

Simplified methods for seismic vulnerability assessment of Italian masonry churches

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ABSTRACT

The Italian monumental buildings, and particularly churches, are affected by an exceptional seismic vulnerability: one need only think to the large amount of damages and collapses occurred on about ten thousand churches in the aftermath of the last Italian seismic events (e.g. Umbria-Marche, 1997; Molise, 2002; L’Aquila, 2009; Emilia, 2012; Central Italy, 2016-17). The importance of preserving the enormous and widely distributed ecclesiastic heritage induces to face such an important challenge at a territorial scale. With reference to this complex issue, a national project, namely MaRS, is being developed, promoted by the agreement between the Italian consortium ReLUIS and the Department of Civil Protection (DPC). The main goal of this research project, that involves various Italian university departments, is to implement seismic risk maps at a national scale for different building typologies (e.g. schools, bridges, residential buildings, etc.), including masonry churches. One of the hardest challenges regarding this structural typology is to implement vulnerability assessment methods based on the limited available informations. Based on these premises, a simplified method aimed at defining seismic vulnerability classes for masonry churches using only qualitative parameters is presented in this paper. The proposed method has been calibrated on the basis of the damage scenario observed on about two hundred churches in the aftermath of the L’Aquila (2009) and Central Italy (2016-17) earthquakes [1] [2]. Therefore, for each inspected church an analytical vulnerability index has been calculated following the macro-element approach proposed by the Italian Guideline of Cultural Heritage, considering the presence of anti-seismic devices and fragility indicators, as well as their influence in inhibiting or enhancing the development of damage mechanisms. Then, vulnerability classes has been defined and sensitivity analyses have been carried out in order to identify the parameters that mainly influence the seismic vulnerability of the detected churches. By means of these preliminary analyses and based on similar studies present in literature [3], a new simplified empirical method, calibrated in order to obtain the same results in terms of vulnerability classes, is proposed considering only qualitative information available at a national scale. Even if with a certain degree of approximation, a good correspondence between the implemented methodology and the analytical one can be revealed in the outcomes, setting the stage for a wider application.

REFERENCES

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