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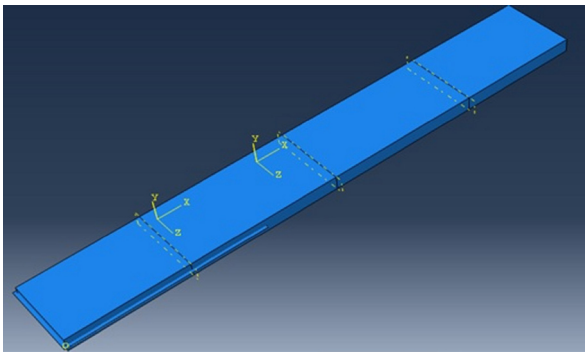
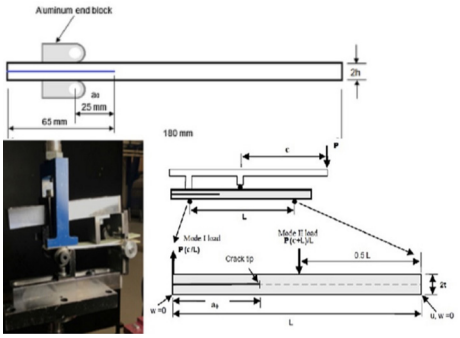
Research Area 8: **Planning, Modelling and System Design** Idea Number: **128**

Three-dimensional numerical analysis of delamination growth in composite materials under mixed-mode I/II loading

Composite materials are mainly responsible for the innovation revolution taking place in aerospace manufacturing today. This is because using composites in aircraft results in significant weight savings, increased payload capacity and reduced fuel burn. Thus, airlines using these aircraft may remain profitable in the face of increasing fuel prices. Delamination is an important mechanism of fatigue failure that occurs in composite materials. Composite delamination is often induced by cyclic compression, shear or bending loads. Fatigue failure usually occurs under mixed-mode I/II loading (i.e. a combination of tension and shear loading). Several failure theories are available for evaluating the crack growth in mixed mode I/II crack problems, which form the majority of crack problems. Since the complete stress functions and the contribution of stresses in all directions are considered through the strain energy density function, the Minimum Strain Energy Density (SED) theory provides a more complete physical description of damage in the crack tip zone. The 3-D numerical analysis model created during this project using ABAQUS software is based on a Cohesive Zone Model (CZM) combined with the Extended Finite Element Method (XFEM). This model is validated by comparing its output with the results of mixed-mode crack propagation experiments using carbon-epoxy specimens in order to check if the numerical model reproduces the experimental results with minor discrepancies. In conclusion, the implementation of the numerical model aims at effectively predicting experimentally-observed damage propagation in composite materials.





Key Characteristics

Composite materials • Composite delamination • Fatigue failure