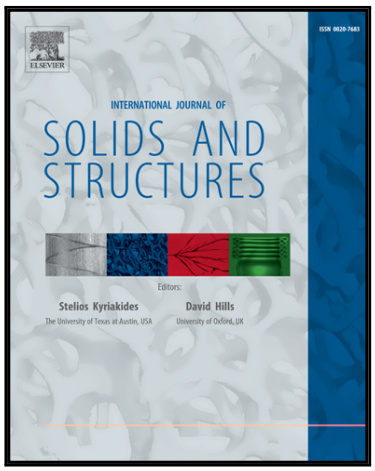

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Wei Tong, Mohammed Alharbi

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Comparative Evaluation of Non-Associated Quadratic and Associated Quartic Plasticity Models for Orthotropic Sheet Metals

Wei Tong and Mohammed Alharbi

Department of Mechanical Engineering, Lyle School of Engineering, Southern Methodist University, Dallas, Texas 75275-0337 USA

Abstract

A non-associated quadratic model and an associated quartic model are comparatively evaluated in this study for their description of anisotropic yielding and plastic flow of 21 representative sheet metals. The quartic yield stress function used in the associated model is a particularly reduced version of Gotoh's fourth-order polynomial that has only seven independent material constants. The same experimental inputs of four yield stresses and three plastic strain ratios of a sheet metal are used via simple algebraic relations to calibrate the seven material constants in each model. The modeling results of these selected sheet metals show that both models give nearly identical performance for sheet metal plasticity under uniaxial and equal biaxial tension and similar predictions under other plane stress states. The quadratic yield and flow stress functions are shown however to have a larger domain of admissible yield stress and plastic strain ratios for the case of planar isotropy and it is much easier to verify their strict convexity conditions in general. Once it has been calibrated for each sheet metal considered in this study, Gotoh's yield function is verified to be convex via a numerical minimization approach. A procedure is suggested to obtain an approximate but convex Gotoh's yield function in case an as-calibrated Gotoh's yield function is found to be non-convex. A reduced but convex 3D fourth-order polynomial yield function based on a convex Gotoh's 2D yield function is also

[1]The corresponding email: wtong@lyle.smu.edu