AEROSPACE APPLICATIONS OF FIBRE METAL LAMINATES AND THE FAILURE ANALYSIS OF FMLS SUBJECTED TO HIGH VELOCITY IMPACT AND BLAST LOADING

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ABSTRACT

A fibre-metal laminate (FML) is a type of sandwich structure consisting of alternating layers of metal and fibre-reinforced composite. The particular interest in using these hybrid materials is due to their attractive properties, such as high strength/weight ratio, cost-effectiveness, ability to tailor material properties, and good fatigue, impact and corrosion resistance. Currently, FMLs are attracting the interest of a number of aircraft manufacturers. For example, GLARE is being used in the manufacture of the upper fuselage of the A380, an aircraft that is capable of carrying up to 700 passengers. However, with such composite materials being more widely used, an on-going concern is the effect of foreign object impacts and blast on their mechanical properties and failure modes. An example of impact is that of an aircraft underbelly or wing impacted at high velocity during take-off and landing by stones (include hailstones) and other small debris from the runway. In addition blast can also occur in aircraft due to accident or terrorist attack. In this talk, manufacturing of FMLs and their applications are firstly introduced. Then, 3D nonlinear finite element models are presented to show the simulation of projectile impact and blast failure of FMLs, including oblique impact. Here, the effort was concentrated on modelling woven glass fibre reinforced composites, as simulation of aluminium alloys is a relatively simple task. In the work presented here, a damage evolution law is incorporated into the composite constitutive behaviour to obtain the impact and blast response of FML panels. The modelling outputs for projectile impact and blast loadings are validated against the corresponding experimental results, with good correlation in terms of load displacement relationship, deformation and failure modes. The validated computer models can be used to assist design FML components suitable for different applications.