COHESIVE ZONE AND EXTENDED FINITE ELEMENT MODELLING FOR BONDED JOINT STRENGTH PREDICTION

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ABSTRACT

The integrity of multi-component structures is usually determined by their unions. Adhesive-bonding is often used over traditional methods because of the reduction of stress concentrations, reduced weight penalty and easy manufacturing. Commercial adhesives range from strong and brittle (e.g., Araldite® AV138) to less strong and ductile (e.g., Araldite® 2015). A new family of polyurethanes combines high strength and ductility (e.g., Sikaforce® 7888). Different overlap lengths (L_O) give rise to distinct stress states in the adhesive layer. In this work, the performance of the above mentioned adhesives was tested in single-lap joints with varying values of L_O. The experimental work carried out is accompanied by a detailed numerical analysis by Cohesive Zone Models (CZM) or the eXtended Finite Element Method (XFEM). CZM was highly accurate, except for largely ductile adhesives, although this could be circumvented with a different cohesive law. XFEM is not the most suited technique for mixed-mode damage growth, but a rough prediction was achieved.

KEYWORDS: Finite Element Method, Cohesive Zone Models, structural adhesive, joint design, fracture toughness.

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