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Impact Damage Formation on Composite Aircraft Structures

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ABSTRACT

Composite aircraft structures can incur impact damage that is potentially difficult to detect during external visual inspection. Damage sources having low-visibility are the general topic of this research. This includes understanding and characterizing the impact threats, observing and clearly describing the process of damage initiation and growth, relating how subsequent damage is visually detectable (or not), and evaluating methods of analysis by which these impact damage modes can be simulated, typically via finite element analysis (FEA). Ground service equipment (GSE) impact is a major source of damage, producing a "blunt impact" scenario by which high energy wide area blunt impact (HEWABI) damage can be the result. This past year's achievements are focused on: (i) second generation HEWABI test specimens design and analysis, including C-frame to floor beam stiffness interaction, (ii) fabrication of stringer-stiffener-frame test specimens for HEWABI test, (iii) improved modeling capability for C-frame failure under combined bending and torsion loading.

Impact damage and core crush response of Nomex core sandwich panels is also a major topic of research. Ongoing studies are focused on understanding the governing mechanisms that lead to honeycomb core failure in specimens subjected to impact and transverse loading. The effects of core geometrical defects and variability from manufacturing are also of interest. The heterogeneity of the core is found to be a critical governing aspect of the core's crushing-fracture response. Specifically, at core wall junctions, significant resin buildup exists as a result of the manufacturing process whereby the core is repeatedly dipped into resin to accumulate increased wall thickness. The resin build-up at these junctions produces a stiff resin column" system" oriented in the transverse direction which acts as the major load-bearing path under transverse compression loading, rather than the thin walls themselves since they buckle at relatively low stress level. Modeling techniques to account for core defects and manufacturing-induced geometric features is under way.