A lattice model for the failure of reinforced cementitious shells

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Abstract

Shell structures made of reinforced cementitious composites are often curved and slender, making their failure process complex due to the strong interaction of material and geometric nonlinearities. A new lattice approach is proposed for modelling this failure process. The model is an extension of a 3D frame element formulation based on the rigid-body spring concept proposed in [1]. The shell geometry is discretised into a lattice of elements, with cross-sections of the elements selected so that the shell volume is fully represented [2]. Geometric nonlinearity is modelled by considering large rotations. Material nonlinearity is incorporated by evaluating the vectorial constitutive response at multiple points of the cross-sections of the elements with a damage-plasticity constitutive model relating generalised internal forces to normalised displacement jumps. Interaction of the cementitious matrix and the reinforcement is modelled by link elements [3,4]. The model is applied to multiple benchmarks for the elastic response of shells. It is then used to study the failure response of reinforced cementitious shells.

Key words: *Shells; reinforced cementitious materials, material nonlinearity, geometric nonlinearity*

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