Comparison of two Different Approaches for the Seismic Evaluation of the Bonet building of the National Palace of Sintra, Portugal

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ABSTRACT

Complex masonry monuments represent an important part of the built cultural heritage and most of them are vulnerable to seismic actions. Their large scale, irregularity and heterogeneity, makes it challenging to characterize their structural behaviour.

This work addresses the state of conservation as well as the structural behaviour and seismic vulnerability of the most ancient body of the National Palace of Sintra, Portugal: the Bonet building. This body, a URM building, was built on top of Arabic foundations during the reign of King Dinis, around the year of 1281. Since then few alterations were made to the building. Due to an exemplary conservation of the Palace, crack patterns were identified only on the top floor of the Bonet building, an area that is not open for visitors and that has been recently submitted to restoration works.

In order to minimize the multiple uncertainties usually existing in complex masonry buildings, whether related to geometry or to masonry mechanical properties, a detailed structural survey was conducted using a laser-scanner and a drone and *in-situ* experimental tests were performed. Different *in-situ* experimental tests took place, semi-destructive and non-destructive, such as: samples collection, flat-jack tests, GPR (ground penetrating radar) campaign and ambient vibration tests. All these tests are important to the adequate characterization of building and to the calibration of the numerical model. The final values adopted for the mechanical properties of the rubble stone masonry are presented and can be used as reference for future works in ancient Portuguese monuments of the same period.

Afterwards, nonlinear static numerical analyses were performed in two different FEM software (3MURI and ABAQUS), and comparisons and discussion of the results are made. The differences in modelling strategies and characterization of materials between the two software are considered with regard to their realism, computational effort, data availability and applicability to large scale structures. Efforts to calibrate and obtain the same behaviour of the building for the different software were made, involving geometry, boundary conditions and characterization of the material constitutive laws. One of the most difficult challenges when modelling complex structures is the definition of the boundary conditions. Therefore, the adjacent buildings were modelled to take into account the interactions.

REFERENCES

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