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Northwestern University:
W. K. Liu, T. Belytschko, B. Moran, L. Keer, H. Espinosa
University of California, Los Angeles (UCLA):
J. S. Chen, J. W. Ju, E. Taciroglu, S. Osher, N. Ghoniem

A CM Modeling of the Shear Test on Masonry

Ferretti Elena, Casadio Elena, Ricci Patrizia, Di Leo Antonio

Abstract

The Cell Method (CM) is applied in order to investigate the failure mechanisms of masonry walls under shear force. The direction of propagation is computed step-wise by the code, and the domain is updated by means of a propagation technique of intra-element nodal relaxation with re-meshing. The crack extension condition is studied in the Mohr/Coulomb plane, using the criterion of Leon.
The main advantage of using the CM for numerical analyses of masonry is that the mortar, the bricks and the interfaces between mortar and bricks can be modeled without any need to use homogenization techniques, simply providing each of them with their own constitutive properties. The capability of CM to handle domains with more than one material is exploited to capture how the propagation direction changes when the crack overcome the joints or passes from the brick to the interface and to the mortar. Also the principal stresses and the principal directions of stress are mapped for the bricks, the interfaces and the mortar.
In comparison with those presented in previous studies ([1], [2]), the computational capabilities of the CM code have been improved considerably. Actually, a new version of the CM code has been implemented, which is able to self-compute the position of crack initiation and manage several cracks propagating at the same time. This allows us not to impose a-priori the number and the position of crack initiations, letting the code estimate them as the imposed displacement is increased.
Interactions between propagating cracks are simply taken into account by the code, leading to modification of the failure direction or to crack arrest as soon as a new crack activates. The code is also able to self-estimate whether or not one or more cracks bifurcate and to follow the propagation of each branch of bifurcation.

References

1. E. Ferretti, “Crack propagation modeling by remeshing using the Cell Method (CM)”, Computer Modeling in Engineering & Science, v. 4, No. 1, p. 51-72, 2003.
2. E. Ferretti, “A Cell Method (CM) Code for Modeling the Pullout Test Step-Wise”, Computer Modeling in Engineering & Science, v. 6, No. 5, p. 453-476, 2004.