The present work is concerned with the numerical simulation of nonlinear behaviour in advanced composite material structures using the Finite Element method. Thereby special attention is paid to nonlinear material behaviour and shell structures. Often Fibre Reinforced Polymers are utilised within shell-like and layered structures because of their superior stiffness to weight ratio and the possibility to design material and structural behaviour, respectively. Unfortunately the use of a layered laminate may introduce the important failure mode of delamination. In this study phenomenological material models known from literature are presented, which are capable of describing the overall structural response including local effects like delaminations. Based on the work of [11] an anisotropic plasticity model combined with anisotropic hardening, which is capable to describe the overall nonlinear structural response, is first presented. In order to study the effect of the anisotropic hardening plasticity model structural examples are compared and assessed.

Secondly the frequently observed and very dangerous type of failure delamination is
considered in particular. For this the delamination process is described within a thin layer of finite thickness in the framework of three-dimensional finite shell-elements with layerwise Reissner-Mindlin kinematics [5]. The Hashin [15] delamination criterion is utilized in the framework of a softening plasticity formulation based on [34]. The softening behaviour is assumed to be linear with transition to an exponential function at high equivalent plastic strains. The approach is assessed through a comparison of experimental and numerical results of a DCB test. An elaboration on the overall approach can be found in [18].

Stichworte: composite, delamination, shells, finite elements, plasticity

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