Loading influence on the local strain fields of an interface crack in a DCB sandwich composite

Miron Matei-Constantin[1], Constantinescu Dan Mihai[1*],

Major Zoltan[2], Picu R. Catalin[3]

[1] University POLITEHNICA of Bucharest, Splaiul Independentei nr. 313, Bucharest, Romania

[2] Johannes Kepler Universität, Altenberger Straße 69, Linz, Austria

[3] Rensselaer Polytechnic Institute, 110 Eighth Street, Troy, New York, USA

[*] dan.constantinescu@upb.ro

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The concept of cohesive zones has received revived interest and the cohesive zone modeling (CZM) approach has emerged as a powerful analytical tool for nonlinear fracture processes. This model considers the relation between the traction and separation that are normal to the fracture surfaces, and the unphysical stress singularity at the crack tip in the traditional linear elastic fracture mechanics is removed. The need of determining cohesive parameters is crucial in the understanding of the critical and post-critical behaviour of the sandwich composites, as their weakest part is the interface between the joining materials. Modern numerical methods provide solutions of predicting the behaviour of the sandwich materials' interface zone using the cohesive zone model.

In this paper we calibrate the constitutive parameters of a cohesive zone model to be used in larger scale models of structures containing an epoxy-bonded interface. The calibration is performed by comparing the local fields at the crack tip measured experimentally by the digital image correlation (DIC) method, with a FEM model which uses a cohesive zone representation of the respective interface. Two set-ups are employed for this purpose (Fig. 1). The first studied configuration involves bonding two hinges on the tested sandwich specimen and the second by applying the loading through two rigid loading arms bonded to the sheets of the sandwich material.

Fig. 1. First and second experimentally applied loadings

In order to simulate with cohesive elements the evolution of strain fields as provided previously by an ARAMIS system, virtual strain gages measure average strain values close to the crack tip region. The effect of loading and initial delamination propagation on the interface and core strains has been established, which leads afterwards to the determination of the failure parameters which describe the cohesive model. The first experimental setup provides an easier method for determining the damage finalization parameters, while the second setup gives information regarding the damage initiation and the interface behaviour.

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