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Three-Dimensional Modelling of Thermo-Elasto / Viscoplastic Solids Containing Adiabatic Shear Bands

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Adiabatic shear banding is here considered as an anisotropic continuous damage process in the context of finite anisotropic elasto-irreversible strains. The anisotropic mechanical degradation induced by the bands is dealt with by using a tensorial damage variable, and the kinematic consequences of the presence of the bands are described by means of the corresponding part of the velocity gradient. Constitutive equations are derived from thermodynamic potentials namely the free energy and dissipative potentials. The hypothesis of a single yield function has been put to describe the strong coupling between plasticity and damage. The conditions of adiabatic shearing initiation and band orientation are obtained from a simplified analysis based on the linear theory of perturbations. The three-dimensional constitutive model has been implemented in the finite element code LS-DYNA. Its predictive capabilities are encouraging considering numerical simulations performed on boundary value problems related to dynamic hat shape structure test.

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