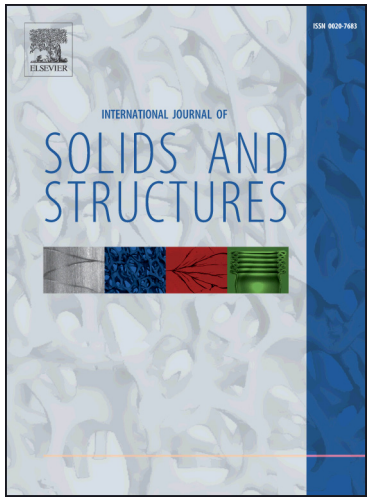

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A non-associated plasticity model with anisotropic and nonlinear kinematic hardening for simulation of sheet metal forming

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Abstract

A material model for more thorough analysis of plastic deformation of sheet materials is presented in this paper. This model considers the following aspects of plastic deformation behavior of sheet materials: (1) the anisotropy in yield stresses and in work hardening by using Hill's 1948 quadratic yield function and non-constant stress ratios which leads to different flow stress hardening in different directions, (2) the anisotropy in plastic strains by using a quadratic plastic potential function and non-associated flow rule, also based on Hill's 1948 model and r-values, and (3) the cyclic hardening phenomena such as the Bauschinger effect, permanent softening and transient behavior for reverse loading by using a coupled nonlinear kinematic hardening model. Plasticity fundamentals of the model were derived in a general framework and the model calibration procedure was presented for the plasticity formulations. Also, a generic numerical stress integration procedure was developed based on backward-Euler method, so-called multi-stage return mapping algorithm. The model was implemented in the framework of the finite element method to evaluate the simulation results of sheet metal forming processes. Different aspects of the model were verified for two sheet metals, namely DP600 steel and

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