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ELASTO-PLASTIC MODEL BASED ON THE THIRD INVARIANT OF THE DEVIATORIC STRESS TENSOR: MONOTONIC AND CYCLIC LOADING APPLICATION.

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In this contribution, a new elasto-plastic model, based on the J_2 theory but also dependent on the third invariant of the deviatoric stress tensor, J_3, is proposed. The study starts with both quantitative and qualitative analyses of several elasto-plastic models reported in the literature which also considers the effect of J_3, including those proposed by Hosford , Bai and Gao, amongst others. In the sequence, three new possibilities for the introduction of the third invariant effect on the plastic flow rule of the material are considered. Mathematical models considering nonlinear isotropic hardening (for application in monotonic loading) and non-linear kinematic hardening, as proposed by Chaboche (for application in cyclic loading) are addressed. Numerical integration algorithms based on the operator split methodology and backward Euler scheme are developed. In order to assess the resulting model, numerical simulations are carried out simulating mechanical tests upon specimens subjected to simple shear and combined shear/tensile/compression loading conditions. The evolution of the equivalent plastic strain at fracture and the reaction curves are analysed. The resulting simulations exhibit good correlation with experimental data under condition of predominant shear loading.

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