Buckling and postbuckling behaviour of Glare laminates containing splices and doublers. Part 1: Instrumented tests

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Abstract

The progressive damage and fracture behaviour of Glare® fibre-metal laminates (FMLs) was investigated experimentally for the buckling and postbuckling regimes of laminates containing internal ‘splice’ and ‘doubler’ joints. Specimens were either ‘pristine’ or contained artificial delaminations in the form of strips of release film to represent manufacturing defects. Each was tested under in-plane compression. Tests were monitored using Digital Image Correlation (DIC) for visualisation of three-dimensional full-field displacements whilst acoustic emission (AE) monitoring – combined with the novel Delta-T location algorithm – was used for the first time to detect and locate damage events in these FML structures. Results were validated using Scanning Electron Microscopy (SEM) to determine the damage mechanisms present. Large numbers of AE events were recorded at the splice and doubler locations during initial loading and throughout the postbuckling regime, suggesting that the novel AE location algorithm used is suitable for the monitoring of delaminations and matrix cracks in internal features in Glare® laminates. Moreover,

AE events located away from internal features correlated well with buckling and postbuckling deformation as identified by the full-field DIC data. Finally, good correlation was observed between the onset of buckling and a rapid increase in cumulative AE energy, demonstrating that as well as locating damage, AE monitoring is able to indicate quite clearly when the buckling load has been reached.

Keywords: Glare, Buckling, Postbuckling, Delamination, Acoustic emission, DIC, SEM