



## Seismic Life Cycle Cost Analysis of Indian RC Building Considering Hazard Uncertainty

Satwik Rayjada<sup>1</sup>, Jayadipta Ghosh<sup>1</sup>, Meera Raghunandan<sup>1</sup>

<sup>1</sup>Department of Civil Engineering, Indian Institute of Technology Bombay, Mumbai, India

### Abstract

Seismic life cycle cost analysis (SLCCA) is a reliable approach to assess the economic implications of the structure over the lifetime of the structure in terms of present-day value for lifetime investment planning, especially when located in moderate to high seismic zones. The state-of-the-art methodology of SLCCA incorporates three essential components: a) seismic hazard curves representing expected seismic intensity at the site, b) seismic fragility curves describing the likelihood of a structure being damaged beyond an explicit damage level and c) cost related to damage levels. The expected seismic intensity at the site can vary significantly due to various sources of uncertainty such as earthquake source and site characteristics, ground motion prediction equations, etc. For engineering applications, the mean hazard curve is typically used. However, the possible values of hazard can be significantly higher than the mean estimates. As seismic hazard assessment is the furthestmost component of the SLCCA framework, the seismic hazard uncertainty propagates through subsequent components, and seismic life cycle cost (SLCC) may vary substantially. Presently, limited literature exists that calculates the SLCC in the Indian context and quantifies and propagates different sources of uncertainty. This study aims to assess the influence of hazard curve uncertainty on SLCC using a case study example of reinforced concrete (RC) building located in cities with different seismic zones (Chennai, Mumbai, Delhi, Bhuj). For that purpose, a Monte Carlo simulation-based approach is used. Results reveal the criticality of incorporating uncertainty as opposed to a deterministic approach.

**Keywords:** Fragility, Hazard, Indian building, Reinforced concrete, Seismic life cycle, Uncertainty