Earthquakes and Schools

National Clearinghouse for Educational Facilities

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Earthquakes are low-probability, high-consequence events. Though they may occur only once in the life of a school, they can have devastating, irreversible consequences. Moderate earthquakes can cause serious damage to building contents and non-structural building systems, serious injury to students and staff, and disruption of building operations. Major earthquakes can cause catastrophic damage, including structural collapse and massive loss of life. Those responsible for school safety must understand and manage these risks, particularly risks that threaten the lives of students, teachers, and staff.[1]

Earthquake Basics

Is your school vulnerable to earthquakes? Here are the risk factors:

Likelihood of an earthquake. The Federal Emergency Management Agency designates each state as either a moderate, high, or extremely high risk for earthquakes. Go to the FEMA webpage Earthquake Risk by State and Territory to determine the category you are in. Then visit the U.S. Geological Service's webpage U.S. Earthquake Information by State for more specific seismic information.

Soil. Some soils "liquefy" during an earthquake and lose their ability to support structures built on them. Some soils amplify the earth's shaking more than others. If you don't have good information about the soils under your school, talk to a soils specialist.

Construction. Some building materials and construction methods are better than others at withstanding the shaking motions of an earthquake. Wood and steel tend to flex and bend more than masonry and concrete; high buildings sway more than low ones. But these are generalities, and only a structural engineer can determine your school's earthquake resistance.

[1] From the introduction to FEMA 395, *Incremental Seismic Rehabilitation of School Buildings (K-12)*, page vi.

Cascading hazards. Earthquakes can cause landslides, dam breaches, gas line breaks, and fires. Discuss your school's vulnerability to such hazards with local emergency management officials.

Nonstructural building hazards. Wall- or ceiling-hung television monitors, bookcases, cabinets, lighting fixtures, water heaters, and other objects can fall during an earthquake. These are risks your school can minimize at a relatively low cost.

Preparing for an Earthquake[2]

Earthquake injuries and damage can be reduced or avoided entirely if appropriate measures are taken:

1. Consult with a qualified engineering firm to determine if your school meets current structural safety standards.

2. Prepare and regularly update earthquake plans. Integrate them into your school's crisis planning and hazard mitigation process; see the U.S. Department of Education's Office of Safe and Drug-Free Schools publication, *Practical Information on Crisis Planning: A Guide for Schools and Communities*, and the National Clearinghouse for Educational Facilities' publication, *Mitigating Hazards in School Facilities*.

3. Determine and post primary and alternate routes for emergency evacuation of the school. Establish procedures for those needing evacuation assistance.

4. Hold periodic drills and exercises. Institute ongoing training programs in emergency procedures, first aid, CPR, evacuation, search and rescue, use of fire extinguishers, and damage assessment.

5. Conduct "hazard hunts" to find nonstructural hazards in offices, classrooms, storerooms, laboratories, and other areas.

6. Include articles on earthquake safety in school newsletters and parent handouts.

[2] Adapted from California's Department of Emergency Services' School Planning Guide.

7. Develop an inventory of critical supplies and equipment. Assemble emergency kits with first aid supplies, radios, flashlights, batteries, heavy gloves, etc. Maintain these kits in several accessible and secure locations. (Do not, however, stockpile long term emergency supplies – they can use up valuable storage space for years and then be useless when needed; see Appendix C.)

Reducing Nonstructural Hazards

The best guidance for securing school building components, furnishings, and equipment from falling during an earthquake is contained in the *Guide and Checklist for Nonstructural Earthquake Hazards in California Schools*. This comprehensive, illustrated online source covers:

Ceiling and overhead items. Light fixtures (hanging and pendant), recessed light fixtures in suspended ceilings; recessed HVAC registers in suspended ceilings; lay-in tiles in suspended ceilings; hanging displays and plants; suspended space heaters and air conditioning units; decorative ceilings and latticework; conduits and piping; ductwork; exterior soffits; tile roofing; unreinforced masonry chimneys;

Walls and wall-mounted items. Free-standing and cubicle partitions; shelving; wall-mounted cabinets, lockers, and coat closets; wall-mounted television monitors and speakers; unsecured ceiling-height walls; entry glass.

Furniture and equipment. File cabinets; bookcases; desktop and countertop equipment; equipment on carts; display cases, art objects, and potted plants; aquariums; equipment on wheels and rollers (pianos, whiteboards); office equipment; vending machines; shop and gym equipment; gas cylinders; gas piping; storage racks; electrical equipment (cabinets, switchgear, and transformers); mechanical equipment (chillers, fans); Kitchen equipment (ovens, range hoods, refrigerators and freezers, dishwashers).

Additional information is available from FEMA 74, *Reducing the Risks of Nonstructural Earthquake Damage, A Practical Guide*.

Also see Appendix A, *Reducing Nonstructural Hazards in Schools*, below.

Seismic Upgrading

Seismic upgrading begins with a thorough evaluation of your school facilities. If they do not meet current seismic safety standards, measures should be taken to either upgrade or replace them.

If upgrading is considered, the least disruptive and often the most economical approach is ***incremental seismic rehabilitation***, which divides the work into a series of smaller upgrade projects that can be implemented to coincide with regularly scheduled repair, maintenance, and capital improvement work. The upgrades often can be completed during school vacations or over the traditional 10-week summer break. FEMA 395, *Incremental Seismic Rehabilitation of School Buildings (K-12)*, addresses this upgrading process in three parts:

- *Part A*, "Critical Decisions for Earthquake Safety in Schools," is written for superintendents, board members, business managers, principals, and other policy makers.

- *Part B*, "Managing the Process for Earthquake Risk Reduction in Existing School Buildings," is written for school district facility managers, risk mangers, and financial managers.

- *Part C*, "Tools for Implementing Incremental Seismic Rehabilitation in School Buildings," is written for those responsible for implementing the upgrading process.

To gain a better understanding of building seismic safety concepts and issues, see FEMA 424, *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, Chapter 4, "Making Schools Safe Against Earthquakes." FEMA provides a free, online Seismic Rehabilitation Cost Estimator to help determine the cost of upgrading your school to current code requirements.

Mitigation and Preparedness Checklist[3]

Use the following checklist to determine how prepared your school is for earthquakes and to identify additional preparation that may be needed:

[3] Adapted from Earthquake Preparedness and Checklist for Schools. Used with permission from John A. Martin & Associates, Inc., and based on California's Department of Emergency Services' *School Planning Guide*.

1. Does your school have a disaster plan, and is your staff aware of their roles and responsibilities under the plan? Do they realize they may be responsible for students for up to 72 hours after a disaster occurs? (In California, teachers are considered disaster service workers; during school hours their initial responsibility is to the school. Determine if your school operates under similar requirements and train staff accordingly.

3. Does staff know the location of the main gas, electricity and water shut-off valves? Who has been instructed to turn them off if the need arises?

4. Have you prepared and distributed to all staff members a map of the school and its grounds that includes basic evacuation procedures and potential earthquake hazards to avoid? Does it include the locations and availability of emergency kits?

5. What nonstructural hazard mitigation measures have been completed at your school?

6. Have inventories been made of hazardous chemicals in areas such as the science building and maintenance shops? Has anyone been appointed to check on these chemicals after an earthquake?

7. Does the school have arrangements with structural engineers or local contractors who will report to the school directly after a disaster to help determine the extent of damage and whether or not to close the school?

8. Do you know if your school has been designated as a potential mass care shelter? If so, see Appendix C.

9. Does your school have a back-up communications system to communicate with local emergency services? What will you do if cell phone service is unavailable?

10. Is there an earthquake preparedness program in your curriculum? Is it inclusive of special needs students? How is it communicated to students, staff, parents, and caregivers, including those whose primary language is not English?[4]

11. How and where are you storing vital data and records? Do you have back-ups of important information stored in off-site locations?

[4] Refer to Appendix 3, Earthquake Considerations for Special Needs Students, in Arkansas' *School Preparedness Guidebook*

12. What will be your plan for conducting classes if some school facilities are damaged? Half-day sessions, alternative sites, portable classrooms?

13. Has a central "command post" or location been identified for managing emergency response activities after a disaster?

14. Do classroom teachers have basic operating procedures to follow such as:

- Knowing how to implement the basic "duck and cover" actions when an earthquake begins?
- Having a file handy that contains a roll sheet, special medical information, and student release information?
- Knowing when to evacuate and when to remain in the classroom after an earthquake?
- Knowing how to administer first aid to the injured and comfort those who are in shock, frightened, or hysterical?
- If an evacuation is necessary, knowing what to do with the injured?
- Knowing the check-out procedures to be taken before a student is released to an adult?
- Working in a "buddy system" with another teacher and class, so that if one teacher is injured the other can take care of the students and get them to safety?

15. What are your immediate damage assessment procedures?

16. Who has been designated for search and rescue, and have they received training?

Appendices

A Reducing Nonstructural Hazards in Schools
B An Overview of Earthquake Damage to U.S. Schools
C The School as Earthquake Shelter

Resources

Federal Emergency Management Agency (FEMA) and United States Geological Survey (USGS):

FEMA Earthquake Risk by State and Territory (online)
http://www.fema.gov/hazard/earthquake/risk.shtm

USGS online: U.S. Earthquake Information by State,
http://earthquake.usgs.gov/regional/states

FEMA 395, *Incremental Seismic Rehabilitation of School Buildings (K-12) : Providing Protection to People and Buildings (June 2003),*
http://www.fema.gov/library/viewRecord.do?id=1980

FEMA 424, *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, (January 2004),
http://www.fema.gov/plan/prevent/rms/rmsp424.shtm

FEMA Seismic Rehabilitation Cost Estimator (online),
http://www.fema.gov/srce/index.jsp

FEMA and USGS earthquake teaching resources:
http://fema.gov/plan/prevent/earthquake/schools.htm and
http://earthquake.usgs.gov/learning/kids

State of California:

School Planning Guide (no date),
http://www.johnmartin.com/earthquakes/EQGUIDES/eqgui_1101.htm

Guide and Checklist for Nonstructural Hazards in California Schools (no date),
http://www.documents.dgs.ca.gov/dsa/pubs/SB1122.pdf

Earthquake Preparedness for Schools (no date),
http://www.johnmartin.com/earthquakes/EQGUIDES/eqgui_4301.htm

State of Arkansas;

School Earthquake Preparedness Guidebook (no date),
http://quake.ualr.edu/schools/guide

U.S. Department of Education, Office of Safe and Drug-Free Schools:

Practical Information on Crisis Planning: A Guide for Schools and Communities,
http://www.ed.gov/admins/lead/safety/emergencyplan/crisisplanning.pdf

National Clearinghouse for Educational Facilities (NCEF):

Mitigating Hazards in School Facilities. Includes assessment, planning, and funding techniques, and links to 25 NCEF Assessment Guides,
http://www.edfacilities.org/pubs/mitigating_hazards.pdf

NCEF Safe School Facilities Checklist,
http://www.edfacilities.org/checklist/index.cfm

NCEF resource list, *Disaster Preparedness and Response for Schools and Universities*,
http://www.edfacilities.org/rl/disaster.cfm

NCEF resource list, *School Preparedness for Natural Disasters,* http://www.edfacilities.org/rl/natural_disasters.cfm

NCEF resource list, *State and Local School Emergency Planning Guides*,
http://www.edfacilities.org/rl/statelocal_emergency.cfm

Appendix A
Reducing Nonstructural Hazards in Schools[5]

Equipment and Furnishings

1. Are desktop computers secured?

2. Are the tops of tall (4- or 5-drawer) file cabinets secured to the wall?

3. Do file cabinet drawers have latches?

4. Are large and heavy office machines restrained and located where they will not slide a few inches, fall off counters or block exits?

5. Are wall-mounted objects over 5 lbs. connected to structural framing?

6. Are tall cabinets, bookshelves, coat closets attached to the wall or attached to each other?

7. Are desks or tables located such that they will not slide and block exits?

[5] Adapted from *Identification and Reduction of Nonstructural Earth Hazards in California Schools* by the Bay Area Regional Earthquake Preparedness Project and Office of the State Architect, Structural Safety Section, February, 1990. Available online on the John A. Martin & Associates website.

8. Are tall storage racks cross-braced in both directions or, for racks significantly taller than wide, are there large anchor bolts connected to the concrete slab?

9. Are heavy or sharp wall decorations securely mounted, with closed eye-hooks, for example?

10. Are valuable, fragile art objects or trophies protected against tipping over, breaking glass or sliding off shelves or pedestals?

11. Are refrigerators or ranges restrained by built-in kitchen cabinetry or attachments to floor or wall?

12. Is floor-supported freestanding shop equipment secured against overturning or sliding?

13. Are fire extinguishers securely mounted?

14. Are potted plants or heavy items on top of file cabinets or other high locations restrained?

15. Are display cases or aquariums protected against overturning or sliding off tables?
16. Are weight room equipment and racks anchored and weights properly stored? (provide secured racks)

17. Is freestanding equipment on wheels locked against rolling?

Hazardous Materials

1. Are compressed gas cylinders secured top and bottom with a safety chain?

2. Are laboratory chemicals on shelves restrained?

3. Are gas tank legs anchored to a concrete footing or slab?

4. Are containers of hazardous materials stored on braced storage racks or tall stacks? (provide secured storage)

5. Do gas pipes have flexible connections? (provide flexible connections)

Overhead Elements

1. Does the suspended ceiling have diagonal bracing wires?

2. Are the fluorescent light fixtures merely resting on the hung ceiling grid, without another support?

3. Do pendant mounted light fixtures or chandeliers have safety cables?

4. Will hanging light fixtures swing freely, not hitting each other if allowed to swing 45 degrees minimum?

5. Are decorative ceiling panels or latticework securely attached?

6. Will spotlights remain securely attached if shaken?

7. Are sound system speakers in elevated locations anchored to structure?

8. Are suspended space heaters, especially gas-fired, braced and/or have flexible gas connections?

9. Do hanging plants, mobiles, or displays have closed eye-hooks, and can they swing freely 45 degrees?

10. Could chandeliers swing freely, not hitting each other, or windows, roof trusses, or walls?

11. Are air distribution grills or diffusers securely mounted?

12. Do large metal air distribution ducts, especially those suspended a few feet, have diagonal bracing?

13. Have heavy objects been removed from the tops of shelves? For 5 & 6 year olds, overhead objects are only 3 feet off the floor.

Electrical Equipment

1. Are fluorescent light bulbs and lenses fastened securely?

2. Are emergency battery-powered lights fastened securely on shelves?

3. Is essential communications equipment secured?

Mechanical Equipment

1. Are the water heaters restrained?

2. Is the furnace or boiler restrained?

3. Are there masonry incinerator chimneys on the school site that have not been reinforced?

4. Are large diameter pipes braced or do pipes that cross expansion joints have accommodation for movement?

5. Are fans, chillers, pumps, or other heating-ventilating-air conditioning equipment--typically found in mechanical rooms--restrained or mounted correctly?

6. Do the fire sprinkler risers have a v-brace to the wall, and do the large diameter sprinkler pipes have diagonal braces to the structure above?

Prepared under a grant from the U.S. Department of Education, Office of Safe and Drug-Free Schools

Partitions

1. Are freestanding, movable, partial-height partitions--especially if supporting bookshelves--adequately braced?

2. Have all unreinforced masonry partitions, usually brick or hollow tile walls in pre-1933 buildings, been removed?

3. Are light-weight drywall partitions that extend as high as the hung ceiling braced or supported by the structure above, particularly if these partitions are used as lateral support for tall shelving or cabinets?

4. Are the clear panels in partitions made of plastic or safety glass? (replace with shatter-proof material or apply shatter-resistant film)

Windows

1. Are the large panes made of safety glass, and is it known if the mounting of the panes was designed by an architect/engineer to accommodate expected seismic distortion of the surrounding structure?

2. Are transoms (glass panes over doors) of safety glass?

Exteriors

1. Are decorations or appendages adequately attached?

2. Are statuary or decorative objects anchored?

3. Are tall backboards or fences supported by pressure-treated wood posts or galvanized metal posts?

4. Are fences made of concrete, concrete block, stone or brick, adequately reinforced to resist earthquakes?

5. If large trees are leaning or in poor health are they supported?

6. Is signage adequately secured, especially if heavy?

Appendix B
An Overview of Earthquake Damage to U.S. Schools[6]

California and the Field Act

Most information on earthquake damage to schools comes from California. Its high incidence of earthquake activity has also resulted in sophisticated seismic building codes for all buildings and special plan checking and inspection requirements, enforced by the state, for school buildings.

Considering the number of significant earthquakes in California since the early years of the 20th century, there has been remarkably little severe structural damage to schools, except in the Long Beach earthquake of 1933, and there have been very few casualties. In California, no school child has been killed or seriously injured since 1933. *This good fortune has been primarily because all major California earthquakes since 1925 have occurred outside school hours*.

In the Long Beach earthquake that occurred at 5:55 p.m. on March 10, 1933, damage to unreinforced masonry school buildings was so severe that *there would have been many casualties had they been occupied*. As a result, the state passed the Field Act within a month of the earthquake.

The Field Act required that all public school buildings be designed by a California licensed architect or structural engineer; all plans were to be checked by the then Department of General Services and construction was to be continuously inspected by qualified independent inspectors retained by the local school board. The Department of General Services set up a special division, staffed by structural engineers, to administer the provisions of the Act. The Field Act, which is still enforced today, has greatly reduced structural damage to California schools.

The earthquake also resulted in the passage of the Riley Act, which governed all buildings, with a few exceptions. The Riley Act required all buildings in the state to be designed to a specified lateral force, and effectively outlawed unreinforced masonry construction.

In 1952, a series of earthquakes occurred in Kern County, in the Bakersfield region, some 70 miles north of Los Angeles. Two groups of earthquakes occurred; the first, in the last week of July, included one with a magnitude of 7.6 on the Richter scale. The second group occurred in late August, and one earthquake, near the city of Bakersfield, had a magnitude of 5.9 on the Richter scale. There were 10 deaths in the July earthquake and 2 in the August earthquake.

This earthquake was of particular interest because the incidence of school damage might represent that of comparable earthquakes striking in regions today where seismic codes have not been adopted and enforced due to the rarity of seismic events.

There were no casualties in schools in 1952, because *these earthquakes also occurred outside school hours*. At that time, the Field Act had been in force for nearly 20 years, and the newer schools had been constructed to conform to its requirements. Of the 58 masonry schools in the region, 18 had been constructed after the Field Act. Of these, one suffered moderate damage; this school was constructed of grouted

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[6] Excerpted from Sections 4.3.2, 4.3.3, and 4.3.4 of FEMA 424, *Design Guide for School Safety Against Earthquakes, Floods, and High Winds*,. http://www.fema.gov/plan/prevent/rms/rmsp424.shtm.

reinforced brick masonry and incurred approximately 1 percent damage. Of the 40 non-Field Act schools, 1 collapsed, 15 suffered severe damage, and 14 suffered moderate damage. In the Bakersfield City School District, 175 classrooms and 6,500 students were displaced and only about 10 classrooms could quickly be put back in service. There was considerable nonstructural damage to ceilings and light fixtures.

In other states, similar damage to unreinforced masonry (URM) and early reinforced concrete structures occurred. Considerable damage to schools occurred in Helena, Montana, in 1935. In 1949, severe damage was inflicted on several URM schools, resulting in one fatality, in Seattle. At Puyallup High School, three boys on the stage just managed to escape when the roof collapsed. Widespread damage to furniture and contents also occurred.

Significant School Damage in Recent U.S. Earthquake

In the Anchorage, Alaska, earthquake of 1964, which registered 8.4 on the Richter scale, a number of public schools were damaged, but there were no collapses. The earthquake occurred on Good Friday at 5:36 p.m., when the schools were unoccupied. The most seriously damaged school was subsequently demolished. At the West Anchorage High School, a two-story nonductile concrete frame and shear wall classroom wing suffered severe structural damage and near total failure in a number of columns. Structural distortion also created a number of severe glass breakages. The second floor was removed during reconstruction and the first floor was repaired and retained.

In the San Fernando earthquake of 1971, there were no injuries and no schools collapsed; however, the earthquake caused $13.2 million in damages (in 1971 dollars), and 100 pre-Field Act schools were demolished within 1 ½ years after the earthquake.

A survey of 1,544 public school buildings showed that only three schools sustained severe damage as a result of the Loma Prieta (San Francisco Bay area) earthquake of 1989. A portable classroom near Santa Cruz was rocked off its unbraced and unanchored supports. An elementary school in Los Gatos was subjected to severe shaking, but damage was limited to nonstructural and contents shifting, except in one classroom wing, where ground heaving raised and cracked the floor slab, jamming a door and window shut.

A San Francisco High School suffered severe structural cracking. This school was constructed in 1920 as an automobile manufacturing building and was structurally upgraded in 1947. Restoration costs were estimated at $10 million. Total restorations for the San Francisco school district were estimated to be $30 million; for Oakland, the district losses were $1.5 million. Though undamaged, an elementary school in San Francisco was closed because of the potential collapse of a nearby elevated freeway structure, which was considered a hazard to the building and its occupants. Hazards from unbraced and unanchored nonstructural items were evident in many buildings, including pendant-mounted light fixtures, suspended acoustical ceilings, and unanchored furniture and contents such as filing cabinets and shelving.

In the Northridge, California, earthquake of 1994, state inspectors red-tagged 24 school buildings and yellow-tagged 82 school buildings, although this was later considered over-conservative. No structural elements collapsed. There was, however, considerable nonstructural damage that was costly to repair, resulting in the closure of a number of schools and, if the schools had been in session, would have caused casualties. The Field Act focused on structural design and construction, and only recently were nonstructural elements included in the scope of the Act.

Consequences: Casualties, Financial Loss, and Operational Disruption

Casualties in California schools have been few and minor, primarily due to regulation by the Field Act and to chance. *Significant Alaskan and California earthquakes, from Santa Barbara (1925) to Northridge (1984) have all occurred outside of school hours*: therefore, the effects of a major earthquake when schools are fully occupied have not been experienced. In other regions, casualties have been few; in the Seattle earthquake of 1949, two school children died in Tacoma when bricks cascaded onto exit ways. The closure of Seattle schools for spring vacation had averted fatalities and serious injuries in similar building failures at a number of sites in the city.

The impact of school closure as a result of damage is the loss of public service and severe disruption for students, faculty, and staff. Ultimately, the taxpayer will pay the costs, but this is spread over the whole community, the state, and the Federal Government. Typically, schools are self-insured and do not purchase insurance on the private market. For a private school, closure means a serious loss of revenue; in addition to the costs of repair, the students may not return if the school is closed for a long period of time. Therefore, obtaining insurance may be a prudent measure.

As with any of the natural hazards, an earthquake can close a school, keeping the school district from doing its main job (i.e., teaching students). The length of the closure will depend on the severity and types of damage. It may also depend on whether the building was fully insured or whether disaster assistance will be available quickly enough to allow speedy repairs and reconstruction. Sometimes repairs are put on hold, pending a decision on whether the building should be repaired or condemned. There are also social and psychological factors, such as difficulties imposed on students, parents, faculty, staff, and the administration during the time the school is not usable.

Appendix C
The School as Earthquake Shelter[7]

It is common in earthquake-prone regions for school sites to provide the first kind of immediate shelter. There are several good reasons for this. First, schools are conveniently located in every community, with easy and known access to the local population that they serve. Second, schools have suitable space (e.g., gymnasiums or multiuse rooms) where large numbers of people can be accommodated for a few days. Food services are often available and there is ample space for assembly, processing, and delivery of goods and equipment. Third, because schools are public property, the financial costs of making use of the facilities for a few weeks are minimal, and arrangements can be worked out in advance. Finally, particularly in California, where schools are subject to the Field Act, schools are well constructed and probably among the most likely of all the community's buildings to survive intact and in a usable condition.

The only problem that has been encountered is that of ensuring that the time of use is limited; no school district wishes for its schools to be used as shelters for weeks, unless it is during the summer break. However, improvisation can generally ensure that some semblance of a normal school teaching program can be reinstated within a day or so of a moderate event.

No specific design decisions are necessary for this use, *nor is it necessary to stockpile emergency supplies, because they could use up valuable storage space for years and then be useless if needed. The exact circumstances of the event and the number and types of people to be accommodated will determine the supplies that are necessary. Experience has shown that local and even regional manufacturers and suppliers are very effective in providing services after an event.* Following the Coalinga 1983 earthquake, temporary shelter was provided in the high school gymnasium. A regional beer canning plant substituted drinking water for beer for a few shifts and rapidly delivered the chilled cans to the site.

However, pre-event planning should be undertaken between the school district and the local emergency services agency to anticipate key issues that will need quick solutions if an event occurs. This includes determining what spaces will be available and how many people can be accommodated, signing a pre-contract with a local engineer or architect for immediate post-earthquake inspection to determine safety, looking at strategies for continued operation in the event some spaces are occupied by refugees, and the possible provision of food and sanitary supplies by the district.

[7] Excerpted from Section 4.7 of FEMA 424, *Design Guide for School Safety Against Earthquakes, Floods, and High Winds*, http://www.fema.gov/plan/prevent/rms/rmsp424.shtm.