A Criterion for Void Coalescence in Anisotropic Ductile Materials Based on Concepts of Continuum Damage Mechanics

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ABSTRACT

Anisotropy of ductile materials has an effect on damage growth rates and a value of the overall strain, at which the material breaks. A criterion for the onset of coalescence of voids in the material, that is, for the appearance of the transition stage from the stable growth of volume of voids as a result of distracted plastic deformation to the abrupt stage of the localized connection of neighbouring voids is a critical constituent of any predictive model for ductile fracture. Especially when this phenomenon occurs along with the macroscopic strain localization.

In this contribution, the method proposed by Tvergaard and Needleman (see in [1]) by means of the two-part yield condition (i.e. the first part producing the original yield loci for void volume fractions less than the void volume at which voids coalescence and the second part including the enhancement occurring for void volume fractions greater than this volume) is completed by the assumption that the close-to-zero value of the function of material continuity (which is defined according to concepts of continuum damage mechanics with the material length) triggers the coalescence of voids in the material [2]. This is consistent with the strain localization criterion proposed by Rice and Rudnicki.

Numerical predictions of void coalescence in the anisotropic ductile material have been created using own finite element code, written in FORTRAN, for analysis of plastic porous materials obeying the Hill's orthotropic criterion [3]. Results of computer calculations have been compared with the experimental data described in [4]. Two different stress update algorithms have been used in computer calculations.

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