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Accounting for weave bridging in the fracture characterisation of textile composites

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Abstract

This paper describes the required testing approach for characterising delamination in 2-D woven textile composites. In these materials under mode I loading in Double Cantilever Beam (DCB) specimens, the delamination can grow either side of a weave of a fibres causing the weave to bridge the delamination. This bridging inhibits the delamination growth in static and fatigue tests and gives unconservative values of the fatigue threshold. These fatigue thresholds are used in no-growth design philosophies and unconservative values will give incorrect damage tolerance evaluations. This paper describes a method of normalising the delamination fatigue state with the static R-curve to give more representative values of threshold for damage tolerance design purposes that are 40% of those measured using conventional testing approaches. Further this normalisation method reveals that composites have slower fatigue delamination growth rates (i.e. more damage tolerant) than previously reported.

***Key words**: Composite materials, Woven composites, Delamination, Threshold fracture toughness, Mode I*

1. Introduction

The use of woven textile composites is steadily increasing in structural applications (Hur and Kim, 2008). This includes the use of high performance carbon fibre composites in aerospace and motorsport applications and with plain weave glass composites in marine and defence applications. More recent developments of bio-composite woven prepregs manufactured from woven flax fibres and furan bio-resin to make vehicle panels (Giannis *et al.*, 2008).

There are various reasons for the use of woven composites. They are efficient for manufacturing purposes in the way that they can represent a cross-ply lay-up being laid down as a single layer. They are robust for net shape manufacture methods such as resin transfer moulding or resin infusion. Also, the woven architecture helps to prevent transverse matrix cracking that may often occur in unidirectional composites. Predominantly the woven fabrics used are 2-D and are still laid up in layers to form a laminate. These layers can delaminate in a similar manner to conventional unidirectional tape composites. Hence, methods for characterising delamination in woven composites need to be developed.

The characterisation of delamination in composite

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