COHESIVE CRACK PROPAGATION ANALYSIS IN DAMAGING NONLOCAL CONTINUA

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The limit state analysis for fracture propagation in large concrete structures, like e.g. large concrete dams, is still a challenging task from the computational standpoint. A finite element code to be used for this purpose should be equipped with specific procedures allowing to: generate a large scale initial mesh; avoid the mesh dependence due to loss of ellipticity of the equation governing the boundary value problem and consequent strain localization in the early stage of damage evolution; adapt the mesh on the basis of suitable indicators to resolve the shrinking localization band during damage growth; account for material separation in the late stage of damage growth for vanishing material strength.

In the present work an integrated strategy for the analysis of quasi-brittle continua up to the fracture limit state is proposed. In the initial stage of damage growth, the material can be considered to be macroscopically integer and the use of a damage continuum model is justified. Mesh dependence is avoided through the formulation of a nonlocal model in the line of what originally proposed by Bažant and Pijaudier-Cabot [1] and more recently by Comi [2]. The mesh refinement for the resolution of the localization band is driven by an analytical estimate of the current bandwidth. The accuracy and effectiveness in 2D mixed mode conditions of the estimates of the process zone width obtained either by means of a dynamic perturbation analysis or by a static bifurcation analysis, are investigated [2, 3].

When the bandwidth is estimated to shrink below a pre-assigned threshold, a *cohesive crack* is introduced into the model. The nodes whose support is crossed by the crack, are enriched according to the partition of unit concept so that a displacement discontinuity can be represented at minimal cost, independently of the original mesh layout [4, 5]. The remaining fracture energy still to be dissipated at the moment of the transition is transferred from the damaged continuum to the discrete cohesive law through an energetic equivalence [6].

Numerical examples where the proposed methodology is tested are presented and critically discussed.

References

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