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Investigation on springback behaviours of hexagonal close-packed sheet metals. (English)

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Summary: In this study, a novel analytical method for predicting bending and springback behaviours of hexagonal close-packed (HCP) sheet metals is presented. The proposed analytical approach is developed by using the Cazacu-Barlat 2004 asymmetric yield function and isotropic plastic hardening rule. This model can be used to determine bending moment-curvature relationships and springback of HCP metals under uniaxial and plane strain loading conditions. Furthermore, to capture the nonlinearity in unloading and to improve springback prediction, the variable elastic modulus approach is implemented in the proposed model. The proposed new model reveals that reverse effects of the back force on springback behaviours cannot be found under the plane strain condition, which could not be found by using any existing models. Moreover, the analytical model is implemented into Abaqus via UMAT subroutine for its application in complex cases, and a numerical model is then developed as a showcase. The proposed methods are validated by using those experimental results available in literature. The results show considerable improvements by considering the plane strain condition and nonlinear unloading.

MSC:

74H10 Analytic approximation of solutions (perturbation methods, asymptotic methods, series, etc.) of dynamical problems in solid mechanics

Keywords:

hexagonal close-packed metals; tension-compression asymmetry; springback; bending under tension; analytical and numerical method; plane strain condition

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