Development of a Full-Scale Finite Element Model of the Fokker F28 Fellowship Aircraft and Crash Simulation Predictions

by

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Abstract

In June 2019, a full-scale crash test of a Fokker F28 Fellowship aircraft will be conducted at NASA Langley Research Center's Landing and Impact Research (LandIR) Facility. The F28 is a high-performance twin-turbo fan narrow-body aircraft with seating in a 3+2 configuration. The MK4000 variant, used in this test, is capable of carrying up to 85 passengers on medium range routes. The F28 was first type certified by the Federal Aviation Administration (FAA) in 1969 and now the majority of the F28 fleet has retired from service in the United States. In 2016, the FAA and NASA Langley Research Center (LaRC) signed an interagency agreement for conducting a research program to obtain test data that will support the development of airframe level crash requirements for transport category airplanes [1].

The objectives of the full-scale crash test can be divided into six categories: (1) To compare and contrast responses in identical aircraft undergoing vertical only to combined vertical and horizontal loading conditions, (2) To examine the effects of horizontal loading on aircraft structure during a crash event, (3) To generate data for the use in calibration of computer modelling efforts, (4) To generate data from onboard Anthropomorphic Test Devices (ATDs) for the evaluation of injury, (5) To obtain data from experimental seats, and (6) To obtain data from new and novel ATD designs including Warrior Injury Assessment MANikin (WIAMan) [2], Test device for Human Occupant Response (THOR), and other newly developed child ATDs. The focus of this presentation will be to document finite element model development of the full-scale F28 aircraft and to present preliminary test-analysis predictions.

NASA obtained the full-scale F28 aircraft, depicted during its arrival at Langley Field in Figure 1, plus three fuselage sections and two sets of wings with funding through the NASA Aviation Safety Program in 1998. In addition to the hardware, NASA purchased a full NASTRAN model of the airframe that had been developed by the Dutch manufacturer, Fokker. The original NASTRAN model is shown in Figure 2. Beginning in 2016, the NASTRAN model was converted to LS-DYNA® [4, 5] format and cleaned by combining parts, adding missing parts of internal structure, and including ballast for loading weights, etc. The LS-DYNA model is depicted in Figure 3. It

contains: 89,223 nodes; 24,065 beam elements; 55,404 shell elements; 29,044 solid elements; 740 parts; 80 material definitions; and, 46 Constrained Nodal Rigid Bodies (CNRBs).

Figure 1. Photograph of the F28 as it landed at Langley Field in 1998.

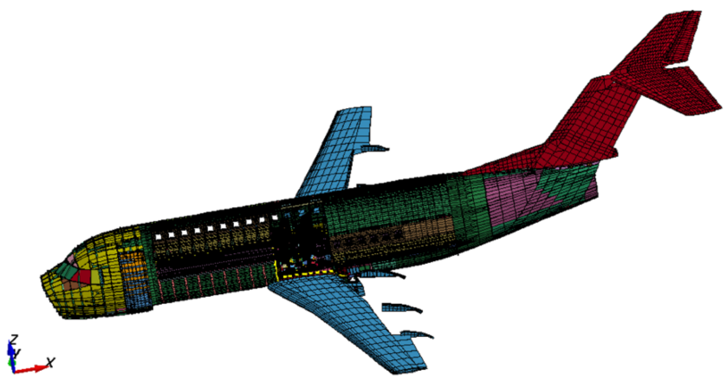

Figure 2. Original NASTRAN model of the F28 aircraft.

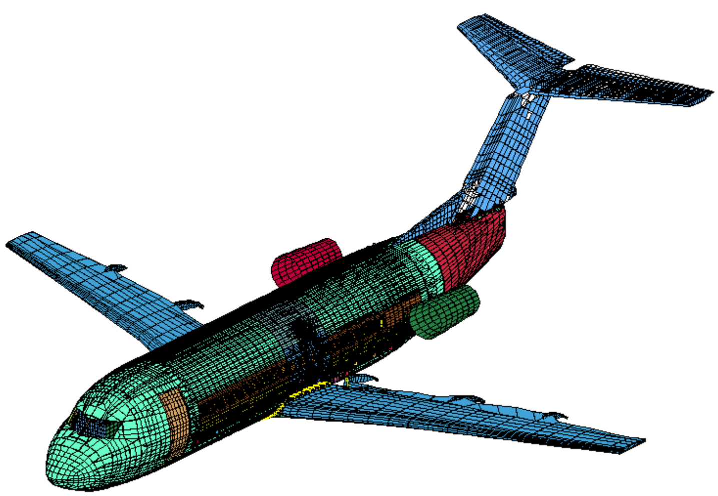

Figure 3. LS-DYNA model of the F28 aircraft.

The aircraft model will be executed in LS-DYNA to simulate the test article impact onto a 2-ft.-high bed of soil under combined velocity conditions of 70-ft/s forward and 30-ft/s vertical velocity. Pre-test simulation predictions will be generated and correlated with test data.

References

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