



ATC-20 (CONDENSED)

- ❑ Post Earthquake Safety Evaluation of Buildings
 - ❑ Condensed Guide for Emergency Service Workers (LAUSD Employees)**
 - ❑ Aid for evaluations****

PRINCIPAL SAFETY CONCERNS

- ☐ **Collapse**
- ☐ **Falling hazards**
- ☐ **Other hazards**

After an earthquake, there are three main safety concerns for damaged buildings:

- ☐ **The threat of overall or partial collapse due to loss of strength, stability, or stiffness of the structural frame or walls.**
- ☐ **The threat of nonstructural building elements, which are not part of the structural frame, becoming falling hazards; these might include loose bricks, light fixtures, or glazing.**
- ☐ **Other hazards: exit doors or stairs become unusable; chemicals and flammables could fall off shelves; broken gas pipes could create fire or fume hazards; broken electrical equipment could be a shock hazard; broken friable asbestos-containing materials could release asbestos.**

BASIC APPROACH

- ☐ **Right to inspect**
- ☐ **Observe expected and unexpected damage**
- ☐ **Assume that significant aftershocks will occur**
- ☐ **Judgment in assessing risk from damage**

Key concepts to remember during a safety evaluation:

- ☐ **You would be assigned the legal right as a building jurisdiction representative to make the inspection.**
- ☐ **You will look for expected and predictable damage, but because every earthquake and building is different, always look for unexpected damage.**
- ☐ **Assume that an aftershock with the energy of one Richter magnitude less than the main earthquake will occur, unless directed otherwise by local seismologists.**
- ☐ **You have experience in building construction that gives you judgment in assessing the risk from the observed damage.**

JUDGEMENT IN ASSESSING RISK FROM OBSERVED DAMAGE

- ❑ Amount of risk is not always proportional to amount of damage**
- ❑ Structural aspects of assessing risk from damage**
 - ❑ Redundancy**
 - ❑ Brittleness and Ductility**

There are two main considerations about judgment in assessing risk from damage:

- ❑ Damage in the sense of economic loss does not always correlate with risk. Some damage, such as a badly cracked slab-on-grade, may be a large economic loss but relatively risk-free. Other damage, such as loose parapet bricks over main building entrances, is a small economic loss but a great risk.**
- ❑ Much of this presentation is about the structural aspects of assessing risk from damage. Later in the presentation, the concepts of redundancy and of brittleness and ductility in structural systems will be addressed.**



POSTING SYSTEM

- ❑ **INSPECTED** (Green): Appears safe for lawful occupancy
- ❑ **LIMITED ENTRY/RESTRICTED USE** (Yellow): Some restriction on use, controlled by building owner/manager
- ❑ **UNSAFE** (Red): Entry controlled by jurisdiction

POSTING SYSTEM CONTINUED

- ❑ A system has evolved over the years that offers a standard method for posting buildings according to the extent of damage they received during an earthquake.
- ❑ The posting system uses three levels of color-coded placards:
 - Inspected – Green
 - Limited Entry (Restricted Use) – Yellow
 - Unsafe – Red
- ❑ The first level is called Inspected rather than safe because the inspection that can be made may be minimal. Inspected means that the building appears to be safe for lawful occupancy and use. A green placard is posted.
- ❑ Limited Entry (Restricted Use) means that some type of restricted use is appropriate for the building, and that this restricted use is controlled by the building owner or manager. The Limited Entry (Restricted Use) posting has been found to be difficult to manage, but it is a necessary option. A yellow placard is posted.
- ❑ Unsafe means the building is quite damaged. Entry to an unsafe building is not allowed. Any exception for entry is controlled by the building jurisdiction, not the owner or manager. A red placard is posted.
- ❑ At present, there are two versions of the posting placards. The old version is found in the ATC-20 and ATC-20-1 documents. The new version is found in the ATC-20-2 document. Both versions are widely used.

"GREEN TAG"



INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

☐

Inspected Exterior Only

☐

Inspected Exterior and Interior

Report any unsafe condition of the L.A.U.S.D. Inspection Dept; reinspection may be required

Inspector comments:

Facility Name and Address:

Date: _____

Time: _____

CAUTION: Aftershocks since inspection may increase damage and risk.

This facility was inspected under emergency conditions for:

LOS ANGELES UNIFIED SCHOOL DISTRICT

L.A.U.S.D. INSPECTOR:

INSPECTION DEPARTMENT

(213) 745-1530

**Do Not Remove, Alter, or Cover this Placard
Until Authorized by the L.A.U.S.D. Inspection Department**

The occupants will experience the earthquake and observe the damage, but they will not know the level of risk. They may evacuate the building and request an inspection. If you inspect this building, you will probably determine that, although it is damaged, it is not hazardous and can be posted Inspected. The building is a one-story wood-frame residence, and this damage to the brittle plaster sheathing is not a hazard for occupancy. With reassurances from the inspection team, the occupants may then move back into the building.



CRACK IN INTERIOR PLASTER

"YELLOW TAG"



LIMITED ENTRY

OFF LIMITS TO UNAUTHORIZED PERSONNEL

WARNING:

This structure has been damaged and its safety is questionable. Enter only at own risk. Aftershocks or other events may result in death or injury.

Date: _____

Time: _____

This facility was inspected under emergency conditions for:

LOS ANGELES UNIFIED SCHOOL DISTRICT

Restrictions on use:

- ☐ Entry for emergency purposes only
☐ Other

on the date and time noted.

L.A.U.S.D. INSPECTOR:

Facility Name and Address:

INSPECTION DEPARTMENT

(213) 745-1530

**Do Not Remove, Alter, or Cover this Placard
Until Authorized by the L.A.U.S.D. Inspection Department**



Some concrete wall buildings have significant interior structural shear walls at service cores or along central corridors. The spandrels above regularly-spaced doorways in these walls may crack. Try to determine whether cracked interior walls are structural shear walls or nonstructural partitions. As with the cracked spandrels of the previous slide, this cracking may create a falling hazard.



"RED TAG"



UNSAFE

DO NOT ENTER OR OCCUPY

WARNING:

This structure has been seriously damaged, safety is questionable, and it is unsafe to occupy. Entry, aftershocks, or other events may result in death or injury.

Comments:

Facility Name and Address:

Date: _____

Time: _____

This facility was inspected under emergency conditions for:

LOS ANGELES UNIFIED SCHOOL DISTRICT

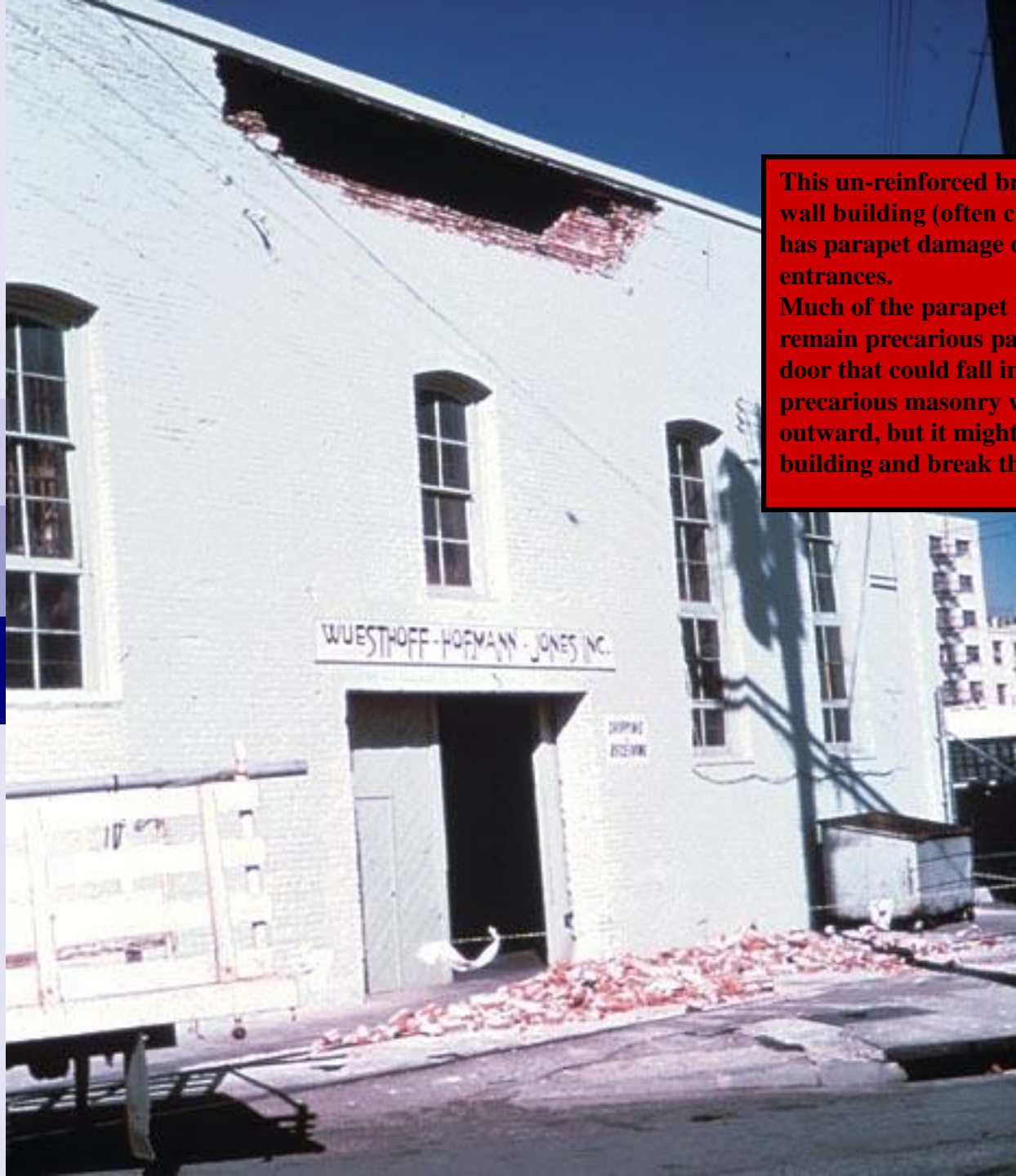
on the date and time noted.

L.A.U.S.D. INSPECTOR:

INSPECTION DEPARTMENT

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**Do Not Remove, Alter, or Cover this Placard
Until Authorized by the L.A.U.S.D. Inspection Department**



This un-reinforced brick masonry bearing wall building (often called “URM” building) has parapet damage over one of several entrances.

Much of the parapet has fallen, and there remain precarious parapet bricks above the door that could fall in an aftershock. This precarious masonry would most likely fall outward, but it might also fall into the building and break through the roof.



Here is an example of a non-ductile concrete-frame building deformed in an earthquake. You can see the widely spaced reinforcing at the cracked and spalled joints. This frame has lost most of its strength and could collapse in an aftershock.



CHANGING A POSTING

- ❑ **Correct oversight or mistake in judgment**
- ❑ **Significant aftershock**
- ❑ **Hired reevaluation and repair**

CHANGING A POSTING (CONTINUED)

Sometimes postings need to be changed to more or less restrictive usage

❑ Some examples of changes to a more restrictive posting are:

- ❑ Previously unobserved damage has been found, or the jurisdiction believes that a reevaluation by a more experienced team is warranted.**
- ❑ Aftershocks have significantly worsened the condition of the building.**

❑ Some examples of changes to a less restrictive posting are:

- ❑ The jurisdiction may allow a posting to be changed to a less restrictive usage by an engineer hired by the owner. (This is called an Engineering Evaluation, to be discussed.) The engineer would evaluate the building. If the engineer believed that a less restrictive posting could be recommended, he or she would submit that recommendation in writing to the jurisdiction.**
- ❑ If the engineer determined that work is needed to reduce the entry or occupancy hazard, the owner would then obtain a permit and hire a contractor to do the recommended work. The engineer would reevaluate the building and, if satisfied that a lower posting could now be recommended, submit that recommendation in writing to the jurisdiction. This process was used in San Francisco following the Loma Prieta earthquake.**
- ❑ For smaller buildings, the jurisdiction might allow this process with only the contractor providing the evaluation and repair services.**



POSTING SHOULD

- ☐ **Be timely**
- ☐ **Be consistent**
- ☐ **Be visible**
- ☐ **Carry authority of jurisdiction**

POSTING SHOULD (CONTINUED)

The posting process should:

- ❑ **Be timely.** Everybody will want to know soon after the earthquake whether they can enter their buildings, and you will be doing your best to inspect the buildings as fast as you can.
- ❑ **Be consistent.** This is best accomplished by assembling uniformly trained and competent teams to inspect the damaged buildings. To do this, the jurisdiction will have people whom they know and others whom they have requested from the mutual aid programs whom they do not know. The mutual aid system should provide a lead person who knows the skills of the volunteers and can help the jurisdiction form teams. Ideally, each team selects the same posting level and conclusion as the next. It has proven helpful initially to have all the teams inspect one building together. As they discuss the inspection and posting of the building, they thus begin to think consistently.
- ❑ **Be visible.** Usually, identical Unsafe and Limited Entry (Restricted Use) placards should be at every entrance. Use judgment when the building is particularly extended in plan and entrances have different addresses.
- ❑ **Your posting carries the authority of the jurisdiction if you have been deputized.**



EVALUATION STEPS

- 1. Examine entire outside of building**
- 2. Examine ground for distress**
- 3. Enter if safe and continue inspection**
- 4. Discuss observations; evaluate by criteria**
- 5. Post building**
- 6. Inform occupants of hazards**

EVALUATION STEPS (CONTINUED)

There are certain steps that you and your team should follow during both the Rapid and the Detailed Evaluation.

- ❑ First, examine the entire outside of the structure. This sounds obvious, but you may approach the front of the building and think it looks safe. Perhaps what you did not notice was that the entire back wall had collapsed. This damage may warrant an Unsafe (red) posting, thus you and your team would not endanger yourselves by going inside. So inspect all around the outside, if you can. Sometimes, with property-line type buildings, you cannot, but you should always try. The jurisdiction may provide “cherry-pickers” or ladder trucks for overhead viewing.
- ❑ Inspect the ground at the building perimeter, visible foundation elements, and the condition and plumb of the building. Look also for hazardous material placards (to be discussed later).
- ❑ Then, if you feel it is safe, enter the building. Make sure someone outside the building knows you are inside. Consider the criteria on the checklists on the Safety Assessment Forms (Appendix C in ATC 20). Discuss with your team all the conditions each member observed. Discuss the appropriate posting level. If, after continued discussion, you cannot agree, the team leader must decide on the posting level.
- ❑ Complete the placard and evaluation form. Post the structure with the placard. Inform the building occupants of the significance of the posting because you probably cannot police them. If they understand the dangers that you have seen, they are more likely to obey the posting restrictions.



RAPID EVALUATION CRITERIA

- ☐ Collapse, partial collapse**
- ☐ Building or story noticeably leaning**
- ☐ Severe racking of walls, obvious severe damage**
- ☐ Chimney, parapet, or other falling hazard**
- ☐ Severe ground displacement or foundation damage**
- ☐ Other hazard present**



RAPID EVALUATION CRITERIA (CONTINUED)

The Rapid Evaluation for hazard conditions includes the following criteria:

- ❑ Look for collapse or partial collapse of the building. Notice if the building or, more likely, a building story, is leaning.**
- ❑ If the leaning story has structural walls, they will necessarily be deformed and show distress in some way, which is called racking of the walls.**
- ❑ Inspect for falling hazards. Chimneys in wood-frame dwellings and parapets in un-reinforced masonry bearing wall buildings are the most common.**
- ❑ Look for ground displacement under or adjacent to the building.**
- ❑ Look for any other hazards.**
- ❑ These hazard conditions are listed on the Rapid Evaluation Form, which will be reviewed shortly. In the presentation to come, we will see examples of all of these hazard conditions. The following slides will show examples of two of these hazard conditions.**

DETAILED EVALUATION

- ❑ **Careful exterior and interior visual examination by more qualified team**
- ❑ **Follows rapid evaluation when required**
- ❑ **Important for essential facilities**

- ❑ The **Detailed Evaluation** is a closer inspection, usually following a Rapid Evaluation. The Detailed Evaluation may take several hours.
- ❑ Essential facilities such as schools, hospitals, and police and fire stations should be given a Detailed Evaluation as soon as possible.
- ❑ Outside the building, you might use binoculars to look for possible falling hazards, such as loose brickwork.
- ❑ Unlike the Rapid Evaluation, the Detailed Evaluation always includes inspecting inside the building. It can mean going room to room. It can mean climbing a ladder and lifting the ceiling tiles to inspect structural members that are not normally exposed. It can mean going into unfinished spaces of the basement to inspect the more exposed structural members.

HAZARDOUS MATERIALS

Recognition – Type of facility



**National Fire Protection
Association (NFPA) diamond
marker**

**Fumes, odors
Visible spills**

Actions –

Leave and post area

**Notify jurisdiction or fire
department**



HAZARDOUS MATERIALS

- ❑ **Hazardous materials** are always a consideration. They can range from a bottle of cleaning fluid that has fallen from a shelf in a home to damaged tanks and pipes at a major chemical installation. We live in a civilization where we use a lot of materials that are flammable, explosive, poisonous, corrosive, or radioactive. These materials may be in damaged tanks or pipes or in containers on damaged shelves in the buildings you are inspecting.
- ❑ Inspectors must always be watchful for hazardous materials. Report hazardous materials conditions to the jurisdiction so that better trained and equipped personnel can respond to them.



COMMON FAILURES CAUSING HAZ MAT RELEASES

- ❑ Building structural failures
- ❑ Dislodged asbestos
- ❑ Underground pipeline breaks
- ❑ Short connector pipe breaks
- ❑ Elephant's foot buckling of vertical cylindrical tanks
- ❑ Overturning of elevated tanks
- ❑ Sloshing from open-topped tanks
- ❑ Falling containers
- ❑ Equipment sliding or overturning

This is a chemistry lab after an earthquake, and a lot of bottles have fallen. The bottled materials themselves may be hazardous, and if they fall and mix together on the floor, the new compounds formed may create a new set of hazards.



- ❑ Asbestos-containing materials in buildings might be marked as shown in this slide, but they usually are unmarked.
- ❑ Inspection teams should protect themselves from asbestos exposure, and post buildings with damaged asbestos-containing materials appropriately to prevent others from being exposed.
- ❑ Notify the jurisdiction when damaged asbestos-containing materials are encountered.

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG
DISEASE HAZARD

FIELD SAFETY

- ☐ Travel in teams of two
- ☐ Wear a hard hat
- ☐ Survey building before entering
- ☐ Enter only if safe
- ☐ Avoid hazardous materials

- ☐ Inspection teams should consist of at least two people.
- ☐ Survey the building exterior before you go in and make sure someone outside knows you are inside.
- ☐ Wear your protective gear, especially your hard hat. A complete list of recommended protective gear and safety equipment can be found in the ATC-20 and ATC-20-1 documents.
- ☐ When you are inside, look out for hazardous materials.
- ☐ Also watch for falling objects, fire hazards, electrical hazards, and gas leak hazards as you inspect the inside of the building



FIELD SAFETY (CONTINUED)

- ☐ **Use safety equipment**
- ☐ **Be alert for falling objects**
- ☐ **In case of fire, evacuate area and alert fire department**
- ☐ **Avoid downed power lines**
- ☐ **Report gas leaks**