

Correlation studies for the in-plane analysis of masonry walls based on macroscopic FE models with damage

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ABSTRACT

Macromechanical finite element (FE) based models are today the most convenient modelling approach when engineering large to super large problems are tackled. The real heterogeneous masonry material is substituted by an effective homogeneous continuum medium, where proper and complex phenomenological constitutive laws have to be introduced. This study explores the use of macro-modelling techniques based on damage and coupled damage-plastic constitutive laws for the cyclic in-plane response prediction of masonry panels.

The numerical investigation is focused on two material constitutive macro-models, known as Total Strain Cracking and Crack and Plasticity models [1]. These show some limitations when analysing the behaviour of masonry structures subjected to in-plane cyclic loading. The latter issues are somehow overcome by introducing an enriched version of the Drucker-Prager model including cohesive softening. A suite of numerical simulations was performed considering the experimental campaign from [2], where a comparison on distinctive features of flexural and shear response of masonry panels is addressed. The adopted material and mechanical properties are deduced from literature references.

The numerical simulations using the adopted two FE macro-models allow the direct comparison between approaches but, as well, with the experimental outcomes. The effects of the geometry, stiffness degradation, and post-peak energy dissipation are investigated. Furthermore, comparisons with other macro-mechanical models are performed. The results are shown in terms of the global in-plane cyclic response of masonry panels, that is envelope capacity curve and crack mechanisms.

REFERENCES

- [1] DIANA, 2019, DIplacement ANALyzer finite element software package, version 10, DIANA FEA, Delft, <https://dianafea.com>
- [2] Anthoine, A., Magonette, G., Magenes, G., 1995. Shear-compression testing and analysis of brick masonry walls, in: Proceedings of the 10th European Conference on Earthquake Engineering, pp. 1657 – 1662.