Advanced tools for fast micro-modelling of masonry structures

M. Petracca[*1], C. Marano[2], G. Camata[2] and L. Pelà[3]

[*1]ASDEA Software
Via Breviglieri, 8 - 65128 Pescara, Italy
web: https://asdeasoft.net

[2] Università degli Studi G. d'Annunzio Chieti e Pescara
Department of Engineering and Geology (InGeo)
Viale Pindaro, 42 - 65127 Pescara, Italy

[3] Universitat Politècnica de Catalunya (UPC-BarcelonaTech)
Department of Civil and Environmental Engineering
Jordi Girona 1-3, 08034 Barcelona, Spain

ABSTRACT

Among all the approaches commonly used to study masonry structures, micro-modelling is the most accurate. Masonry can be seen as a composite material made of bricks and mortar joints. Their different mechanical properties, their geometry and their arrangement inside the micro-structure, lead to very complex behaviours that are often difficult to represent using equivalent homogenous constitutive models commonly available in commercial and research FEM solvers. Micro-modelling can capture the complex non-linear behaviours of masonry by explicitly modelling the micro-structure inside the computational model. Micro-modelling leads to models with a large number of finite elements, thus increasing prohibitively the computational time. This is also due to the problem of solving complex nonlinear solutions involving damage and strain localization, leading to very small time-steps required to achieve convergence. Another issue with micro-modelling is the increased complexity in generating the finite element mesh with all the details of the micro-structure.

This work presents some advanced tools that can decrease the high computational time required by micro-modelling. A 2-parameter tension-compression plastic-damage constitutive model is presented as an extension of an existing model previously formulated by some of the authors [1-3]. The model is implemented in the open-source FEM code OpenSEES with the IMPL-EX method, a mixed implicit-explicit integration method that renders the response of this constitutive model step-wise linear, thus removing the convergence issues typically encountered when dealing with softening responses. This research also presents a tool implemented in the STKO (Scientific ToolKit for OpenSees) pre- and post-processor [4] able to automatically convert a homogeneous CAD geometry of a building into a micro-model.

REFERENCES

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