Modelling interfaces with elastoplastic damage behavior using a dissipation controlled path-following constraint

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ABSTRACT

In order to accurately predict the ultimate limit state of a structure, it is commonly required to consider its complex material behavior. Examples include concrete and masonry walls that are characterized by a softening response. In masonry walls, failure primarily occurs in the mortar joints between the bricks, allowing to model the structure using elastoplastic interface elements [1]. This is computationally efficient as the non-linearity of the model is concentrated in the interface elements and the bricks can be treated as linear elastic. Commonly, dynamic relaxation methods are adopted, and an artificial mass and time step are introduced to trace the static equilibrium path of the structure by means of a dynamic solver.

In this presentation, an elastoplastic damage model is incorporated in the interface elements using an energetic framework [2]. This results in a non-convex free-energy functional, which requires careful treatment during the minimization process. Commonly, a staggered solution scheme is adopted based on the algorithmic decoupling of the displacements, damage variable and hardening parameter. This process results in convex subproblems that can be solved using an interior-point algorithm. The staggered scheme is extended by a dissipation controlled path-following constraint to track the full equilibrium path [3]. This allows to trace snap-backs, which cannot be computed when dynamic relaxation methods are used.

The performance of the proposed methodology is compared to the performance of conventional methods on examples such as the fracture of a perforated beam and a direct shear test under normal compression on a small brick assembly.

REFERENCES

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