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The analysis of fundamental period of cultural heritage buildings: experimental data for church towers in Basilicata (Southern Italy)

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Seismic hazard is among the main factors conditioning the conservation of historical centres and cultural heritage located in them. This consideration is suitable especially for downtown areas located in Italy, whose territory is prone to seismic hazards, in the southern area especially. As a matter of fact, the historical sources inform us that most of monuments located in Southern Italy suffered damage and consequent restoration or rebuilding due to the earthquake of the past. Therefore, knowing what buildings are the most exposed to the seismic risk can help the stakeholders to fix priority actions aimed at mitigating the effects of future events.
Starting from these preliminary remarks, in the framework of the Project PRO_CULT, we started an extensive campaign of measurements of dynamic features of the church towers in some towns of the Basilicata Region (Southern Italy).
The aim of the research activity is to assess the fundamental period of such a typology of historical buildings and comparing it with the dynamic features of the foundation soil to put into evidence possible resonance phenomena responsible of an increase of building damage during the seismic shaking.
The selection of the towns to be considered as a target of the experimental survey was performed taking into account the availability of written sources dealing with the historical seismic effects suffered by the bell-towers over the centuries with special attention to the sites heavily affected by the 16 December 1857 Basilicata and 23 November 1980 Irpinia-Basilicata earthquakes (Gizzi and Masini 2007).
The fundamental period of bell-towers is estimated using ambient noise vibration signals recorded at the highest level of the towers. The techniques used to get the dynamic values are both the Horizontal to Vertical Spectral Ratio (HVSR) and the Horizontal to Horizontal Spectral Ratio (HHSR) (Liberatore et al. 2008). Once the fundamental frequency has been estimated, it is compared with the dynamic features of the soil obtained by free-field measurements.
The detailed architectural survey of each investigated tower will also allow correlating the estimated frequencies with the features of the historic building such as structural symmetry, number of storeys and height of the tower, building materials, presence and dimension of openings, presence of tie rods, and presence of adjoining buildings. In this way, we can get new insights for a tentative scheme of typological classification of such historic buildings.

References

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