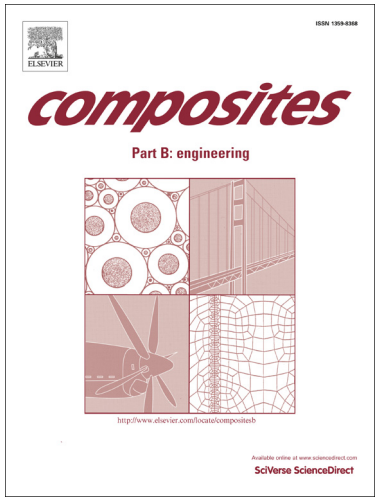

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PII: S1359-8368(14)00179-6
DOI: http://dx.doi.org/10.1016/j.compositesb.2014.04.023
Reference: JCOMB 3008

To appear in: *Composites: Part B*

Received Date: 7 February 2014
Revised Date: 18 April 2014
Accepted Date: 23 April 2014

Please cite this article as: Zrida, H., Marklund, E., Ayadi, Z., Varna, J., Master curve approach to axial stiffness calculation for non-crimp fabric biaxial composites with out-of-plane waviness, *Composites: Part B* (2014), doi: http://dx.doi.org/10.1016/j.compositesb.2014.04.023

Master curve approach to axial stiffness calculation for non-crimp fabric biaxial composites with out-of-plane waviness

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Abstract

The effect of 0^o-tow out-of-plane waviness on the biaxial Non-Crimp-Fabric (NCF) composite axial stiffness is investigated. Homogenizing, the bundle mesostructure of the NCF composite is replaced by layers. Then the composite is represented by a laminate with flat layers with effective stiffness properties representing the curved 0^o-layer and the 90^o-layer with varying thickness. It is shown that the NCF composite knock-down factor characterizing the stiffness degradation has almost the same dependence on wave parameters as the knock-down factor for the curved 0^o-layer. Numerical analysis showed that 90^o-layer knock-down factor versus amplitude curves for different wavelength can be reduced to one master curve which can be described by a one-parameter expression with the parameter dependent on the used material. This observation is used to obtain high accuracy for analytical predictions for knock-down factors for cases with different wavelength and amplitudes based on two FE calculations only.

Keywords: Tow; Polymer-matrix composites (PMCs); Mechanical properties; Laminate mechanics; Finite element analysis (FEA).

1. Introduction

New manufacturing methods and material architectures have been employed over the last decade using dry woven or Non-Crimp-Fabric (NCF) preforms and resin infusion technologies to manufacture high