Mesoscale FE simulation of concrete submitted to fatigue:
use of strong discontinuities

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ABSTRACT

We present in this work a Finite Element based model, which is devoted to describe failure mechanics of concrete submitted to fatigue. The material is studied at mesoscale. The model is formulated in a sound framework of the Enhanced Finite Element Method (E-FEM) [1][2]. As internal enhancements, two kinds of discontinuities are performed. On the one hand, strong discontinuities aim to illustrate cracks and fractures. On the other hand, weak discontinuities are used to describe heterogeneities. As materials exhibiting hysteresis, it is natural to assume that hysteresis and fatigue are linked with each other [3]. Thus in addition to the initiations and propagations of cracks, the closure of cracks is also taken into account.

As a first step of validation, the proposed model is applied to reproduce the mechanical responses of heterogeneous material. We show the ability of the model to simulate some of the main characteristics of such materials, for instance, the emerged asymmetric traction/compression response, and hysteresis loops at macro-scale are also observed for cyclic loadings.

Further, we compare the simulation results to experimental ones [4]. The studied concrete material is composed of a matrix of cement and aggregates. By applying the same formulations and loadings, the proposed model succeeds in reproducing the macroscopic responses for monotonic and cyclic compression tests.

REFERENCES