Macromechanical damage model for the 2D analysis of masonry structures

***†Cristina Gatta[1] and Daniela Addessi[1]**

[1] Department of Structural and Geotechnical Engineering, Sapienza University of Rome, Italy.

*Presenting author: cristina.gatta@uniroma1.it
†Corresponding author: cristina.gatta@uniroma1.it

Abstract

Over the last decades, enormous research efforts have been devoted to understand and predict masonry mechanical behavior. This appears to be very complex due to the composite nature of the material made up of units, blocks or bricks, and mortar joints and the strongly nonlinear constitutive response. Several modeling strategies have been adopted, ranging from simplified to very sophisticated models [1]. Within the finite element framework, multi-scale and micromechanical descriptions provide accurate predictions of the structural response but require high computational effort. To overcome this drawback, the heterogeneous masonry can be regarded as a fictitious homogeneous continuum by adopting a macromechanical modeling technique.

Stemming from these considerations, in this work a phenomenological damage model for the 2D analysis of masonry structures is presented. This is a further enrichment of a recently proposed isotropic damage-plastic model [2]. Here, an orthotropic description of the elastic and inelastic behavior is introduced. Hence, mortar joints act as planes of weakness and their orientation, with respect to the applied stresses, strongly affect overall response [3]. The stiffness degradation due to crushing, cracking and shear is captured by properly defining a damage matrix, considering independent damage variables, whose evolution is ruled by equivalent strain measures.

The model is included into a finite element procedure and is validated through the comparison of numerically evaluated responses and experimental outcomes. Finally, a nonlocal formulation is adopted to efficiently overcome mesh dependency drawback.

Keywords: **Masonry, damage, macromechanical modeling, orthotropic behavior**

References

[1] Roca, P., Cervera, M., Gariup, G. and Pelà, L. (2010) Structural analysis of masonry historical constructions. Classical and advanced approaches, *Archives of Computational Methods in Engineering*, **17**, 299-325.

[2] Gatta, C., Addessi, D. and Vestroni, F., Static and dynamic nonlinear response of masonry walls. (submitted).

[3] Dhanasekar, M., Page, A. W. and Kleeman, P. W. (1985) The failure of brick masonry under biaxial stresses, *Proceedings of the Institution of Civil Engineers*, **79**, 295-313.