Crashworthiness Testing & Simulation FY18 - Composites & Metallic Biz Jet Sec. Drop.

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ABSTRACT

The metallic and composite airframe crashworthiness research at NIAR has focused on developing a certification by analysis methodology that can be used in the future by the aerospace industry. Aerospace crashworthiness structural requirements were defined using detailed finite element models of a metallic narrow-body transport aircraft to study the crash worthiness response of a typical metallic aircraft structure during survivable impact on hard surfaces, soft soil, and water. Typical energy absorbing requirements, loading, and strain rates for various structural components were defined. At the coupon-level, several issues and challenges associated to the dynamic material response of composites materials were addressed by conducting coupon-level tests over a range of strain rates for which testing techniques have not been standardized yet. Component-level test were used to validate the coupon-level material data and the strain rate sensitivity at the component-level of various composite material systems. Joints and connections were evaluated at the element-level. A series of experimental tests at different loading rates were conducted to evaluate single point load transfer mechanisms between structural members. The results were used to evaluate the limitations and capabilities of various modeling techniques used to virtually join two components. At the full-scale level, the experimental and numerical best practices developed through the course of the research are used to develop a Finite Element Model of a representative Narrow Body Aircraft. The model is used to evaluate the ability of a full aircraft numerical model to predict the structural deformations and passenger injuries during crash events. The crash of Turkish Airlines Flight 1951 was selected for the evaluation. The structural response predicted by the model is compared with the crash data provided by the accident investigation team. The model provides researchers with comprehensive and thorough data on the behavior of the aircraft structure and passenger injuries when subjected to real crash scenario. This model will be used to further study different variety of crash conditions (e.g. ditching). Additionally, this numerical model and two full-scale tests were conducted to support the Transport Aircraft Crashworthiness and Ditching ARAC working group with addressing potential needs for new rules and or guidance related to ditching and crashworthiness of transport aircraft at the airframe level. A 10 ft Hawker 4000 composite fuselage section and a 10 ft Challenger 601 metallic fuselage section were dropped from a height of 14ft to achieve an impact velocity of 30 ft/s.

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