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BEAM-PARTICLE MODELING OF DISCONTINUOUS CRACK GROWTH IN CONCRETE

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Softening of concrete can be explained by two different mechanisms [1] : the formation of micro-cracks and the macro-crack bridging. To capture numerically those mechanisms, a fine description of crack initiation and propagation must be achieved.

Discrete Elements Models (lattice models or particle models) are designed to describe discontinuous mediums. Therefore, those models are suitable to simulate and study the failure mechanisms of quasi-brittle materials such as concrete.

The model used here combines the lattice approach and the particle approach [2]. Lattice models have been used to study the brittle and quasi-brittle behaviour in tension but cannot describe the fracturing process in compressive and shear mode. Particle models have been proposed to study the behaviour of granular assemblies in contact under compression or shear and cohesion can added to study tensile behaviours but the framework leads to much higher computation time than lattice models. Therefore, a combination is used to correctly reproduce the failure pattern for compressive or tensile simulations with reasonable computational costs.

In this beam-particle model, heterogeneities are introduced by assigning random values for the breaking thresholds. The choice of the probability distribution allows to model discontinuous crack growth.

The confrontation with two complex test cases of mixed-mode failure [3] is performed to give us further insights in the ability of our approach to capture the complex behaviour of concrete during failure.

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