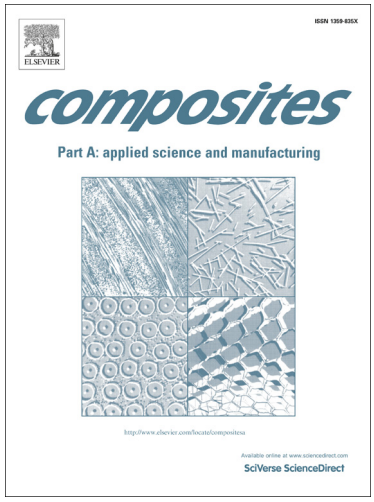
Accepted Manuscript



An investigation into the damage development and residual strengths of open-hole specimens in fatigue

O.J. Nixon-Pearson, S.R. Hallett

PII: S1359-835X(14)00352-2
DOI: http://dx.doi.org/10.1016/j.compositesa.2014.11.013
Reference: JCOMA 3780

To appear in: *Composites: Part A*

Received Date: 4 July 2014
Revised Date: 14 October 2014
Accepted Date: 8 November 2014

Please cite this article as: Nixon-Pearson, O.J., Hallett, S.R., An investigation into the damage development and residual strengths of open-hole specimens in fatigue, *Composites: Part A* (2014), doi: http://dx.doi.org/10.1016/j.compositesa.2014.11.013

An investigation into the damage development and residual strengths of open-hole specimens in fatigue.

O. J. Nixon-Pearson[a*], and S.R. Hallett[a]

a - Advanced Composites Centre for Innovation and Science, University of Bristol, Queen's Building, University Walk, Bristol BS8 1TR, UK
* Corresponding author, Email: on5405@bristol.ac.uk, Tel: +44 (0)117 3315797

Abstract

An extensive experimental program was carried out to investigate and understand the sequence of damage development throughout the life of open-hole composite laminates loaded in tension-tension fatigue. Quasi-isotropic carbon/epoxy laminates, with stacking sequence $[45_2/90_2/-45_2/0_2]_S$, $[45/90/-45/0]_{2S}$ and $[45/90/-45/0]_{4S}$ were examined. These were selected on the basis that under quasi-static loading the $[45_2/90_2/-45_2/0_2]_S$ configuration exhibited a delamination dominated mode of failure whilst the $[45/90/-45/0]_{2S}$ and $[45/90/-45/0]_{4S}$ configurations showed a fibre dominated failure mode, previously described as "pull-out" and "brittle" respectively. Specimens were fatigue loaded to $1x10^6$ cycles or catastrophic failure, which ever occurred first. A number of tests were interrupted at various points as the stiffness dropped with increasing cycles, which were inspected using X-ray Computed Tomography (CT) scanning. A static residual strength program was carried out for run-out specimens of each configuration.

Keywords*: A. Carbon-fibre; B. Fatigue; B. Fracture; X-ray Computed Tomography.*

Introduction

Fibre-reinforced composites laminates are increasingly being used to manufacture load bearing primary structures in the aerospace industry as composites offer a much greater strength to weight ratio than metals. The initial perception was that composite materials don't suffer from the effects of fatigue, however in recent years it has become well established that composites can exhibit damage under cyclic loading conditions. Laminates with stress concentrations have complex damage sequences and failure events, and show a wide variety of