

PROBABILISTIC BUILDING LOSS ASSESSMENT

Hesameddin Aslani and Eduardo Miranda

One of the main strategic plans of the Pacific Earthquake Engineering Research (PEER) Center is to improve decision-making procedure for the owners, financial institutions and other interested parties of different facilities by providing improved information about the seismic performance of structures. One important seismic performance measure in a facility is the direct economic losses in the facility. Different approaches can be used to estimate economic losses in a building. One approach is to estimate losses as a function of the damage in individual structural and non-structural components.

The main objective of this project is to develop a methodology to estimate the expected annual loss and the probability of experiencing an economic loss greater than a certain dollar loss in a building. The methodology is developed on the basis of PEER's probabilistic framework, in order to account for various sources of uncertainty that contribute to the economic losses in buildings. The uncertainties that contribute to economic losses in buildings stems from four sources; uncertainty corresponding to the occurrence of a certain earthquake scenario, uncertainty corresponding to the seismic demand of the building at a given earthquake scenario, uncertainty corresponding to the damage in each component and uncertainty corresponding to the repair/replacement cost of the component. The effects of correlation between the losses in individual components at each of these levels of uncertainty on the dispersion of the total dollar loss conditioned on a given ground motion intensity and on the probability of having losses greater than a certain dollar amount are also considered in developing the methodology.

The proposed methodology estimates loss at two levels; element-level and system-level. Estimation of the economic losses at the element-level involves four steps:

1. Estimation of the engineering demand parameter in each component as a function of the ground motion intensity.
2. Estimation of the level of damage in the component as a function of the level of engineering demand parameter in that component.
3. Estimation of loss corresponding to the repair or replacement of the component in each damage state.
4. Estimation of the component expected loss and dispersion of the loss as a function of the earthquake ground motion intensity.

At the system (building)-level the loss estimation methodology involves three steps:

1. Estimation of the seismic hazard at the site.
2. Estimation of the correlation between losses in individual components.
3. Estimation of the expected annual loss and the probability of experiencing an economic loss greater than a certain dollar loss in the building as a function of the component losses.