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Numerical Model of Low Cost Rubber Isolators for Masonry Housing in High Seismic Regions

Authors : Ahmad B. Habieb, Gabriele Milani, Tavio Tavio, Federico Milani

Abstract : Housings in developing countries have often inadequate seismic protection, particularly for masonry. People choose this type of structure since the cost and application are relatively cheap. Seismic protection of masonry remains an interesting issue among researchers. In this study, we develop a low-cost seismic isolation system for masonry using fiber reinforced elastomeric isolators. The elastomer proposed consists of few layers of rubber pads and fiber lamina, making it lower in cost comparing to the conventional isolators. We present a finite element (FE) analysis to predict the behavior of the low cost rubber isolators undergoing moderate deformations. The FE model of the elastomer involves a hyperelastic material property for the rubber pad. We adopt a Yeoh hyperelasticity model and estimate its coefficients through the available experimental data. Having the shear behavior of the elastomers, we apply that isolation system onto small masonry housing. To attach the isolators on the building, we model the shear behavior of the isolation system by means of a damped nonlinear spring model. By this attempt, the FE analysis becomes computationally inexpensive. Several ground motion data are applied to observe its sensitivity. Roof acceleration and tensile damage of walls become the parameters to evaluate the performance of the isolators. In this study, a concrete damage plasticity model is used to model masonry in the nonlinear range. This tool is available in the standard package of Abaqus FE software. Finally, the results show that the low-cost isolators proposed are capable of reducing roof acceleration and damage level of masonry housing. Through this study, we are also capable of monitoring the shear deformation of isolators during seismic motion. It is useful to determine whether the isolator is applicable. According to the results, the deformations of isolators on the benchmark one story building are relatively small.

Keywords : masonry, low cost elastomeric isolator, finite element analysis, hyperelasticity, damped non-linear spring, concrete damage plasticity
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