International Doctorate in Civil and Environmental Engineering

Mechanical response of masonry panels subjected to seismic action

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Abstract

Italy is a territory characterized by a high seismic risk: the assessment of the structural vulnerability is the key aspect for the seismic risk reduction. Nonlinear static analysis is the most common and recommended analysis procedure to evaluate seismic vulnerability of masonry buildings.
Beside the known issues of nonlinear static analyses such as the choice of the loading pattern and appropriate equivalence of the structural behaviour with a single degree-of-freedom system (problems that are common to all kind of structures and that originated –for example– the research on adaptive push-over analyses), there is a further concern for masonry structures, namely the correctness of N2 method (proposed by Italian and European Building Code) to perform vulnerability assessment using nonlinear static analysis. Within such approach, in fact, the displacement demand is assumed to be the same of an elasto-plastic oscillator. However, as shown in some experimental studies, masonry panels are characterized by a quite different cyclic behaviour, as a function of their failure mechanism: masonry panels with low compression level exhibit a rocking behaviour, characterized by small permanent displacements, low damage, and almost absent energy dissipation; panels with higher compression level and small height-to-width aspect-ratio exhibit diagonal cracking, with significant stiffness reduction and lower ductility; finally, panels with very high compression exhibit permanents displacements due to toecrushing, resembling therefore an elasto-plastic cyclic behavior, although with a very small ductility.
Therefore, considering their individual behaviour, it can be concluded that the seismic displacement demand of masonry structures can be significantly different from the one of reinforced-concrete and steel frames, for which the currently adopted nonlinear static analysis has been developed.

References
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