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MIXED FINITE ELEMENTS FOR STRAIN LOCALIZATION UNDER MONOTONIC, CYCLIC AND DYNAMIC LOADINGS

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It is well established that the standard FE formulation produces mesh-biased results in many situations. Additionally, in cyclic loading situations, isotropic damage models are inadequate for considering the microcrack closure-reopening (MCR) effects, making the use of orthotropic models mandatory.
Recently, mixed finite elements have been re-examined by [1-2] to deal with cracking problems with enhanced accuracy using isotropic and orthotropic damage. The use of an independent approximation for the strain field increases the accuracy of the computed stress and strain fields, resulting in a more precise computation of the nonlinear behaviour. In this way mesh-bias independent outcomes are obtained without the need of auxiliary crack tracking techniques or other computational schemes that alter the continuum mechanical problem.
In this work, the mixed formulation is used together with orthotropic damage to compute strain localization problems under monotonic, cyclic and dynamic loading in 2D and 3D simulations. The proposed model is capable of considering tensile and compressive damage, as well as the phenomena of MCR effects and irreversible strains that appear during cracking development. In order to assess the feasibility and accuracy of the method, an extensive comparison with experimental evidence is included. The correlation with the experimental tests shows the capacity of the mixed formulation to reproduce the experimental crack path, failure mechanism and the force-displacement curves with remarkable accuracy.

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