developed.

The written word for CRISIS in Chinese combines two characters, one signaling danger and the other opportunity. We are fortunate to have the opportunity to learn from recent seismic events. It now takes a personal commitment from all of us to put this experience into actions that will reduce the suffering in the next disaster.

References

Degenkolb Associates. (1981) Seismic Hazard Survey University of California Buildings.

Steinmetz, W. H. (1979). Earthquake! How One Campus Survived. Risk Management.

Felszeghy, S. F., & Miller, R. K. Engineering Features of the Santa Barbara Earthquake of August 13, 1978.

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Attachment 1

Policy P-5512
February 1, 1985

POLICY ON SEISMIC HAZARD REDUCTION

I. **REFERENCES.**

University Policy Regarding Seismic Hazards, adopted 1975

II. **POLICY:**

Earthquakes are a source of continued concern on the University of California, Santa Barbara Campus. It is the policy of the University, to the maximum extent feasible by present engineering practices and funding, to provide reasonable levels of earthquake safety for its faculty, students, staff, and public. This policy includes the following program for abatement of immediate seismic hazards:

A. All appurtenances such as bookcases over 42 inches in height, wall cabinets, display cabinets, lockers, heavy and large laboratory equipment, and compressed gas cylinders shall be fastened to wall or floor in a manner to preclude their falling over in a moderate earthquake.

B. All lockers, cabinets, or any other fixtures permitted in corridors by the Fire Marshal must be firmly attached to prohibit their falling or breaking.

C. Shelving containing bottles of chemicals must have seismic retaining strips or devices installed.

D. Storage of large, heavy items must be maintained as low as possible. Heavy items that must be maintained at a level above 42 inches must be attached or restricted in such a manner as to preclude their falling in a moderate earthquake

E. All campus personnel shall have earthquake emergency training conducted periodically within their departments.

F. Overall responsibility for compliance and funding of this policy rests with department chairpersons and department heads. The Office of Environmental Health and Safety will act in an advisory capacity and assist as required.

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