Chapter 5
APPLICATIONS SCENARIOS

Every seismic rehabilitation project occurs because someone has chosen or been required to modify a building. Because "every building has its own story," actual seismic rehabilitation projects depend upon the local societal and organizational contexts in which they take place. While the purpose of Chapter 3 was to present three alternative models to help the user of the *Guidelines* documents select a path through the forest of general issues related to seismic rehabilitation, this chapter narrows the focus and offers the reader a set of relevant scenarios that illustrate specific "typical" situations and highlight key factors important to achieving seismic rehabilitation. Although many variations are possible, these three scenarios (a private initiative, a local regulatory approach, and a professional service request) represent common seismic rehabilitation motivations and processes.

The first scenario focuses on a private voluntary decision. The facilities manager of a company owning 16 buildings in various cities across the United States received the *Guidelines* documents and wishes to determine if all or any of his buildings are possibly hazardous in earthquakes. If this proves to be the case, the facilities manager will recommend whether a seismic rehabilitation process be initiated with the company's own funds.

The second scenario addresses the public policy dilemma of a city manager whose chief building official received a copy of the *Guidelines* documents. After review and conference, they jointly decide to initiate the preparation of a proposed mandatory seismic rehabilitation ordinance for the city council's consideration.

The third scenario places a private consulting structural engineer, who knows little about earthquake engineering, in the difficult situation of needing to respond to his/her client by determining if any of the client's multiple properties in the Midwest is susceptible to earthquake damage. If so, the consulting structural engineer is to recommend whether any or all of the client's buildings should be seismically rehabilitated.

SCENARIO ONE: THE PRIVATE COMPANY

Situation

As the corporate facilities manager, you are responsible for all property acquisition, leasing, construction, remodeling, operations, and maintenance of the company's buildings. Your employer owns 16 buildings of various ages, sizes, and types of construction nationwide (Los Angeles, 5; Albuquerque, 1; Seattle, 2; St. Louis, 3; Charleston, 1; Baltimore, 2; and New Haven, 2).

Because of your position as facilities manager, you recently attended a workshop on seismic rehabilitation of existing buildings and you received the Guidelines documents. As a result, you became concerned about the potential earthquake performance of your company's buildings. The chief executive officer (CEO) has authorized you to evaluate the earthquake risk and likely earthquake performance of the 16 buildings. Your task is to assess the risk and likely earthquake performance of the 16 buildings and make seismic rehabilitation recommendations (which include doing nothing) to the CEO and possibly to the company's board of directors.

Considerations

Many factors have to be taken into account in your report which will influence the decision to invest or not invest in the seismic rehabilitation of the buildings. You may have to collect some information from other company units. Some of the issues you need to consider are:

- The geographic distribution of objective earthquake risk;
- The expected loads from the most likely seismic events;
- The probability of those events likely to occur (e.g., the planning horizon);
- The expected performance of the buildings from the expected earthquake loads;
- Competing needs for the funds and the trade-offs between short-term profits and long-term asset protection, including inventory and equipment values;
- The current status of capital replacement timetables and the flexibility of those timetables;
- Current business planning that could affect short-term and long-term use of the buildings (e.g., changes in product lines and markets, rates of facility obsolescence, and the existence or nonexistence of functional redundancy in other "safer" locations); and
- The benefits and costs associated with seismic rehabilitation.

You are aware that implementation of a voluntary seismic rehabilitation program within the company will require:

- Conducting a formal comparative risk evaluation and an initial screening or rapid assessment of the buildings;
- Developing an upgrading program that addresses various levels of desired performance;
- Specifying alternative design strategies to achieve those desired performance levels;
- Determining whether there are financial incentives external to the company that might be available for seismic rehabilitation;
- Determining what penalties external to the company may be imposed for not choosing to rehabilitate.
- Assessing the extent and depth of commitment to seismic rehabilitation of the company's top management and the board of directors; and
- Judging how and where seismic rehabilitation will fit in with and help meet the company's overall business objectives and priorities.

You are also aware that operational considerations must be factored into the decision about how to deal with the earthquake risk to the company's buildings by:

- Locating design professionals and contractors capable of performing seismic risk evaluations and the rehabilitation work;
- Determining if a seismic rehabilitation project will trigger requirements to comply *with other* local building code provisions that could add significantly to the costs and increase business interruption (e.g., disabled access, plumbing, electrical, life safety, asbestos removal, and energy conservation requirements);
- Estimating the costs of permits and inspections including the timeliness and difficulty of the process; and
- Assessing the value to the company of enhanced visibility and the goodwill associated with public knowledge that the company has engaged in a program of voluntary seismic rehabilitation of its buildings.

SCENARIO TWO: LOCAL GOVERNMENT POLICY DECISION

Situation

You are a city manager and generally aware that your community might experience periodic damaging earthquakes. Your chief building official has informed you that he has received and studied the recently issued *Guidelines* documents by the Federal Emergency Management Agency. The building official informs you that your community has two classes of exceptionally vulnerable buildings -- unreinforced

masonry (URM) and early (pre-1973) concrete tilt-up light industrial buildings.

As the city's chief executive officer, you agree with the building official that an appropriate action would be to prepare an ordinance for city council consideration. The proposed ordinance would require the owners of these two identified classes of building to seismically rehabilitate them and to use the *Guidelines* to meet the ordinance's requirements. In effect, this course of action means that you and the building official have to prepare the proposed ordinance; serve as the city's lead staff members for advising the council on the technical, socioeconomic, and other issues likely to arise if the ordinance is passed; and be ultimately responsible for enforcement of the "Community Earthquake Rehabilitation Ordinance."

As city manager, your experience tells you that *regardless* of the merits of a proposed ordinance to require the strengthening of URM and early tilt-up buildings, enacting and implementing it will be highly controversial. You also know that for the ordinance to both pass and then be effectively implemented, the city will need political leaders and a coalition of supporters behind the proposal.

Considerations

You and the building official have to be prepared to explain to the city council, media, and the public several important items:

- The earthquake threat to the community;
- What other communities facing a comparable threat are doing about the problem;
- The community-wide benefits of avoiding future losses, the costs of doing nothing, and the costs of rehabilitation;
- Plans to address the unique problem of historic buildings;
- The capabilities of local design professionals and contractors to meet the provisions of the ordinance;
- Ways to ameliorate the dislocations and economic effects caused by rehabilitation; and
- The need for rapid improvement of your staff's technical abilities.

From a program implementation perspective, you will have to address several other points including:

- The minimum level of compliance;
- The square foot costs and how costs will be shared, if at all, by building owners and the city;
- What other upgrade requirements will be triggered;
- The capabilities of city staff and whether staff will need to be increased and how;
- The appeal and arbitration procedures;
- The length of time for compliance;
- For what period of time owners will be exempt from additional retroactive measures; and
- The process and cost for handling noncomplying buildings (e.g., through condemnation and demolition).

Interestingly, this scenario demonstrates why jurisdictions often use "nonmandatory" alternatives to achieve the goal of seismic rehabilitation. For instance, an ordinance might only require that owners of buildings in the two suspect classes have licensed architects or structural engineers evaluate the buildings and file with the city reports that then become a matter of public record. This strategy could result in the quasivoluntary strengthening of buildings because the owners possess "guilty knowledge" of the susceptibility of their buildings, knowledge that could raise questions of liability associated with an existing hazard should a damaging earthquake occur.

SCENARIO THREE: THE CONSULTING ENGINEER'S DILEMMA

Situation

You are a consulting engineer in a small midwestern town located in a low seismic zone. Because of your professional interests, however, you are aware of specialist peers in the field of "earthquake engineering." Moreover, you are aware that the New Madrid fault

zone, which has received a lot of publicity of late, is about 200 miles away.

While a particular concern for earthquakes has not been part of your lengthy practice, one of your best long-term clients has raised the earthquake issue with you. Following the client's attendance at a seminar on New Madrid area earthquakes at the University of Memphis' Center for Earthquake Research and Information where she obtained a copy of the newly released *Guidelines* documents, your client is concerned about the earthquake resistance of her apartment and commercial buildings located in Memphis, St. Louis, Kansas City, and several other smaller cities in the same general area. The client is concerned about the area's earthquake risk and her responsibilities and liabilities as a property owner.

Considerations

This situation is a real dilemma for both you as the consulting engineer and your client. Some of your key considerations include:

1. Getting more exact risk information;
2. Defining other skills needed to augment your own and their availability;
3. Determining if the cities where the buildings are located require seismic rehabilitation and if so, to what level;
4. Determining whether other code requirements will be triggered by work undertaken to seismically strengthen the buildings; and
5. Determining, now that you are a "knowing person," what, if any, liabilities are associated with the earthquake performance of your client's buildings.

Further considerations relate to evaluating client's properties; establishing priorities based on risk, occupancy, function, and other factors; determining acceptable levels of performance under expected events; designing effective rehabilitation schemes; accurately estimating costs; determining whether seismic rehabilitation can somehow be linked to the owner's general long-term property improvement plans; and deciding whether advising your client to sell the properties is a viable solution. Clients seldom understand that there are no guarantees in earthquake engineering and especially in the seismic rehabilitation of existing buildings. The consulting engineer who oversees a seismic rehabilitation project always has lingering concern about what will happen when an earthquake does occur and a rehabilitated building does not perform to the client's expectations. For example, a California Seismic Safety Commission report (p. 49) noted that "many engineers view the performance of retrofitted buildings in the Northridge earthquake positively" but "many owners were unaware that a retrofitted (rehabilitated) building could still be damaged to the point of not being economically repairable." One way to lessen this concern is for the design professional and the client to understand that, just as with the performance of new buildings, the effectiveness of seismic rehabilitation will vary with the severity of the earthquake. To illustrate this point, FEMA's benefit-cost volumes note that the anticipated effectiveness of an investment in seismic rehabilitation varies with the intensity of an earthquake. The greatest economic benefit derives from rehabilitation measures that perform best in lower magnitude but more frequent events. For example, rehabilitating a common low-rise tilt-up building is expected to reduce damages by 50 percent at modified Mercalli intensity (MMI) VI but only 30 percent at MMI XII.