Simulating the Impact Response of Composite Airframe Components

by

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In 2010, NASA Langley obtained a prototype composite airframe that was originally built by Sikorsky Aircraft Corporation under the US Army's Survivable Affordable Repairable Airframe Program [1]. Even though the airframe had been previously impacted, post-test inspection indicated that damage was primarily limited to the roof area, with little or no damage found in the subfloor, or the forward framed fuselage section. Consequently, the airframe was cut-up into six different types of specimens of varying complexity from the coupon level all the way to full-scale test articles. Beginning in May 2011, NASA and Sikorsky worked collaboratively to pursue common research interests, including: structural testing of composite airframe structures under dynamic loading; development and assessment of material models to predict aircraft structural response; and, validation of analytical models through test-analysis correlation. This work was based on testing of SARAP residual hardware, that included laminate characterization testing of coupons; dynamic crush testing of two I-beam specimens, two T-section specimens, and two cruciform sections; a longitudinal impact of a subfloor section; and, a vertical impact of a framed fuselage section. Recently, the NASA crashworthiness research program [2] was refocused to assess current analytical capabilities used to predict crashworthiness of composite airframe structures. Thus, obtaining the SARAP residual hardware was fortuitous and allowed testing of fairly simple coupons, more complex subcomponents, and complex built-up airframe structures for the purpose of model validation. The objective of the research program was to assess the capability of LS-DYNA [3], a commercial nonlinear explicit transient-dynamic finite element code, for predicting damage initiation and progression of composite airframe structures subjected to impact loading. This presentation will focus on dynamic crush testing and simulation of I-beam, T-section, and cruciform subcomponents. Additional information may be found in Reference 4.

References

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