Perforation of Aluminium Alloy-CFRP Bilayer Plates under Quasi-static and Impact Loading

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PII: S0734-743X(18)30157-X
DOI: 10.1016/j.ijimpeng.2018.06.011
Reference: IE 3123

To appear in: *International Journal of Impact Engineering*

Received date: 22 February 2018
Revised date: 21 June 2018
Accepted date: 30 June 2018

Please cite this article as: B. Yu , V.S. Deshpande , N.A. Fleck , Perforation of Aluminium Alloy-CFRP Bilayer Plates under Quasi-static and Impact Loading, *International Journal of Impact Engineering* (2018), doi: 10.1016/j.ijimpeng.2018.06.011

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Abstract

The ability of a metallic surface layer to protect CFRP cross-ply plates against perforation is explored. Aluminium alloy plates (either AA1050A or AA6082-T6) were placed in front of a CFRP layer, and the bilayer was subjected to either quasi-static indentation or to ballistic impact by a spherical projectile, with rigid back support or an edge-clamped boundary condition. The observed perforation mechanism of the CFRP layer is neither influenced by the presence of the metallic layer nor by the choice of loading rate (i.e. quasi-static versus ballistic). In the back-supported condition, the CFRP layers fail by an indirect tension mode that consists of tensile failure of plies in the material directly beneath the indenter or projectile. Alternatively, in the edge-clamped condition, the CFRP layers fail by a shear plugging mechanism. Although the presence of metallic layers does not suppress the shear plugging of the underlying CFRP layer, the loaded area in the CFRP layer increases by the addition of the protective metallic layer, thereby increasing the perforation resistance of the CFRP layer.

Keywords: multi-layer composites, perforation mechanisms, quasi-static indentation, ballistics, shear plugging, indirect tension

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