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Micro-Meso 3D FE Damage Modelling of Woven Carbon Fibre Reinforced Plastic Composite under Quasi-Static Bending

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Abstract : This research presents a three-dimensional finite element modelling strategy to simulate damage in a quasi-static three-point bending analysis of woven twill 2/2 type carbon fibre reinforced plastic (CFRP) composite on a micro-meso level using cohesive zone modelling technique. A meso scale finite element model comprised of a number of plies was developed in the commercial finite element code Abaqus/explicit. The interfaces between the plies were explicitly modelled using cohesive zone elements to allow for debonding by crack initiation and propagation. Load-deflection response of the CRFP within the quasi-static range was obtained and compared with the data existing in the literature. This provided validation of the model at the global scale. The outputs resulting from the global model were then used to develop a simulation model capturing the micro-meso scale material features. The sub-model consisted of a refined mesh representative volume element (RVE) modelled in texgen software, which was later embedded with cohesive elements in the finite element software environment. The results obtained from the developed strategy were successful in predicting the overall load-deflection response and the damage in global and sub-model at the flexure limit of the specimen. Detailed analysis of the effects of the micro-scale features was carried out.

Keywords : woven composites, multi-scale modelling, cohesive zone, finite element model
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