Aerospace Structural Crashworthiness Research Overview

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Abstract

A building block approach is used to develop analytical methods and predictable computational tools such that they can be used to design, evaluate, and optimize the crashworthiness dynamic structural response of composite airframes including the evaluation of survivable volume, retention of items of mass, deceleration loads experienced by occupants, and emergency egress paths. The crashworthiness structural requirements are identified by developing detailed finite element models of metallic narrow-body transport aircraft to study the crashworthiness behavior of aircraft structures during survivable impacts on hard surfaces, soft soil, and water. At the coupon level, high speed test methods are being investigated experimentally and numerically not only for material property generation but also for material model development. Studies are conducted to quantify the high strain rate component level test variability for Toray - T800S/3900-2B Unitape, Newport - E-Glass Fabric NB321/7781, and Toray - T700G-12K-PW/3900-2. LS-dyna MAT 54 and MAT 58 coupon level models are validated with quasi-static and high strain rate data. Also, a Round- Robin High Strain Rate Testing Material dynamic characterization of the in-plane tensile material properties of CMH-17 material Toray - T700G/2510 PW carbon/epoxy (F6273C-07M) is conducted over a wide range of strain rates ranging between 0.01 to 250 s^{-1} in collaboration with four research partners. At the component level, Pin-Bearing, C-Section Beams, Sine Wave Beams, and a Scaled Fuselage Model are used to validate the computational tools. At the sub-assembly level, the finite element model of a 10-ft fuselage section is used to study the energy absorbing capabilities of individual structural members, the load transfer between components, and how to properly model joints and connections used in subassemblies. At the full scale level, a full aircraft model evaluation is conducted.

References

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