CERIS : Civil Engineering Research and Innovation for Sustainability

Reduction of the seismic risk of monuments: a multi-disciplinary approach

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Summary

Past events have proved how existing masonry buildings are easily vulnerable to seismic action, and in countries such as Portugal and Italy, historical unreinforced masonry aggregates represent a large part of their cultural heritage. The main goal of this research is to suggest the best numerical modelling approach for historical masonry monuments comprised of various assemblies joined together, such as palaces, by developing an optimized seismic-oriented assessment framework, and to propose retrofitting solutions for the built cultural heritage. The National Palace of Sintra will be considered as a case study. The interoperability between Building Information Modelling (BIM) and Equivalent Frame Modelling will be studied, so that the direct use of BIM models in the development of the numerical models can simplify the seismic assessment process of this type of building. A relevant aspect in the study of complex structures is the interaction between adjacent bodies. Therefore, the connections between buildings will be modelled and calibrated, considering the different possible types of connections.

A seismic assessment of the global model of the Palace will be contrasted with the assessment of the independent structural subassemblies considering the interaction between adjacent bodies. Lastly, considering the usual need for and the importance of seismic retrofitting of the built cultural heritage in Mediterranean countries, quasi-static experimental tests will be performed to understand the seismic behaviour of ancient rubble stone walls retrofitted with different strengthening techniques. The retrofitting solutions here studied, with materials compatible with the ancient substrates, are injection of mortar, FRCM (fabric-reinforced cementitious matrix) systems with glass and carbon meshes, and the combination of both (injection + FRCM). Furthermore, different connections of the FRCM technique to the foundation will be tested. From the results obtained in the experimental campaign, this study aims at proposing design values for the improvement of strength and drift capacity of strengthened walls.

Keywords

Seismic risk assessment, historical complex structures, nonlinear analyses, multi-disciplinary methodology.

Quasi-static cyclic tests setup on a rubble stone wall.