Accepted Manuscript

A progressive damage model for predicting damage evolution of laminated composites subjected to three-point bending

Yuxing Yang, Xueshu Liu, Yi-Qi Wang, Hang Gao, Rupeng Li, Yongjie Bao

PII: S0266-3538(16)31457-9

DOI: 10.1016/j.compscitech.2017.08.009

Reference: CSTE 6864

To appear in: *Composites Science and Technology*

Received Date: 12 October 2016

Revised Date: 4 July 2017

Accepted Date: 9 August 2017

Please cite this article as: Yang Y, Liu X, Wang Y-Q, Gao H, Li R, Bao Y, A progressive damage model for predicting damage evolution of laminated composites subjected to three-point bending, *Composites Science and Technology* (2017), doi: 10.1016/j.compscitech.2017.08.009.

A progressive damage model for predicting damage evolution of laminated composites subjected to three-point bending

Yuxing Yang[1], Xueshu Liu[2], Yi-Qi Wang[1,*], Hang Gao[1], Rupeng Li[3], Yongjie Bao[1]

[1] *Key Lab. for Precision and Non-traditional Machining Technology of Ministry of Education, School of Mechanical Engineering, Dalian University of Technology, Dalian 116024, China;*

[2] *School of Automotive Engineering, Dalian University of Technology, Dalian 116024, China;*

[3] *Shanghai Aircraft Manufacturing Co. Ltd., Shanghai 200120, P.R. China.*

Abstract

Based on the Hashin-type failure criteria and cohesive zone method, a new progressive damage model with a set of gradual stiffness degradation rules was developed to investigate the flexural behavior and the damage evolution of laminated composites subjected to three-point bending. Eight kinds of failure modes were considered for damage evolution in the present model. Compared the analysis results of the present model and Linde's model with the results of three-point bending experiments, it was found that both stiffness and the maximum strength obtained from the present model were in accordance with experimental results. The relative errors of stiffness and the maximum strength between the present model and the experiments were -0.35% and 0.75%, respectively. The degradation stages of the load-deflection curve after the ultimate load can be well predicted by the present model with relative load errors less than 12.5% and relative deflection errors less than 8.5% for four typical points of the degradation stages. Both final predicted failures and damage evolution were in good agreement with the damage micrographs observed from the failed specimens.

Key words: Progressive damage model; Gradual stiffness degradation rules; Damage evolution; Delamination

1. Introduction

As the leading edge of materials science, composites become the strong candidate materials for

*Corresponding author: Tel.: +86-411-84707929

E-mail: wangyiqi@dlut.edu.cn