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Seismic Performance Assessment of the 18th Century Jesuit College in Dubrovnik

Introduction

Seismic performance assessment of cultural heritage architecture presents many challenges due to the restrictions set forth by the conservation principles to protect the associated social and cultural values. These buildings are usually characterized by the unreinforced masonry walls connected together by tie-rods, vaults, and wooden floors. The period of construction dates to the time when seismic design conventions were largely unknown, making the heritage structures potentially vulnerable to earthquake damage. This study presents the seismic performance assessment of the Jesuit College located in the southern part of the Old City of Dubrovnik (UNESCO world heritage list).

Figure 1. Overview of the geometrical characteristics

Field Investigation

The stiffness of the structure is determined using the vibrational characteristics of the case study building (i.e., natural frequencies), where the geometrical properties are known, and the material characteristics are determined by a trial-and-error process.

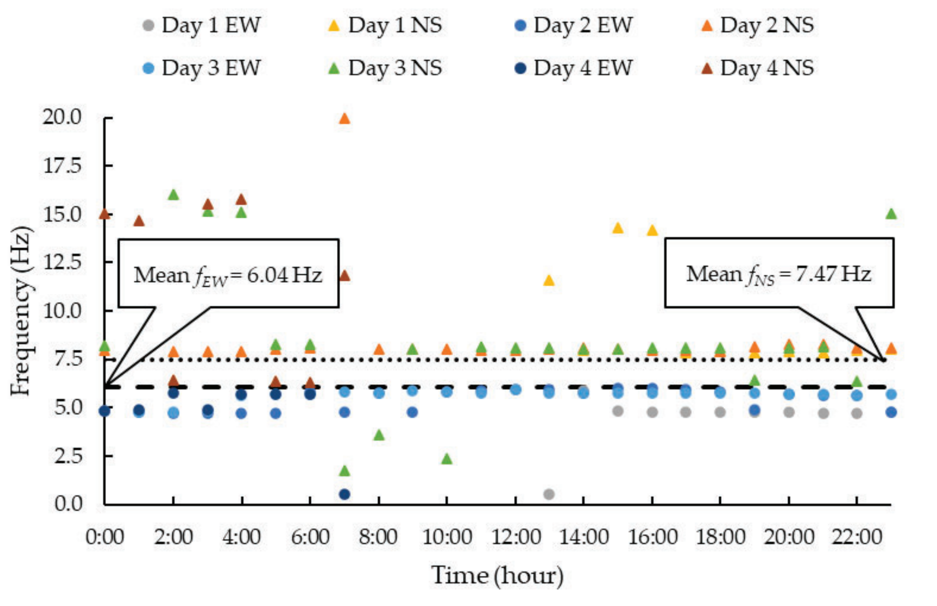


Figure 2. Natural frequencies obtained from AVT

Analytical Results

The finite element model mesh consists of 4-node hexahedral and quadrilateral volumetric elements. The mesh density is determined through a parametric calibration in conjunction with the convergence analysis of the dynamic response.

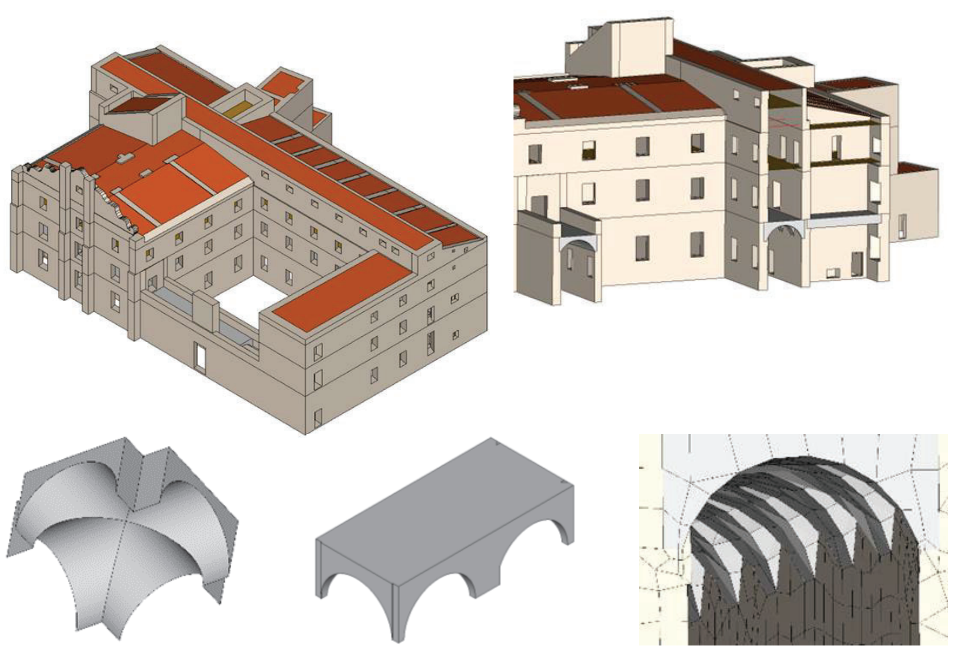
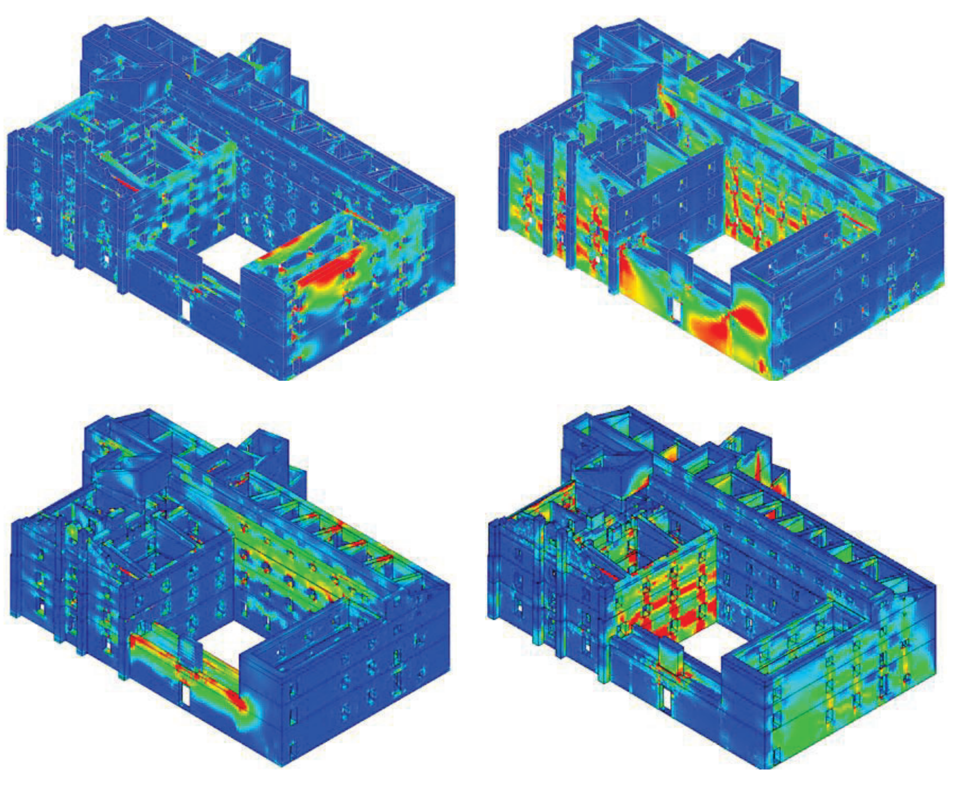


Figure 3. Finite element model of the case study

The preliminary analysis points towards numerous structural components in the building that experience stresses higher than the elastic tensile limit. Critical zones with a high shear stress concentration are also identified (using the local modes) to provide recommendations for further strengthening/retrofitting.



The assessment further reveals substantial out-of-plane bending of critical structural components (identified by the local vibration modes) at very low peak ground acceleration levels.

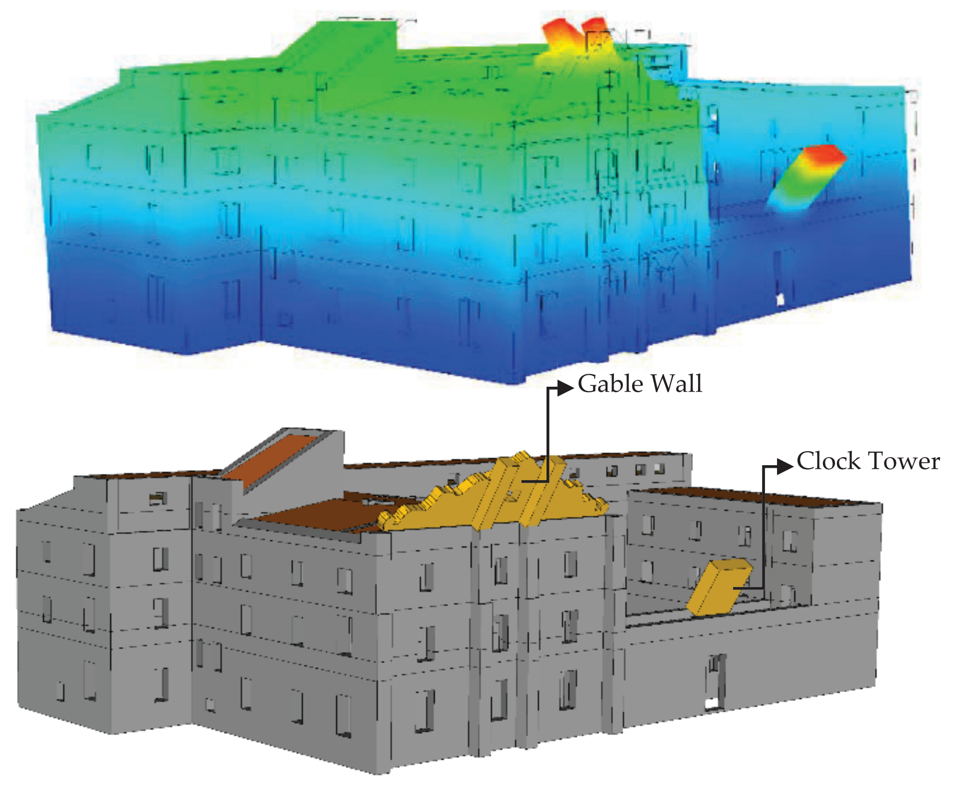


Figure 4. Overview of the critical zones

Reference

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