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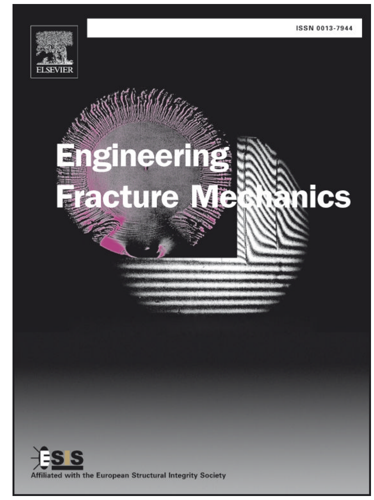

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Evaluation of the energy release rate in Mode I of asymmetrical bonded composite/metal assembly

G. Zambelis[a,b], T. Da Silva Botelho[a], O. Klinkova[a], I. Tawfiq[a], C. Lanouette[b],

[a] *Laboratoire Quartz (EA7393) Supméca, 3 rue Fernand Hainaut, 93407 Saint-Ouen, France*
[b] *Airbus Helicopters, 1 Place du Général Valérie André 93440 Dugny, France*

Abstract

Composite structures assembled by bonding are widely found in different areas of high performance applications such as aeronautics. The energy release rate (G) is mainly used to predict fracture. However, in some special cases, this parameter serves to investigate the propagation, the rate or the stability of a crack. The main issue resides in the calculation of this energy release rate because it strongly depends on the crack geometry and the loading mode. An energetic criterion based on the compliance method was chosen, assuming that the release of potential energy is transformed in surface energy due to the creation of wider cracks (new surfaces). To investigate the properties of an asymmetrical composite/metal bonded structure, modified Double Cantilever Beam (DCB) specimens were tested in mode I. The fracture toughness and the fatigue behavior were evaluated by experimental means, finite elements modeling (FEM) and linear elastic fracture mechanics (LEFM) theories. Timoshenko and Kanninen theories, experimental and FEM results were compared on an R-curve. A modified Kanninen theory was then proposed, to take into account the specific assembly design. As a result, the Paris' law was built for that situation. The objective of this work was to adapt and validate a non-standard fatigue compliance methodology which calculates the energy release rates in mode I, for asymmetrical bonded structures.

Keywords: Structural composites, adhesive, damage tolerance, DCB, fatigue tests, mode I