STRENGTH OF METAL/COMPOSITE ADHESIVE JOINTS WITH NOVEL INTERLOCKING REINFORCEMENT

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Abstract: With an ever increasing demand for lightweight structures in transport applications, efficient joining techniques are required to enable their development. While adhesive joining represents a highly efficient joining method, the inconsistency in bond strength combined with a propensity for sudden failure limits its applications. The introduction of a novel interlocking reinforcement into the adhesive bondline is proposed in order to mitigate these shortcomings. In the presented study these interlocking reinforcements were integrated into an aluminium-carbon fibre reinforced plastic (CFRP) joint. The aluminium adherends were made from AA5754 alloy with PA12/stretch broken fibres used for the CFRP adherends. The adherends were bonded with commercial epoxy resin. Single lap shear testing was conducted to examine the joints Mode II performance. The interlocking reinforcement has been found to introduce additional loading phases which significantly alter the performance of the adhesive joints. Standard adhesive joints experience an initial crack initiation phase followed by total joint failure due to the rapid propagation of the crack through the bondline. The interlocking reinforcement impedes this crack growth as it passes the rows of interlocking features, allowing additional reloading after the crack begins to propagate. This additional reloading causes a 20% increase in maximum shear strength with a doubling of the energy absorbed before total joint failure. The additional reloading also creates a more progressive failure allowing the detection of damage before catastrophic failure.

Keywords: Hybrid, Joints/Joining, Aluminium CFRP structures, Strength, Damage Tolerance