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Modeling Anisotropic Damage Algorithms of Metallic Structures

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Abstract : The present paper is concerned with the numerical modeling of the inelastic behavior of the anisotropically damaged ductile materials, which are based on a generalized macroscopic theory within the framework of continuum damage mechanics. Kinematic decomposition of the strain rates into elastic, plastic and damage parts is basis for accomplishing the structure of continuum theory. The evolution of the damage strain rate tensor is detailed with the consideration of anisotropic effects. Helmholtz free energy functions are constructed separately for the elastic and inelastic behaviors in order to be able to address the plastic and damage process. Additionally, the constitutive structure, which is based on the standard dissipative material approach, is elaborated with stress tensor, a yield criterion for plasticity and a fracture criterion for damage besides the potential functions of each inelastic phenomenon. The finite element method is used to approximate the linearized variational problem. Stress and strain outcomes are solved by using the numerical integration algorithm based on operator split methodology with a plastic and damage (multiplicator) variable separately. Numerical simulations are proposed in order to demonstrate the efficiency of the formulation by comparing the examples in the literature.

Keywords : anisotropic damage, finite element method, plasticity, coupling
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