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# A mechanical-based calibration for a rapid vulnerability assessment of masonry buildings subject to floods

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ABSTRACT

The frequency and the extension of high intensity flood events are expected to increase in the nearest future because of to the intensification of the hydrological cycle caused by the climate change (Tabari (2020)). Therefore, the development of risk assessment strategies, aimed at quantifying the flood risk of large areas is a research topic of great relevance. Masonry buildings represent a structural typology that could be highly vulnerable to the action of high intensity floods. In fact, the masonry walls generally lack of out-of-plane strength and, if subject to high intensity hydraulic forces (Marvi (2020)), can undergo severe damage or collapses that can compromise the overall stability of the structure.

In order to cope with this problem, in this work we propose a rapid tool for the risk assessment of masonry structures subject to floods (Capparelli et al.(2023)). The proposed strategy is based on the estimation of a risk class, through the calculation of a simplified damage level (DL) that is a function of two indices, namely a Hazard Index (HI) and a Vulnerability Index (VI). Both indices are linear combinations of scores and weights assigned to some indicators of the event, for HI, and of the intrinsic structural features (VI). One of the key aspects of the proposed approach resides in its calibration that is carried out by adopting the results of numerical simulations.

The numerical simulations, based on a Finite Element model of the masonry building, are first employed to detect the most significant parameters. Subsequently, a large population of buildings and events is generated using a Monte Carlo approach and analysed. Finally, the best fit between the DL estimated by the proposed method and that evaluated through the numerical simulations is found.

The accuracy of the proposed method is tested by comparing the obtained results with those provided by the accurate numerical simulations. Then, the method is applied to assess the vulnerability to three different floods of the buildings located near the river Esaro, in the municipality of Crotone, Italy. The application of the method has required input data easily obtained through outdoor site visits and by consulting available census database. The results can help to identify the most at-risk buildings, providing valuable guidance on necessary mitigation or retrofitting measures.

**References**

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