Plastic ductile damage evolution and collapse of plates and shells

I. Kreja[1] & R. Schmidt[2]
[1]*Technical University of Gdansk, Poland*
[2]*Aachen University of Technology, Germany*

Abstract

This paper deals with modelling and simulation of plastic ductile damage evolution in thin-walled structures and its effect on the load-carrying behaviour in the geometrically and physically non-linear range of deformation. In this context, gradual stiffness degradation, damage evolution, local failure initiation, and final collapse of the structure are problems of primary interest. The approach adopted accounts for elastic-plastic material behaviour, isotropic as well as kinematic hardening, material damage, finite displacements and finite rotations. Finite element simulations illustrate the effect of material damage on the load carrying behaviour of thin-walled structures.

1 Introduction

The accurate determination of the ultimate load carrying capacity of thin-walled structures in the geometrically and physically non-linear range of deformation is of crucial interest for safe design of structural components in many problems of advanced technology, e.g. in mechanical, aerospace, and civil engineering. In this context recent results of material science in the field of damage mechanics concerning the initiation and progression of material damage should be used for modelling and simulation of the load-carrying behaviour of structures. The complex interaction of the different types of non-linearity, e.g. large deflections and rotations, elastic-plastic hardening material behaviour, and gradual stiffness degradation due to material damage evolution, poses a considerable problem for the numerical simulation of structures close to failure.

The majority of papers on material damage evolution in structural members deal with uniaxial tension and compression of bars or plane problems of flat

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