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M.W. Joosten

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An enhanced ply damage model for failure prediction in unidirectional composite structures

MW Joosten^a

^a Deakin University, Geelong, Australia, School of Engineering, Faculty of Science Engineering and Built Environment, 75 Pigdons Road Waurin Ponds, VIC 3217

Corresponding Author

Dr Mathew W Joosten

Email: mathew.joosten@deakin.edu.au

Address: 75 Pigdons Road Waurin Ponds, VIC 3217, Australia

Abstract: The objective of the present study is to develop a validated damage model for simulating progressive damage and failure in unidirectional fibre reinforced composites. In order to represent the evolution of damage two distinct regimes are introduced. The sub-critical regime introduces damage due to the presence of matrix micro-cracks and fibre-matrix de-bonding. Sub-critical damage may result in both damage and plasticity. The post-critical damage model describes strain softening once failure has been detected using the well-established Hashin criteria. A strategy for calculating the required model parameters is presented and two material systems were examined. The present model was capable of predicting the non-linear material response, evolution of sub-critical damage, evolution of irreversible plasticity and ultimate rupture for several laminate configurations. It is envisaged that contemporary analysis approaches, such as the present model, will become widely accepted and allow the full potential of composite designs to be realised.

(Keywords: Damage model, Finite Element Analysis, Plasticity, Failure)

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