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MODELING IN-PLANE, OUT-OF-PLANE AND COMBINED FAILURES OF URM STRUCTURES USING A NEW FINITE-DISTINCT MACROELEMENT MODEL

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ABSTRACT

A new Macro-Distinct element model (M-DEM) for the low-cost analysis of both in-plane, out-of-plane and combined failure mechanisms of unreinforced masonry (URM) structures is presented in this work. According to the M-DEM, which is the first macroelement model ever implemented in a discontinuum framework, Finite Element (FE) homogenized macro-blocks are connected by discrete spring interfaces, which accounts for shear/tension damage. Compressive failure, instead, is modeled within the FE macro-blocks, whose layout is determined a priori as a function of the masonry bond pattern. To validate the proposed modeling strategy, previous experimental tests on reduced and full-scale URM specimens are selected and simulated. Both static and dynamic loading protocols are considered, as well as a variety of different masonry types, boundary conditions, vertical surcharges, and confinement levels. The results indicate that the M-DEM can satisfactorily reproduce the behavior of in-plane and out-of-plane-loaded URM components, as well as their response under combined actions, in a reasonable timeframe, in terms of both force-displacement relationship, dissipated energy and failure modes.

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