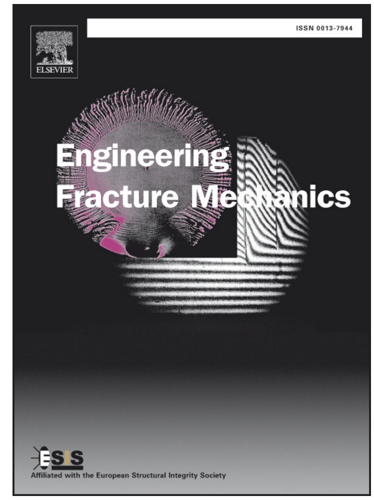

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Comparative Study on Prediction of Fracture Toughness of CFRP Laminates from Size Effect Law of Open Hole Specimen Using Cohesive Zone Model

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Abstract:

Carbon fibre reinforced polymer laminates (CFRPs) are widely used in the aerospace industry. However, the longitudinal fracture toughness of this composite material is a major factor that causes its failure. Here, physical linear and exponential softening laws are used to predict the fracture toughness of CFRPs. The model estimates the predicted strength of an open hole specimen of the material by using the cohesive law and the limiting value of the critical crack opening and unnotched strength obtained using a simple tension test. The critical crack opening is calculated based on a thickness formula. The model results are in good agreement with the experimental results, with errors of 6.33% and 11.29% for the linear and exponential cohesive laws, respectively.

Keywords: Cohesive law, Fracture processing zone, Size effect, Laminates

List of nomenclatures

$E_x, E_y, G_{xy}, \nu_{xy}$	Elastic constant of composite laminates
G_{IC}	Surface release energy or may called fracture toughness
K_{Ic}	Fracture toughness
K_s	Remote stress intensity factor
K_t	Total stress intensity factor at crack tip
K_σ	Cohesive stress intensity factor
S_n	Nominal strength of composite structure
Y_1	Geometric correction factor for circular hole and finite width
Y_2	Geometric correction factor at partially loaded crack
a_i	Crack length at point (i)
l_{FPZ}	Length of fracture processing zone
β_i	Connecting function
δ_C	Critical Crack opening displacement
δ_i	Crack opening at pint (i) on crack face
ε_f	Fracture strain in simple tension test