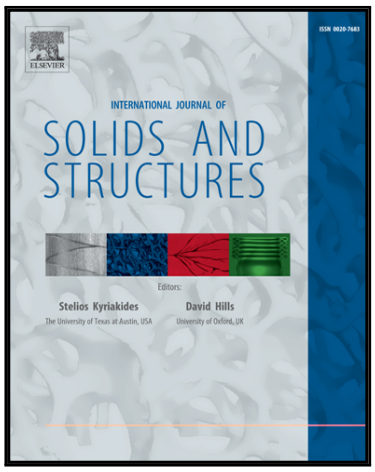

Damage accumulation and ductile fracture modeling of notched specimens under biaxial loading at room temperature

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PII: S0020-7683(17)30489-4
DOI: 10.1016/j.ijsolstr.2017.10.028
Reference: SAS 9780

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

Received date: 16 February 2017
Revised date: 30 August 2017
Accepted date: 25 October 2017

Please cite this article as: L. Derpenski , J. Szusta , A. Seweryn , Damage accumulation and ductile fracture modeling of notched specimens under biaxial loading at room temperature, *International Journal of Solids and Structures* (2017), doi: 10.1016/j.ijsolstr.2017.10.028

DAMAGE ACCUMULATION AND DUCTILE FRACTURE MODELING OF NOTCHED SPECIMENS UNDER BIAXIAL LOADING AT ROOM TEMPERATURE

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Keywords: ductile fracture, damage accumulation, biaxial loading, notched specimens, fracture criterion

Abstract: This paper presents the results of ductile fracture tests conducted on axisymmetric specimens with notch made from EN AW 2024 T351 aluminum alloy. Tests were conducted for five notch radius and seven cases of biaxial, proportional loading with tensile force and torsional moment. A model of damage accumulation and fracture based on variables of stress strain state and damage on a physical plane is proposed. The fracture criterion assumes that crack initiation will occur when a certain combination of normal and shear stress on the physical plane (elliptical criterion in the tensile stress zone and Coulomb criterion in the shear stress zone) reaches a critical value dependent on the value of the damage state variable on this plane. The damage accumulation law was formulated incrementally, and the increment of the damage state variable was made dependent on the increment of plastic deformations and stress values on the physical plane. This model was successfully verified by experimental tests and numerical simulations, which are presented in papers by (Derpenski, Seweryn, 2016a, 2016b)

1. Introduction

The fracture process is complicated in the case of materials exhibiting plastic properties, under both monotonic and cyclically loading conditions. Fracture initiation and propagation in ductile materials may depend on many factors, such as: the mechanical properties of material, shape of the structural element, technological process, service conditions, loading method). An extensive review of methods of modeling damage accumulation and fracture in materials under multi-axial loading states and experimental verification of these methods are presented in papers by Thomason (1990), Öchsner et. al. (2001), Bandst and Koss (2004), and Wierzbicki and Bao (2005). The ductile fracture process is considered on two scales. In the first approach (microscopic), it is assumed that fracture is the consequence of complex