

# **Mitigating Risks to Infrastructure Systems Through Natural Hazard Reduction and Design**

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## **ABSTRACT**

This paper provides a brief summary of the issues and opportunities associated with the reduction of risks to urban lifeline systems. In this paper, the term lifeline (which is commonly used to define utility and transportation systems) is used interchangeably with infrastructure. The general focus of this paper is on all natural hazards, however, earthquakes are used to illustrate most points. The basic thesis for this paper is that the cost of rebuilding lifeline systems after major natural disasters is becoming prohibitively expensive, even for large federal budgets. As our cities continue to develop and expand geographically, we increase the chance of "direct hits." Therefore, the design of our systems must consider these risks and perhaps more importantly, ways of effectively reducing these risks through land use planning, modification of hazardous site conditions, or increased design and/or retrofit.

## **INTRODUCTION**

Recent disasters have underscored the need to assess the vulnerability of our nation's lifeline systems to natural hazard effects. Current estimates of lifeline damage as a result of the 1994 Northridge earthquake are in excess of \$2 billion. While this amount may appear low relative to other types of losses (e.g., damage to buildings), it only reflects those costs associated with the repair of damaged lifeline systems. Other costs which may more accurately reflect the impact of damaged or inoperable systems, such as business losses due to

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