Accepted Manuscript

Evaluation of cross-ply laminate stiffness with a non-uniform distribution of transverse matrix cracks by means of a computational meso-mechanic model

Néstor Darío Barulich, Luis Augusto Godoy, Patricia Mónica Dardati

PII: S0263-8223(17)33021-0
DOI: https://doi.org/10.1016/j.compstruct.2017.11.063
Reference: COST 9129

To appear in: *Composite Structures*

Received Date: 15 September 2017
Revised Date: 14 November 2017
Accepted Date: 21 November 2017

Please cite this article as: Barulich, N.D., Godoy, L.A., Dardati, P.M., Evaluation of cross-ply laminate stiffness with a non-uniform distribution of transverse matrix cracks by means of a computational meso-mechanic model, *Composite Structures* (2017), doi: https://doi.org/10.1016/j.compstruct.2017.11.063

Evaluation of cross-ply laminate stiffness with a non-uniform distribution of transverse matrix cracks by means of a computational meso-mechanic model

Néstor Darío Barulich[*1,2], Luis Augusto Godoy[1,3], Patricia Mónica Dardati[2]

1: Instituto de Estudios Avanzados en Ingeniería y Tecnología, IDIT UNC-CONICET, Avda. Vélez Sarsfield 1611, Ciudad Universitaria, X5016GCA – Córdoba, Argentina

2: Facultad Regional Córdoba, Universidad Tecnológica Nacional, Maestro M. López esq. Cruz Roja Argentina, X5016ZAA – Córdoba, Argentina

3: Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, Avda. Vélez Sarsfield 1611, Ciudad Universitaria, X5016GCA – Córdoba, Argentina

Abstract

This work addresses the evaluation of the stiffness of fiber-reinforced composite laminates, by means of a computational meso-mechanic model, considering two non-uniformly spaced transverse matrix cracks. Laminates with $[0_n/90_8]_S$ and $[90_8/0_n]_S$, with n = 1 and 8, have been studied. The meso-mechanic model includes a three dimensional Finite Element continuum model at meso-scale and the macro-scale contains a classical thin laminated plate model. Periodic boundary conditions were used and the stress resultants were evaluated accounting for the equivalence of mechanical power between scales (Hill-Mandel principle). The results obtained with the present model showed good agreement with numerical and experimental data reported in the literature. A parametric analysis allowed identifying the stiffness components which are more influenced by a non-uniform crack distribution. The results suggest that the model with uniformly distributed cracks underestimates the in-plane and bending stiffness, while the bending-extension coupling stiffness components are overestimated.

Keywords: composite laminate; intra-laminar cracks; finite elements; plate homogenization

1 Introduction

[*] nbarulich@frc.utn.edu.ar