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Simulation of Lueders bands using regularized large strain elasto-plasticity. (English)

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Summary: This paper deals with the numerical simulation of an instability phenomenon called Lueders bands with two regularized material models: viscoplasticity and gradient-enhanced plasticity. The models are based on large strain kinematics and temperature-dependence is incorporated. The Huber-Mises-Hencky yield condition and multi-branch hardening are employed. After a brief presentation of the constitutive description, test computations are performed using AceGen and AceFEM symbolic packages for Wolfram Mathematica. The first benchmark is a rectangular tensile plate in plane strain isothermal conditions. For the viscoplastic model, simulation results for different values of viscosity, loading duration and enforced displacement are compared. For the gradient model different internal lengths are used. Mesh sensitivity of the results and the influence of boundary conditions are also examined. Next to the Lueders-type response to a softening-hardening yield strength function, an additional softening stage leading to failure is also considered. The second example concerns a bone-shape sample under tension, for which, next to mesh sensitivity and the effect of regularization, the influence of heat conduction on simulation results is evaluated.

MSC:

74C15 Large-strain, rate-independent theories of plasticity (including nonlinear plasticity)
74S05 Finite element methods applied to problems in solid mechanics

Keywords:

Lueders bands; viscoplasticity; gradient plasticity; thermo-mechanical coupling; parametric study

Software:

AceGen; Mathematica; AceFEM

Full Text: DOI

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