A new CM code for modeling cracks in masonry walls

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The Cell Method (CM) is applied here in order to investigate the failure mechanisms of masonry walls under shear force. The direction of propagation is computed step by step by the code, and the domain is updated by means of a propagation technique of nodal relaxation intra-element with re-meshing. The crack extension condition is studied in the Mohr/Coulomb plane, using the criterion of Leon. The direction of propagation is computed as the slope of the line joining the Mohr's pole to the point tangent to the Leon limit surface.

The main advantage of using the Cell Method for numerical analyses of masonry walls is that the mortar, the bricks and the interfaces between mortar and bricks can be modeled without any need to use a homogenization technique, simply providing each of them with their own constitutive properties. The capability of the CM to handle domains with more than one material is exploited here 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 here considerably. Actually, a new version of the CM code has been set out, 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.

The stress analysis and the complete failure path are provided here for masonry panels of several dimensions, with several boundary conditions between panels and testing machine.

References

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