Numerical investigations for assessing the seismic performance of multi-tiered Nepalese temples

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Abstract

In this study, the seismic performance of old multi-tiered temples in Nepal has been addressed using three different computational approaches, including a) linear elastic; b) nonlinear static; and c) nonlinear dynamic analyses. Also, a sensitivity study was undertaken to understand the influence of wall thickness and height of Nepalese temples on their seismic behavior. Vertical oscillating modes using the elastic response spectrum of the Nepalese Building Code were obtained using linear analysis. Nonlinear static analysis (NLSA) were implemented to obtain the load carrying capacities of different in geometry temples e.g. different thickness of central core walls and number of tiers. Additionally, nonlinear dynamic analysis (NLDA) using the Finite Element Method (FEM) were performed to evaluate the characteristic tensile damage patterns. The results comparatively indicate the weakest zones depending on wall thickness, central core slenderness, opening distribution, box-like confinement, vertical misalignment of walls and so forth. Also, the results of the NLDA affirm high vulnerability of the multi-tiered temples showing extensive cracks at relatively low peak ground accelerations. It is anticipated that outcomes of this study can help practicing engineers to understand how these structures behave when subjected to seismic loads and provide insights towards their strengthening and retrofitting.

Keywords: Nepal earthquake, Cultural heritage buildings, Seismic damage, Masonry, Numerical modelling, Finite element method