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Abstract

Pseudo-ductility could be sought in composite structures to avoid their brittle behaviour and, consequently, to withstand higher levels of external loading due to an extended non-linear response. This mechanism has been deeply examined in the literature for angle-ply laminates submitted to uniaxial tests. Nonetheless, the pseudo-ductile effects could appear also under flexural loading because tension and compression are applied in different regions of the cross-sections simultaneously. In this sense, bending testing presents a higher degree of complexity introduced by the variation of the strain through the cross-section thickness. Taking this into account the main scope of this work is to understand, describe, predict and optimise the pseudo-ductile flexural response of symmetric ±45º angle-ply laminates consisting of unidirectional and continuous CFRP plies. The outcome of three-point bending tests is reviewed analytically and experimentally. The analytical study considers the different behaviour of the material under tension and compression as well as the neutral fibre deviation from the mid-height plane. During testing the full normal strain field is acquired by means of a DIC system while strain-rosettes help to complete the data. The post-process based on microscopic characterization using SEM technology allows to observe the procedure of damage initiation and its evolution. Finally, the determination of the stacking sequences that minimise the bending-twisting coupling but favour the pseudo-ductile response is developed applying optimisation techniques with design purposes.

Keywords: A. Carbon fibres, B. Non-linear behaviour, C. Laminate theory, D. Scanning electron microscopy (SEM), Digital Image Correlation (DIC).