



Seismic Risk Assessment of a Himalayan Town: A Case Study of Queen of Hills, Mussoorie, Uttarakhand, India

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Abstract

The Himalayan region in north India is characterized by both mild-to-steep hill slopes as well as high seismicity. The presence of topographic features significantly alters the earthquake ground-motion characteristics in terms of both the amplitude and frequency content. In addition, the building configurations observed in these regions are also significantly different than those usually observed in the plain areas. As a result, hilly regions pose significantly higher seismic risk compared to their plain terrain counterparts with comparable seismicity. In the present study, probabilistic seismic risk assessment is conducted for a typical Himalayan town of Mussoorie, in the state of Uttarakhand, India. Firstly, the topographic amplification effects are estimated corresponding to various hill geometries using finite element simulations and amplified seismic hazard maps are developed. The building stock inventory for the town is prepared using a combination of satellite imagery and random sample ground surveys. The available building fragility and vulnerability functions from the Global Earthquake Model along with the developed hazard and exposure models are integrated into OpenQuake to obtain seismic risk maps for Mussoorie, with and without considering the topographic amplification effects. It is shown that the topographic amplification effects alone can increase seismic losses upto ~200%, thereby highlighting a need to include them in seismic design of structures.

Keywords: Seismic hazard, Topographic amplification effects, Seismic vulnerability, Seismic risk