

Architectural and Nonstructural Elements—Field Investigation

Types of Data to Be Collected and Recorded

Research in these fields should be directed at determining the effect that architecture has on the performance of buildings and blocks of buildings. Attention should be paid to performance of interior nonstructural elements, entrances, exits, and exterior cladding.

CHECKLIST

Architectural and Nonstructural Elements

Interaction with Structural System

1. Describe building configuration and its role in building performance.
2. How did the architectural elements of the building interact with its structural system? How did they affect building performance? Describe architectural elements used and their connection to structure.
3. Are any changes in architectural design indicated by damage patterns?

Exterior Treatment and Elements

1. Describe glass, glazing details, and mullions, including provisions for distortion of openings.
2. Note condition of cladding and veneer on walls, including attachments.
3. Did canopies or marquees overhang critical exits or pedestrian areas? If so, how did they perform?
4. Describe performance of decorative screens of metal, masonry, wood, or plastic.
5. Were there sunshades over windows and openings? If so, how did they affect damage?
6. Note performance of precast panels, including their attachment to structure.
7. Note any damage caused by large-scale graphics or illuminated signs.

Interior Treatment and Elements

1. Describe performance of veneers and finish materials on walls, including their attachments to structure.
2. Did building have suspended ceilings? If so, describe materials, grid system, hangers, light fixtures, ceiling grills, and bracing. How did they perform?
3. Describe movable and fixed partitions with respect to provisions for clearances, bracing (in and out of plane), and anchorage.
4. Note performance of furniture and equipment, including wall-hung objects, storage cabinets, displays, shelving systems, and files.
5. Note performance of desktop computers.
6. Note presence and performance of mainframe computers. Were they on raised floors?
7. Describe performance of office landscaping systems. Was decorative sculpture or ornamentation present? If so, describe anchorage.
8. Note performance of sprinkler systems.

9. Describe performance of heating, ventilating, and air conditioning systems.

Mechanical, Electrical, and Plumbing

In General

1. Note what performed well and what did not.
2. Document which systems remained operational after the quake. Which did not?
3. Conduct a general evaluation of anchorage or bracing of equipment.
4. Collect specific data on principal equipment critical to operational use of building.

Mechanical

1. Equipment in general:
 - a. Was equipment bolted down, anchored, or specially braced?
 - b. Was it properly designed and installed?
2. Was equipment itself damaged, even when adequately anchored and braced?
3. Examine heating and ventilating ducts, including automatic dampers, hangers, straps, and ties.
4. Examine ducts passing through walls at chases or sleeves.
5. Did objects fall on equipment?
6. What was the interaction of the equipment with structural and architectural elements?
7. Did equipment continue to perform, even though damaged?

Electrical

1. Examine electrical light fixtures, both suspended and flush.
2. Determine whether or not damage occurred related to overturning, sliding, or to other objects falling on equipment.
3. Collect information on electrical central control stations in tall buildings. How did they perform?
4. Were auxiliary or alternate power supplies available? Did they function?
5. Was there damage at expansion joints?

Plumbing

1. Was piping braced to resist earthquake forces? Was it effective? Were flexible joints used? If so, how did they perform? Describe.
2. Document locations of breaks and apparent causes. Note materials.
3. Assess condition of pumps, drains, and controls.
4. What were the impacts on the automatic sprinkler system?

Anchorage Systems

1. Are anchor bolts cast in place or expansion anchors?
2. Can you identify the manufacturer of the anchor?
3. What is their length of embedment?
4. What is their diameter?
5. Were they tested after installation?
6. Did they fail? If so, how?

7. Did they pull out of concrete?
8. Is the concrete cracked?
9. Did fracture cones develop in the concrete?
10. Did the bolts stretch? Break?
11. Is there any indication that they were installed incorrectly?
12. What were the standards, if they existed, when the equipment was installed?
13. How many bolts were there and how were they laid out?
14. Did the bolt pass through a structural member in the equipment framing?
15. Are there signs of distress in the equipment, in the region around the anchor bolt?
Cracked or chipped paint? Deformation of metal?
16. Did the equipment introduce a prying action in the bolt?
17. Is the bolt hole appropriate to the bolt diameter?
18. Does the load path from the equipment frame to the bolt or weld introduce flexibility in the anchorage system?
19. What are the sources of loading on the anchorage? Note equipment weight, height of center of gravity, dimensions of the base of the equipment.
20. Were there loads applied through interconnections to adjacent equipment?
21. Did the base of the equipment move on its footing?
22. Is there a gap around the footing or equipment pedestal indicating differential movement?
23. Was reinforcing installed around bolt? Note placement, size, hooks, etc.
24. Note bolt spacing and bolt edge distance in concrete.

Elevators and Exitways

Elevators

1. Were seismic provisions of the building code applied to the elevator?
2. Describe types of earthquake safety devices used. Did counterweight (CW) derail device and seismic switch work?
3. Did CW derail, and if so, what were the contributing factors? Rail weight, retainer plates, added ties or brackets? Bracket anchorage failure? Location of CW when it failed? Deformation of brackets or ties?
4. Did CW hit cab?
5. Describe any other elevator system damage.
6. Was there movement of controllers, motors, traction equipment in the control room?
7. Was there emergency power? Did it work? If not, describe problems.

Exitways

1. Document any debris on stairs, landings, and passageways.
2. Note type of enclosing walls.
3. Note emergency lighting system. How did it perform?
4. Stairways: Note types, locations, widths, and attachments to structure.

5. Note foot traffic circulation patterns and distance to exterior spaces, alleys, streets, or courtyards.
6. Note any debris in streets and exterior spaces that impeded pedestrian circulation, particularly at exits.
7. Were there handrails and other safety devices?
8. Examine exit doors. Were there any operational impairments due to warping, jamming, or other damage?

Occupant Behavior

1. Describe patterns of evacuation.
2. Were there any impediments to evacuation?
3. Was an emergency evacuation plan in place? If so, had occupants been educated to use plan? Had drills been held? Were monitors part of plan? Did plan work?

Field Investigation Form—Architectural and Nonstructural Elements

Use this form for all structures examined in depth: office buildings, emergency services facilities, historical monuments and buildings, etc.

Name of Investigator: _____ Date: _____

Location of structure:

Use of structure at time of earthquake:

Influence of architectural design:

Structural damage:

Original construction drawings available:

Note observations concerning damage that was hazardous, disruptive, or costly: Note performance of code or design criteria or typical construction practice:

Architectural

Suspended ceilings:

Plaster, sheetrock ceilings (interior):

Lights:

Raised floors:

Exterior:

plaster, sheetrock soffits (exterior):

veneer:

concrete cladding:

concrete block fences:

Exit paths blocked?

Mechanical

Sprinkler system:

Other water supply:

Waste plumbing:

HVAC ductwork:

HVAC equipment:

Elevators:

Electrical

Backup power generators:

UPS units:

Transformers, large panels:

Contents

File cabinets:

Tall shelving:

Computers, desktop:

Computers, mainframe:

Use back of this sheet for sketches and additional notes.

Recommendations for Additional Follow-up

Research in Architectural and Nonstructural Elements in the Near-Term