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LOW-VELOCITY IMPACT DAMAGE CHARACTERIZATION OF COMPOSITE FACESHEET SANDWICH PANELS

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ABSTRACT

Composite facesheet sandwich panels are commonly used in aviation due to their good stiffness and specific strength, however they are vulnerable to damage caused by low-velocity impact. Relatively conservative allowable damage limits in aircraft standard repair manuals led to the desire for a better understanding of these panels' damage tolerance. A finite element model of these panels is under development. Physical impact testing was thus required to characterize dent depth, force-time response of impacts, and types and extent of damage. Impact testing was performed on composite facesheet sandwich panels with aluminum honeycomb core. The facesheets were 8 ply unidirectional carbon fibre in a quasi-isotropic layup. These aeronautical panels were damaged according to standard repair manual allowable damage limits. The resulting damage can include delamination, matrix cracking, and fibre breakage. The types of damage exhibited depends on the impact energy, the indenter diameter, and the facesheet material. The tests were performed using the drop tower at the National Research Council, using 0.5 in and 1.0 in diameter hemispherical indenters at energy levels between 2 and 20 J. The dent depth and severity of damage increased with impact energy for both sizes of indenters. The 0.5 in indenter produced deeper dents with a characteristic double indentation shape and produced significantly more severe damage. The 1.0 in indenter produced dents with a single smooth indentation and less severe damage. The behaviour of two different carbon fibre-epoxy composite facesheets were compared, one requiring an autoclave cure and the other being able to be cured out-of-autoclave. The out-of-autoclave cured facesheets exhibited less damage, with shallower dents and less severe damage types. The effects of the honeycomb core cell wall positioning relative to the impact location were also observed. The results show that impacts directly over a cell wall have reduced damage compared to impacts in the centre of a honeycomb cell.