Modeling and analysis of unreinforced masonry structure for seismic assessment

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Masonry is the oldest building material that still finds wide use in today's building industries. Despite its popularity, the analysis of masonry structures is a complex task due to the heterogeneity and the nonlinear material behaviour. The failure mechanism of the masonry structure are governed by the mortar joints rather than the stone blocks. The need for reliable analysis procedures capable of predicting damage evolution and failure in historical structures under seismic excitation in order to design effective retrofit has motivated this work.

In this paper, the seismic behavior of the Brooklyn Bridge, New York, is investigated by the numerical approaches. The unreinforced masonry (granite) towers are the most prominent features of the bridge that make its seismic study unique and challenging. The analysis tasks are performed interactively between global and local modeling efforts respectively. A three-dimensional simplified global model of the main bridge is developed and its modal analysis is performed by a software package SAP2000, version 9.0. A detailed computer model of the towers through the standard FEM modelling strategy, based on the concepts of homogenized material and smeared cracking constitutive law, implemented in the software ABAQUS by HKS.

This paper discusses the effectiveness of the macromodelling strategy to predict joint cracking and explore the possible failure mode through performing both static and time history analyses of unreinforced masonry structures. The different approaches are used to compare and verify the adequacy of using homogenization techniques to simulate the masonry structure under seismic excitation.

References

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