Probabilistic Assessment of Seismic Damage of Steel Buildings Considering Soil- Structure Interaction Effect

Mohammadreza Akhondi, Farhad Behnamfar, July 2019

The current thesis focuses on calculation of the seismic fragility curves for steel structures representing special moment frames conventionally used in highly seismic regions. To be able to arrive at results more resembling the reality, flexibility of the underlying soil is taken into account. Moreover, since characteristics of the soft soils can considerably change with seasonal variations, they are assumed to be probabilistic parameters in this study. For this purpose, 4, 8, and 12-srory special moment frame steel structures are adopted. The collapse spectral acceleration of the buildings is calculated using the incremental dynamic analysis under concurrent horizontal components of 11 consistent earthquakes. Assuming a Log-normal distribution, the probability of exceedance of the collapse threshold is calculated at each spectral acceleration value, as a fragility curve. The soil-structure interaction is modelled using the theory of beam on nonlinear Winkler foundation. Using the Tornado analysis, the most influencing soil parameter on collapse is identified to be as shear modulus. The Monte Carlo analysis is utilized to account for uncertainty of the soil characteristics. It is shown that variability of the soil parameters affects the collapse behavior of shorter buildings. Moreover, soil-structure interaction can increase or decrease the collapse fragility in certain cases.

Kaywords: fragility curve, steel structure, soil-structure interaction, soil parameters, probabilistic.