

# A New Probabilistic Seismic Risk Analysis Method for Urban Disaster Mitigation and Earthquake Insurance

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## Abstract

This paper presents a new framework for probabilistic seismic risk analysis for urban disaster mitigation and earthquake insurance, building on the advances in understanding of the earthquakes and their consequences. Seismic risk assessment process is most commonly probabilistic in nature, consisting of two primary components, hazard and vulnerability. However, in traditional seismic risk estimation methods, probabilistic seismic hazard assessment lumps all contributions from all earthquakes of different sizes, occurring at different locations in different earthquake sources at different probabilities of occurrence together, it might not fully characterize the seismic risk contributions from all earthquakes and their consequences. Another approach is proposed for a probabilistic seismic risk analysis directly considering the likelihood of the occurrence of damaging earthquake events and their potential consequences expressed in terms of damage or loss. The source-path-soil-structure system is coupled to simulate the earthquake consequence. The direct way to make probabilistic estimates of seismic consequence (damage ratio, economic loss ratio) is represented as a function of earthquake magnitude, source location and type of soil condition. Then probabilistic consequence exceedance curves (risk curves) are developed in probabilistic analysis. Seismic risk is aggregated directly combining uncertainties in the size, location, rate of occurrence of earthquakes, and the variation of consequence probability distribution associated with earthquake size and location. This allows the temporal and spatial probabilistic pattern of all events from small to large size to be modeled and can be capable of handling uncertainties associate with all the components of risk model. This technology of earthquake consequence simulating and seismic risk modeling emerged as powerful tool for urban disaster mitigation and the insurance industry. The seismic risk curves build the link between earthquake risk assessment and earthquake risk management, providing the variability of consequences and the potential of significant consequences information for all community policy makers (e.g., mayors, city managers, legislatures) and community stakeholders (e.g., earth scientists, engineers, architects, planners, emergency managers, insurers, and policy officials from government, academia, and private practice). It may have applications in many areas, such as infrastructure planning, consequence-based building-code development, and insurance perspective. It might be used to define of earthquake design multilevel through comparing potential seismic risk in a specified site with acceptable seismic risk level. The use of loss exceedance curves will enable the insurance industry to develop more accurate rate structures for coverage against losses from earthquakes and be used in government earthquake insurance pools.

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