Epistemic uncertainty in the seismic response of RC free-plan buildings

Chacón, M. F., Juan, C., Hube, M. A., Marques, J., & Lemnitzer, A. (2017). Epistemic uncertainty in the seismic response of RC free-plan buildings. Engineering Structures, 141, 687-702. https://doi.org/10.1016/j.engstruct.2017.03.015

Abstract

Complex building models consider multiple degrees of freedom and modeling assumptions that influence the accuracy of the predicted seismic response. This study evaluates the epistemic uncertainty inherent to modeling assumptions by evaluating the seismic response behavior of six instrumented reinforced concrete free-plan structures in Santiago, Chile. The free-plan structural concept is frequently used in office buildings and consists of a core of shear walls, a perimeter frame, and a flat slab connecting both lateral force resisting systems. Epistemic uncertainties studied in this paper are inherent to the following modeling assumptions: (1) the type of finite elements used in the building models; (2) the in-plane and out-of-plane stiffness of the diaphragms; (3) the interaction between the basement and the surrounding soil; and (4) the decision where to apply base fixity. The response uncertainty was first evaluated by comparing predicted and measured vibration periods using ambient vibrations and aftershock records of the 2010 Maule, Chile earthquake. Additionally predicted global and local seismic response parameters such as story shears, torques, and drifts were compared between a predefined reference model typically used in design and a set of variant models. A statistical evaluation of the modeling uncertainty showed a strong dependency on the response parameter considered. Larger uncertainties were observed for shear force related response parameters, including the influence of soil-structure interaction on base and story shears, while uncertainties for predicting fundamental periods or the depth at which building fixity was assumed had moderate impact on the overall building response. In general, uncertainties identified in core forces were larger than uncertainties in story forces and also larger at the underground stories than in comparison to upper levels.

Keywords: Epistemic uncertainty||Free-plan buildings||Reinforced concrete||Finite element||Diaphragm stiffness||Soil-structure interaction||Basements effect||Instrumentation||Seismic response
Creado: Sábado, 21 de Noviembre, 2020