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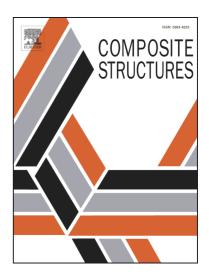
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MATRIX CRACKING EVOLUTION IN OPEN-HOLE LAMINATES SUBJECTED TO

THERMO-MECHANICAL LOADS

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Abstract

In this work, a constitutive model is developed and used to predict matrix cracking and fiber damage

evolution in all the plies of symmetric laminates when both mechanic and thermal loads are applied. A

model previously developed is modified to take into account the thermal stresses that appear in each ply

when the temperature is reduced below the Stress Free Temperature. Data of matrix damage initiation and

evolution due to thermomechanical loads for four materials and six laminate lay-ups taken from the

scientific literature are used to validate the model. A good correlation between the predictions and the

experimental results is found. The model is used to analyze the thermomechanical damage in laminates

containing a centered hole subjected to in-plane tensile loads. It is observed that the thermal load alone

does not produce a stress concentration around the hole but the thermal residual stress accelerates damage

accumulation during mechanical load.

Keywords: Open-hole laminates; Thermomechanical; Transverse cracking; Finite element analysis;

Discrete Damage Mechanic

1. INTRODUCTION

Composite laminates are widely used in aerospace and aircraft industries, in structural applications such

as pressure vessels, aircraft fuselage, etc. These structures are subjected to in-plane loads [1] and

temperatures between -250° and 120°C [2]. Sometimes, these components contain thousands of holes for

joining purpose or cut-outs for opening accesses. The presence of a hole on a laminate produces a stress

gradient that increases the stress field in its proximity. This phenomenon changes the failure mechanisms

of the laminate and produces a reduction of the failure strength of the structure compared to that with no

hole.

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