CYCLIC DELAMINATION ANALYSIS: EXPERIEMENTAL AND COHESIVE-FRICTIONAL INTERFACE FINITE ELEMENT MODELLING

G. Borino*, G.V. Marannano**, F. Parrinello*, A. Pasta** M. Terranova**

Dipartimento di Ingegneria Civile, Ambientale e Aerospaziale, Università di Palermo, Viale delle Scienze – 90128, Palermo, Italia. Email borino@unipa.it

**Dipartimento di Ingegneria Industriale, Università di Palermo, Viale delle Scienze – 90128, Palermo, Italia.*

Composite laminates are recognized as high performance structural materials, since they enjoy low weight and high strength features, moreover composites can be optimally employed since they can be designed and tailored following specific load carry requirements.

One of the main concern regarding laminate materials is the possibility of partial internal debonding between laminae, which can happen for several accidental causes and represent a possible starting condition for crack propagation and eventually structural failure.

The problem has been extensively studied, either in terms of experimental tests, or by nonlinear computational approaches. The most considered delamination test is the DCB (double cantilever beam) test and variations of it [1]. The test is based on a laminate beam, with an initial interlaminar defect, subjected to a monotonic increasing bending load.

The present contribution concerns with the analysis of a progressive delamination processes when a composite beam is subjected to cyclic loading. Actually, the typical experimental test for a composite beam in a mixed mode loading condition is extended to cyclic loading and the results in terms of progressive advancement of the crack and cyclic load displacement response are reported.

The actual mechanical problem is also modelled by Finite Element approach, adopting a recent developed interface element [2], which incorporate cohesive and frictional features.

It is shown that under cyclic loading the dissipation mechanisms are of two types, namely the classical crack opening work (fracture energy release) and the frictional energy dissipated. The last contribution in the cyclic contest is rather relevant, since the closing-opening mechanisms induced by the cyclic loading develops frictional energy dissipation even in the case of no crack propagation condition. Finally the good accuracy between tests and computation is commented.

References

[1] G.V. Marannano, A. Pasta, An analysis of interface delamination mechanisms in orthotropic and hybrid fiber-metal composite laminates, *Engineering Fracture Mechanics,* **74,** 612–626, 2007.

[2] F. Parrinello, B. Failla, G. Borino, Cohesive–frictional interface constitutive model, *Int. J. Solids and Structures,* **46**, 2680–2692, 2009