

## EXECUTIVE SUMMARY

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While natural disasters cannot be avoided, there are ways to *improve safety, minimize loss and injury, and increase public awareness* of the risks involved. One of the most effective ways to lessen the impact of natural disasters on people and property is through risk assessment and mitigation – the topic of this study.

Conducted over a four-year period (1999-2003), the study is a thorough risk and loss assessment of potential earthquakes in the NY-NJ-CT region. This study documents the *scale and extent of damage and disruption* that may result if earthquakes of various magnitudes occurred in this area. In short, it addresses the first step in risk reduction: to identify potential problems. It focuses on the vulnerability of the building stock; future studies will deal with the inventory, fragilities, and losses from lifeline infrastructure systems, such as transportation, communication, water, liquid waste, and energy.

### **An Earthquake in New York City?**

The likelihood of an earthquake in New York City metropolitan area has been assessed as “moderate” by the U.S. Geological Survey. As

recent as 2001 and 2002, two earthquakes of Magnitude 2.4 and 2.6, respectively, had epicenters around Central Park. Earthquakes of Magnitude 5.2 have a 20% to 40% probability of occurrence in 50 years in the study area. Based on seismic records, thousands of earthquakes with magnitudes larger than 2.0 have occurred in New York State over the past few centuries. Catastrophic events with Magnitudes 6 and larger are possibilities.

In order to be prepared for such natural disasters, we must be able to estimate and predict the risk associated with these potential losses. The economic impact of a damaging earthquake in New York City alone would be in the billions of dollars due to direct structural damage, not to mention the additional impacts on the infrastructure, building contents, business continuity, fire suppression, and human safety.

Thus, we believe this report is critical to emergency management officials, facilities managers, building architects, engineers, utility companies, insurance companies, business owners, and policymakers at all levels – local, state, and federal.

### **Predicting the Consequences**

How do you forecast the consequences of an earthquake? To predict what might happen in several “what-if” scenarios, we used Geographic Information Systems (GIS) and a model of the Tri-State area, including detailed data on the buildings and soil of the region. This information, supplemented with additional data about regional geology and history of earthquakes in the region (location, frequency, and magnitude), enabled us to identify the areas, structures, and systems at highest risk.

After identifying possible scenarios, we used federally sponsored software, *Hazards US (HAZUS)*, to estimate probable consequences and potential losses. Developed by the Federal Emergency Management Agency (FEMA) in partnership with the National Institute of Building Sciences (NIBS), *HAZUS* is a standardized, nationally applicable tool for performing loss estimations. Using *HAZUS* formats, we were able to establish the building inventory information for Manhattan at the level of individual buildings, a unique accomplishment for *HAZUS* applications.

### ***New York City would represent over half of the losses of the Tri-State region because of its dense built environment.***

#### **Minimizing Losses**

Most losses caused by an earthquake are directly or indirectly the result of ground shaking and building damage or collapse. Even a moderate earthquake would severely impact the economy of the region. Our research indicates that the building inventory of the Tri-State region represents a total replacement value of \$1 trillion, excluding contents and lifeline infrastructure systems. In a 2500-year event, which is the “maximum considered earthquake” used in designing new buildings, the combined loss of buildings and building-related income could be nearly \$85 billion, comparable to the losses sustained on 9/11, albeit distributed over a larger area.

Using informed estimates, it is possible to mitigate the risks and reduce losses. Some key implementation strategies have already been initiated:

- ▶ Retrofitting vulnerable buildings and existing infrastructure
- ▶ Better regulating future construction by promoting seismic provisions in building codes and implementing them

- ▶ Adding earthquake scenarios to emergency response plans before and after an earthquake
- ▶ Increasing public awareness of the potential hazards.

#### **Creating Awareness**

To increase public awareness of seismic risk in the area, the members of the Consortium will continue to gather data and information about area building stock, supporting infrastructures, and socio-economic systems. Other outreach efforts have included using building inventory data to assist in assessing damage from the 9/11 World Trade Center attacks, a Discovery Channel program on “Earthquakes in New York?” and numerous conferences, and news articles. We anticipate that the activities of the Consortium will stimulate broader community interest in joining this important effort.

#### **Looking Ahead**

With a solid foundation of accurate regional data, the modeling approach can be extended to other disasters, such as hurricanes, snowstorms and floods. In fact, this research and its resources may be extended by implementing a “multi-hazards” approach to mitigation as part of a comprehensive disaster management program.

Emergency response and relief agencies may use this study to project the demand on essential facilities (hospitals, police, fire stations), as well as the financial and material resources required to assist victims. By looking ahead, not only will we be able to identify areas, structures, and systems at highest risk and improve our understanding of the problem, but also our understanding of the *number of lives* and *value at risk*.

Experience has shown that it is cost effective to invest a little now to save a lot later.