ADvanced DIC TEchniques on fracture analysis of Dissimilar adhesive joints - ADDICTED

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Objectives

In the present STSM, an experimental database (missing from the published literature), consisting of data derived from both mechanical experiments and a digital image correlation (DIC) software, is created and subsequently utilized for the evaluation/comparison of the state-of-the-art analytical mechanical models [1-5] for the delamination of beam-like composite laminates with elastic couplings.

Description

Quasi-static mode I and II interlaminar fracture toughness experiments were performed using the double cantilever beam (DCB) (see Figure 1) and end-loaded split (ELS) test configurations, respectively. The typical case of a glass-epoxy composite with two alternative stacking sequences, $[0_2/90_2/0_2//0_2/90_2/0_2]$ and $[0/90_3/0_2//0_3/90/0_2]$, was investigated. The double slash (//) denotes the position of the delamination plane that splits the laminate into two sub-laminates. Obviously, in the first stacking sequence, both sub-laminates are symmetric and balanced (*i.e.* no elastic couplings exist), whereas in the second stacking sequence, both sub-laminates are asymmetric and unbalanced (*i.e.* elastic couplings exist). The production of two plates (one for each stacking sequence) was undertaken by vacuum infusion. Test specimens were cut from the plates using a water-jet cutting machine. The experiments were performed at a 5 kN MTS test frame. During the tests, a camera was used to record the displacements/movements of the specimen.

Main outcomes

With reference to the experimental data obtained, the capabilities of some characteristic analytical mechanical models from the relevant literature [1-4] to predict six kinematic magnitudes of interest (*i.e.* axial displacement ($u_i(x)$), vertical displacement ($w_i(x)$), and rotation ($\varphi_i(x)$) at the mid-thickness plane of the sub-laminate i, i=1, 2, see Figure 1) along specimen's length, were evaluated. Also, using the obtained experimental data, the analytical models of Refs. [1-5] were compared regarding the calculation of the fracture toughness of the studied uncoupled and coupled laminates.

References: [1] P.S. Valvo, *Eng. Fract. Mech.* **165** (2016) 114-139. [2] P. Qiao, F. Chen, *J. Compos. Mater.* **45** (2011) 65-101. [3] P. Tsokanas, T. Loutas, *Eng. Fract. Mech.* **214** (2019) 390-409. [4] S. Bennati, P. Fisicaro, L. Taglialegne, P.S. Valvo, *Appl. Sci.* **9** (17) (2019) 3560. [5] M. Ševčík, M. Shahverdi, P. Hutař, A.P. Vassilopoulos, *Eng. Fract. Mech.* **147** (2015) 228-242.

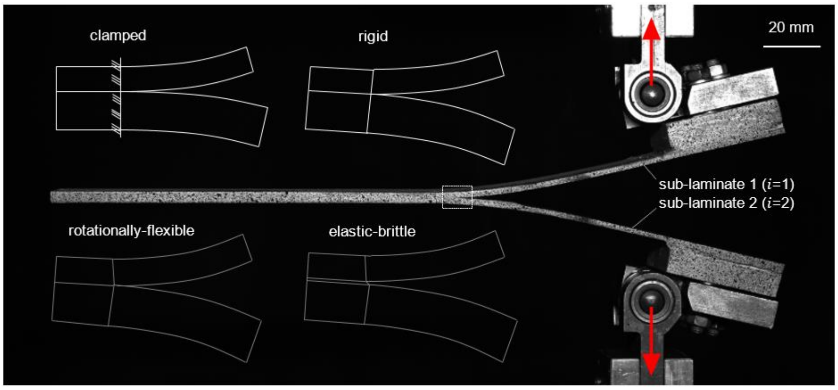

Figure 1: Snapshot during one of the experiments and schematic representation of the classification of the studied analytical models into four categories.

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