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Crash Simulation of a Vertical Drop Test of a B737 Fuselage Section with Overhead Bins

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An important aspect of crashworthiness research is the demonstration and validation of analytical/computational tools for accurate simulation of airframe structural response to crash impacts. In fact, the "validation of numerical simulations" was identified as one of five key technology shortfalls during the Workshop on Computational Methods for Crashworthiness that was held at NASA Langley Research Center in 1992. Analytical codes have the potential to greatly speed up the crashworthy design process, to help certify seats and aircraft to dynamic crash loads, to predict seat and occupant response to impact with the probability of injury, and to evaluate numerous crash scenarios not economically feasible with full-scale crash testing. To build confidence in the application of these finite element codes to aircraft structures, it is important to demonstrate their computational capabilities through analytical/experimental validation.

A 30-ft/s vertical drop test of a narrow body transport category Boeing 737 (B737) airplane was conducted in November of 2000 at the FAA Technical Center. The 10-ft. long fuselage section was outfitted with two different overhead stowage bins and six triple-occupant passenger seats. Also, the cargo hold located beneath the floor was filled with 3,229-lbs. of loose luggage. The purpose of the test was to evaluate the dynamic structural response of the fuselage section and overhead bins for a severe, but survivable, vertical impact. In addition, this test presents an opportunity to evaluate the capabilities of computational tools for crash simulation through analytical/experimental correlation.

A full-scale 3-dimensional finite element model of the B737 fuselage section was developed using the nonlinear explicit transient dynamic code, MSC.Dytran. A crash simulation of the vertical drop test was performed and pre-test analytical predictions were made of seat track, fuselage sidewall, and overhead bin acceleration responses as well as load responses of the bin support linkages. The proposed paper will present the correlation of the pre-test crash simulation predictions with the experimental data from the November 2000 vertical drop test of the B737 fuselage section. Finally, an assessment of model accuracy is provided with suggestions for improvements to achieve better correlation.