Assessing the Role of Lifeline Systems in Community Disaster Resilience

by Stephanie E. Chang and Christopher Chamberlin

Research Objectives

The objective of this research is to advance the state-of-the-art of disaster loss modeling, with particular emphasis on understanding how mitigating lifeline infrastructure systems can improve the disaster resilience of a community. A model will be developed that focuses on direct social and economic losses. It will be applied to the Los Angeles Department of Water and Power (LADWP). Key advances in this model will include evaluating lifeline-related losses within the broader context of the disaster, and developing a socio-economic loss model that is agent-based.

Urban infrastructure systems such as water and electric power networks provide critical services to all sectors of a community. Evaluation of alternative seismic upgrading strategies for these systems should therefore take into account not just the utility provider's own costs and benefits, but the potential impacts on the community as a whole. In this context, MCEER researchers have proposed the concept of "community disaster resilience" as a framework for evaluating and comparing loss reduction strategies (Bruneau et al., 2003). This paper addresses a central question in the resilience framework: how to evaluate the benefits of lifeline mitigations for disaster resilience of the entire community.

This effort builds on research in previous years that focused on the water and electric powers systems serving Memphis, Tennessee. Prior research developed integrated engineering-economic loss estimation models (Chang et al., 2002; Shinozuka et al., 1998), explored the relationship between loss estimation and resilience modeling, and applied the resilience approach to an analysis of alternative seismic upgrading strategies for the Memphis Light, Gas and Water Division (Chang and Shinozuka, 2004).

Currently, the Memphis model is being transferred with major enhancements to a case study of the Los Angeles Department of Water and Power's (LADWP's) systems. As described in the current paper, a key enhancement is the setting of lifeline outage impacts in the context of other earthquake damage (e.g., to buildings), which provides a more realistic and accurate assessment than modeling lifeline outages in isolation. Another important modification consists of the shift from an area-based to an agent-based model

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