DESIGN AND PERFORMANCE ISSUES RELATING TO RETAIL COMMERCIAL FACILITIES 7

7.1 INTRODUCTION

Retail commercial facilities house shops and stores, which contribute a signficiant portion of the nation's economic output. Department store malls, big-box retailers, grocery stores and strip malls are but a few of the almost endless list of retail operations housed in these types of facilities. As these companies make decisions about the buildings that they construct or spaces that they lease, seismic considerations can easily be factored into the decision process.

The following are some unique issues associated with retail commercial buildings that should be kept in mind during the design and construction phase of new facilities:

- Protection of building occupants is a very high priority.
- Occupants are predominantly work-force and shoppers; shopping malls and large retail stores typically are open from about 10 am to 9

pm for 7 days a week, typically with higher occupancy at weekends. "Big box" stores also have a high evening occupancy.

- Most shoppers are generally familiar with the characteristics of the shopping malls stores they frequent, but large retail stores are confusing to the first-time shopper. Familiarity with exit locations and egress routes is questionable.
- Retail stores, particularly department stores, change their interior layouts frequently to respond to market changes and retailing fashions. Big box stores generally retain a simple aisle layout, though some large electronic and furniture stores employ subdivided and clustered layouts related to groups of merchandise.
- Ensuring the survival of business records, whether in electronic or written form, is essential for continued business operation.

7.2 OWNERSHIP, FINANCING, AND PROCUREMENT

Retail malls are generally developer sponsored. Department stores and "big boxes" are developed by regional or national owners; their design and construction are independent of the retail mall developments in which they may be located. In retail malls, the mall developer designs and constructs "shell" structures in which space is leased to retail store owners who use their own design and subcontracting teams to fit out the space to their requirements. This tends to split the responsibility for interior nonstructural and other risk-reduction design and construction measures between the building designers and contractor, and a multitude of tenant store designers and contractors.

Financing for these facilities is typically through private loans. The effective life of a retail mall or store is about 20 years, after which major renovation and updating is necessary. Interior renovation is usually on a much shorter interval.

Shopping malls and stores are generally constructed using a single contractor selected by competitive bid. Large shopping malls may have a number of contractors working on the site because each department store will usually have its own general contractor and subcontractors. Low cost and very rapid construction with reliable achievement of construction schedules are prime considerations. The opening of new retail facilities is often timed to meet key shopping periods such as Christmas or opening of the school year.

7.3 PERFORMANCE OF COMMERCIAL RETAIL FACILITIES IN PAST EARTHQUAKES

There has been considerable damage to retail facilities of all sizes in recent earthquakes.

In the Northridge earthquake of 1994 near Los Angeles, a large regional shopping mall with 1.5 million sq.ft. of retail space suffered severe damage and was closed for 18 months. Some 200 mall stores were closed and six department stores under independent ownership received varying amounts of damage. One department store suffered a partial collapse, and was demolished and replaced (Figure 7-1). The

Figure 7-1 Severe damage to a department store severely shaken by the 1994 Northridge earthquake. Shear failure between the waffle slabs and columns caused the collapse of several floors. (photo courtesy of the Earthquake Engineering Research Institute.)

other stores were repaired. Other shopping malls in the area suffered damage, but their performance was considerably better. The Topanga Plaza Mall in Canoga Park, approximately 5 miles from the epicenter, was built in the early 60's but was seismically upgraded in 1971. Structural damage was confined to cracking of reinforced masonry shear walls and damage to concrete columns in infilled shear walls. Nonstructural damage was significant, however, ranging from damage to floor, ceiling and wall finishes to frequently shattered or dislodged store-front glass panels.

7.4 PERFORMANCE EXPECTATIONS AND REQUIREMENTS

The following guidelines are suggested as seismic performance objectives for retail facilities:

- Staff and shoppers within and immediately outside retail stores must be protected to at least a life-safety performance level during design-level earthquake ground motions.
- Emergency systems in the facility should remain operational after the occurrence of design-level earthquake ground motions.
- Shoppers and staff should be able to evacuate the building quickly and safely after the occurrence of design-level earthquake ground motions.
- Emergency workers should be able to enter the building immediately after the occurrence of design-level earthquake ground motions, encountering minimum interference and danger.

7.5 SEISMIC DESIGN ISSUES

The information in this section summarizes the characteristics of retail facilities, notes their relationship to achieving good seismic performance, and suggests seismic risk management solutions that should be considered.

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Seismic Hazard and Site Issues

Unusual site conditions, such as a near-source location, poor soil characteristics, or other seismic hazards, may lead to lower performance than expected by the code design. If any of these other suspected conditions are geologic hazards, a geotechnical engineering consultant should conduct a site-specific study. If defects are encountered, an alternative site should be considered (if possible) or appropriate soil stabilization, foundation and structural design approaches should be employed to reduce consequences of ground motion beyond code design values, or costly damage caused by geologic or other seismic hazards (see Chapter 3 for additional information). If possible, avoid sites that lack redundant access and are vulnerable to bridge or highway closure.

Structural System Issues

Retail facilities are usually one or two stories; mall structures and "big boxes" are usually light steel frames or mixed steel frame/wood/con-

crete/concrete masonry structures. Reinforced concrete block masonry perimeter walls often provide lateral resistance; for these systems, connections of roof diaphragms to walls are critical. The large building size and long-span light-frame load bearing structures of many of these facilities often lead to large drifts (or sway) during earthquake shaking. When designed to code minimums these drifts may be excessive and cause nonstructural damage, particularly to ceilings and partitions.

Retail buildings are intrinsically simple in their architectural/structural configuration, and basically are large open box-like structures with few interior walls and partitions. This enables their structural design to be simple and their seismic design can be carried out using the basic equivalent lateral force analysis procedures with a good probability of meeting code performance expectations as far as life safety is concerned. The desire for low cost, however, coupled with a tendency to meet only the minimum code requirements, sometimes results in inadequately engineered and poorly constructed structures. The protection of nonstructural components, systems and contents requires structural design to a higher performance level. Configuration irregularities are sometimes introduced for image reasons and the structural design may become more complex and expensive.

Nonstructural System Issues

The extensive use of light-steel-frame structures for retail facilities, together with the tendency for them to be designed to minimum codes and standards, has resulted in structures that are subject to considerable drift and motion. The result has been a high level of nonstructural damage, particularly to ceilings and lighting. This kind of damage is costly and its repair is disruptive.

In most “big box” stores the building structure forms only a weatherproof cover and is lightly loaded. Often there is no suspended ceiling and light fixtures are hung directly from the building’s structure. The merchandise is stacked on metal storage racks, which provide vertical and lateral support. These racks are supplied and installed by specialist vendors. The correct sizing and bracing of these racks is critical because the merchandise is often heavy and located at a high elevation. Even if the racks remain, material may be displaced and fall on the aisles, which are often crowded.

More upscale department stores have complete suspended ceilings and often have elaborate settings for the display of merchandise. These can be hazardous to staff and shoppers.

Excessive drift and motion (building sway) may also lead to damage to roof-top equipment and localized damage to water systems and fire suppression piping and sprinklers.

The responsibilities within the design team for nonstructural component support and bracing design should be explicit and clear. The checklist for responsibility of nonstructural design in Chapter 12 (see Figure 12-5) provides a guide to establishing responsibilities for the design, installation, review and observation of all nonstructural components and systems.