

# *Essential Facilities Performance Study for Seismic Scenarios in Manhattan*

by

Michael Tantala and George Deodatis  
Department of Civil and Environmental Engineering  
Princeton University

---

## ABSTRACT

This paper focuses on the implementation and quantitative results of a detailed critical (essential) facilities analysis, assessing probable damage and facility functionalities for Manhattan from various scenario earthquakes.

To this end, a complete building inventory of every building in Manhattan was assembled from a variety of sources and combined with a detailed geotechnical characterization of Manhattan. This building inventory was used to model scenario earthquakes in *HAZUS* (Hazards US), a standardized earthquake loss estimation methodology and modeling program for these estimations.

Essential facilities are those facilities that must necessarily remain in operation after a seismic event for post earthquake recovery operations. These facilities provide required services to victims of an earthquake and are primarily responsible for the rate of recovery in the affected area. Collapsed and burning buildings, spreading fires, homelessness, and social chaos are just a few examples of secondary crises that follow in the wake of an earthquake and magnify the effects of such a disaster.

Specifically, this paper will **quantify the functionality of essential facilities** including hospitals, schools, police stations and fire stations with respect to number of beds, amount of shelter, average travel time for injured to nearest hospital, probable fire ignitions and water demands. The functionality of a structure is directly related to its particular damage state (i.e. slightly damaged facilities will obviously aid recovery operations more than those that are extensively damaged).

This paper will also **quantify the demands placed on those essential facilities** with respect to casualties, injuries and shelter requirements and assess if the facilities functionalities will be capable of accommodating these needs. The methodology for determining injuries and casualties is based on the assumption that there is a strong correlation between building damage (both structural and non-structural) and the number and severity of casualties.

Eventually, the aim of this loss estimation project will provide a framework for businesses and agencies to take mitigative action to reduce potential damage and losses, which might be experienced after an earthquake.

This study was funded by FEMA Region II and coordinated by the Multidisciplinary Center for Earthquake Engineering Research (MCEER) and the New York State Emergency Management Office (NYSEMO).