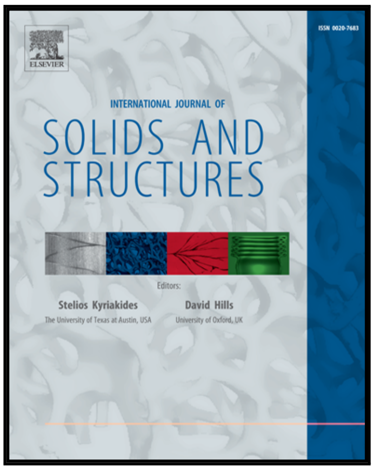

Numerical failure analysis of three-point bending on martensitic hat assembly using advanced plasticity and fracture models for complex loading

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PII: S0020-7683(16)00076-7
DOI: 10.1016/j.ijsolstr.2016.02.014
Reference: SAS 9059

To appear in: *International Journal of Solids and Structures*

Received date: 6 October 2015
Revised date: 3 February 2016
Accepted date: 8 February 2016

Numerical failure analysis of three-point bending on martensitic hat assembly using advanced plasticity and fracture models for complex loading

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Abstract. A variety of phenomenological models have been developed and validated at a specimen level to simulate plasticity and fracture of metallic materials using finite element analysis. It is both scientifically challenging and crucial for the industry to confirm their applicability at a structural level for the engineering practice. An outwardly simple three-point bending on a hot-stamped martensitic (22MnB5) hat assembly yields complex local loading histories, which eventually creates two symmetric macro cracks under a semicircular punch.

Attempts are made to numerically reproduce the deformed configuration with cracks using the Hosford-Coulomb fracture criterion, recently proposed by Mohr and Marcadet (2015). Two constitutive models of different complexity are compared: pure isotropic hardening with linear damage accumulation and combined isotropic − kinematic hardening with non-linear damage accumulation (Marcadet and Mohr (2015)). The model parameters are identified based on comprehensive mechanical tests. The latter model turns out to predict the location and shape of cracks with great accuracy by considering the dominance of kinematic hardening and enhanced ductility upon loading reversal. The force-punch stroke curves are compared with the experiment. Parametric studies are performed on the friction coefficient and possible anisotropic fracture properties. The deformation sequence is also analyzed.

Keywords: martensitic steel, hot-stamping, three-point bending, ductile fracture, Hosford, loading reversal, kinematic hardening

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