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AN EIGENEROSION-PLASTICITY APPROACH TO MODEL CONSTITUTIVE BEHAVIOR OF CONCRETE

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A convenient numerical method to model discontinuities in brittle elastic solids is the eigenfracture scheme. Despite the good results for static and dynamic linear elastic cases [1], more complex material behavior requires a thorough understanding of the processes occurring at the crack tip in order to attribute a reliable mathematical description for simulation purposes.

With its convergence to Griffith fracture theory in the limit case and the regularization done by introducing the concept of crack neighborhood, additionally, having also low implementation and computation costs, the eigenerosion approach is a competitive method for fracture simulations, [2]. In this work, a robust method to model the softening behavior of geomaterials, e.g. concrete, is presented. Plasticity is introduced to describe the initial hardening of the material. To do so, Drucker-Prager plasticity is considered, which is formulated in the microplane framework, proven to be suitable for modeling concrete-like material behavior [3]. The main feature, that one gains from the microplane approach, is the induced anisotropy which is often observed in failure of concrete. A volumetric-deviatoric split of the free energy function is taken into account. In order to regard for plasticity as well, the accumulation of plastic strains at a material point contribute on increasing the crack driving force at this point/element. The combination of plasticity and fracture to capture the softening behavior is crucial if one would like to model cyclic loading conditions.

The introduced scheme is implemented into a standard displacement finite element software. Numerical examples taken from the literature and comparisons to experimental results prove the ability of the approach. Although the tests take place in the small strain regime, expanding to large strains does not appear to have any particular difficulty.

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