Evaluating Seismic Site Effects at Cultural Heritage Sites in the Mediterranean Area

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Present study concern integrated geophysical and numerical simulation aiming at evaluate the seismic vulnerability of cultural heritage sites. Non-invasive analysis targeted to characterize local site effects as well as dynamic properties of the structure were performed. Data were collected at several locations in the Maltese Archipelago (central Mediterranean) and in some historical buildings located in Catania (Sicily). In particular, passive seismic techniques and H/V data where used to derive 1D velocity models and amplification functions. The dynamic properties of a building are usually described through its natural frequency and the damping ratio. This latter is important in seismic design since it allows one to evaluate the ability of a structure to dissipate the vibration energy during an earthquake. The fundamental frequency of the investigated structure was obtained using ambient vibrations recorded by two or more sensors monitoring the motion at different locations in the building. Accordingly, the fundamental period of several Maltese Watchtowers and some historical buildings of Catania were obtained by computing the ratio between the amplitudes of the Fourier spectrum of horizontal (longitudinal and transverse) components recorded on the top and on the ground floors. Using ANSYS code, the modal analysis was performed to evaluate the first 50 vibration modes with the aim to check the activation of the modal masses and to assess the seismic vulnerability of the tower. The STRATA code was instead adopted in the Catania heritage buildings using as reference earthquake moderate to strong shocks that struck south-eastern Sicily. In most of the investigated buildings is was not possible to identify a single natural frequency but several oscillation modes. These results appear linked to the structural complexity of the edifices, their irregular plan shape and the presence of adjacent structures. The H/V outside the buildings were used to determine predominant frequencies of the soil and to highlight potential site-to-structure resonance. The achieved findings can represent useful clues for further additional engineering investigations aiming at reducing the seismic risk, highlighting how the structural complexity and the local seismic response play an important role on building damage.

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Feedback/Corrections?