NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Aviation Engineering Division
Washington, DC 20594

September 14, 2004

ADDENDUM NUMBER 8D TO THE STRUCTURES GROUP CHAIRMAN'S FACTUAL REPORT

DCA02MA001

A. ACCIDENT

Location:	Belle Harbor, NY
Date:	November 12, 2001
Time:	09:16:14 EST
Aircraft:	American Airlines Flight 587, Airbus Model A300-605R, N14053 Manufactures Serial Number (MSN) 420

B. STRUCTURES GROUP

Chairman:	Brian K Murphy National Transportation Safety Board Washington, DC

C. NASA REPORT

1. *"Structural Analysis Report on the American Airlines Flight 587 Accident: Part 3 – Appendix A"*

NASA Structural Analysis Report on the American Airlines Flight 587 Accident– Part 3- Appendix A

-

-

NASA Langley Research Center, Hampton, Virginia

National Aeronautics and Space Administration

Langley Research Center, Hampton, Virginia

This Appendix describes the analysis of a right rear lug of an Airbus A300-600R subjected to loads and boundary conditions representative of the full-scale test conducted by Airbus during the original aircraft certification program and described in Airbus document TNTE541- 2804/85.

A load set for the full-scale test was provided to NASA by Airbus and applied to the global model [Young, et al., 2003]. Airbus load case BI17 was scaled to match the moment and shear resultant loads applied during the certification test of the vertical tail plane (VTP). Scaling was required because the certification test was conducted by applying mechanical loads via a whiffletree to the VTP of an A310 (to simulate the aerodynamic loads experienced during a specified gust condition) whereas the NASA analysis was conducted by directly applying aerodynamic loads to the VTP of the A300. The A300 and A310 are structurally identical, but the certification load requirements are slightly higher for the A310, so Airbus used the test of the A310 VTP for certification of both vehicles. The scaling allowed the test and analysis results to be compared directly.

The global/local analysis procedure was then used to obtain the boundary conditions along the boundary of the local model, including the pin. These boundary conditions were applied in displacement controlled loading during the progressive failure analysis (PFA). The modeling procedure for the global-local and progressive failure analyses is fully documented in Raju, et al. 2003.

The pin-displacements predicted from the global/local analysis are given in Table A1. Note that these values are for the left hand side (LHS) rear lug. The left rear lug is characterized here because the bending loads (M_x) were of opposite sense in the full-scale test compared with the accident condition and resulted in failure of the left, rather than right, rear lug.

Table A.1. Pin Displacements for Full Scale Test Model (LHS)

CASE	u (mm)	v (kN)	w (mm)	δ (mm)	θ_X (deg)	θ_Z (deg)
Full Scale Test	9.260	-27.671	10.332	30.955	0.737	0.228

The computed values obtained from the progressive failure analysis (PFA) for F_{Res} and M_X vs. load factor for the full-scale test case are shown in Figure A.1. The curve of resultant force (F_{Res}) vs. load factor is shown as a solid blue line with open circle symbols and the curve of M_X vs. load factor is shown as a solid red line with filled square symbols. The linearly projected values of M_X and F_{Res} are shown as closed diamonds. Peak values of M_X and F_{Res} are shown on the graph and in the tabular insert as points A and B, respectively. The $F_{Res,}$ failure load, at the maximum moment (Point A) corresponds to 922 kN. The PFA predicted failure load of 922 kN only differs 1.9% from the test failure load of 905 kN. The failure load from the test (905 kN) is shown as a horizontal red line

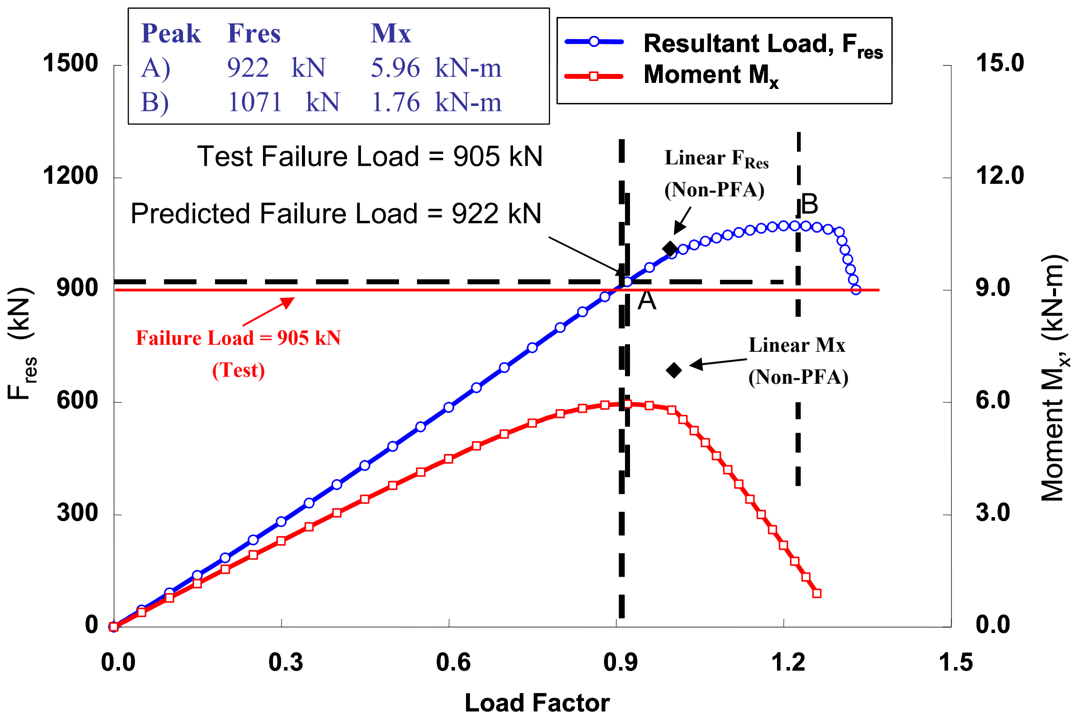

Figure A.1. Load and Moment vs. Load Factor for Full Scale Test Load Case

Further, the extent of the damage predicted by the PFA for this full-scale test case is shown in Figure A.2. The failure pattern is again a cleavage type failure and generally agrees with the failed AA587 right rear lug in Figure A.3. These damage predictions are also similar to those obtained for the 1985 and the 2003 subcomponent tests.

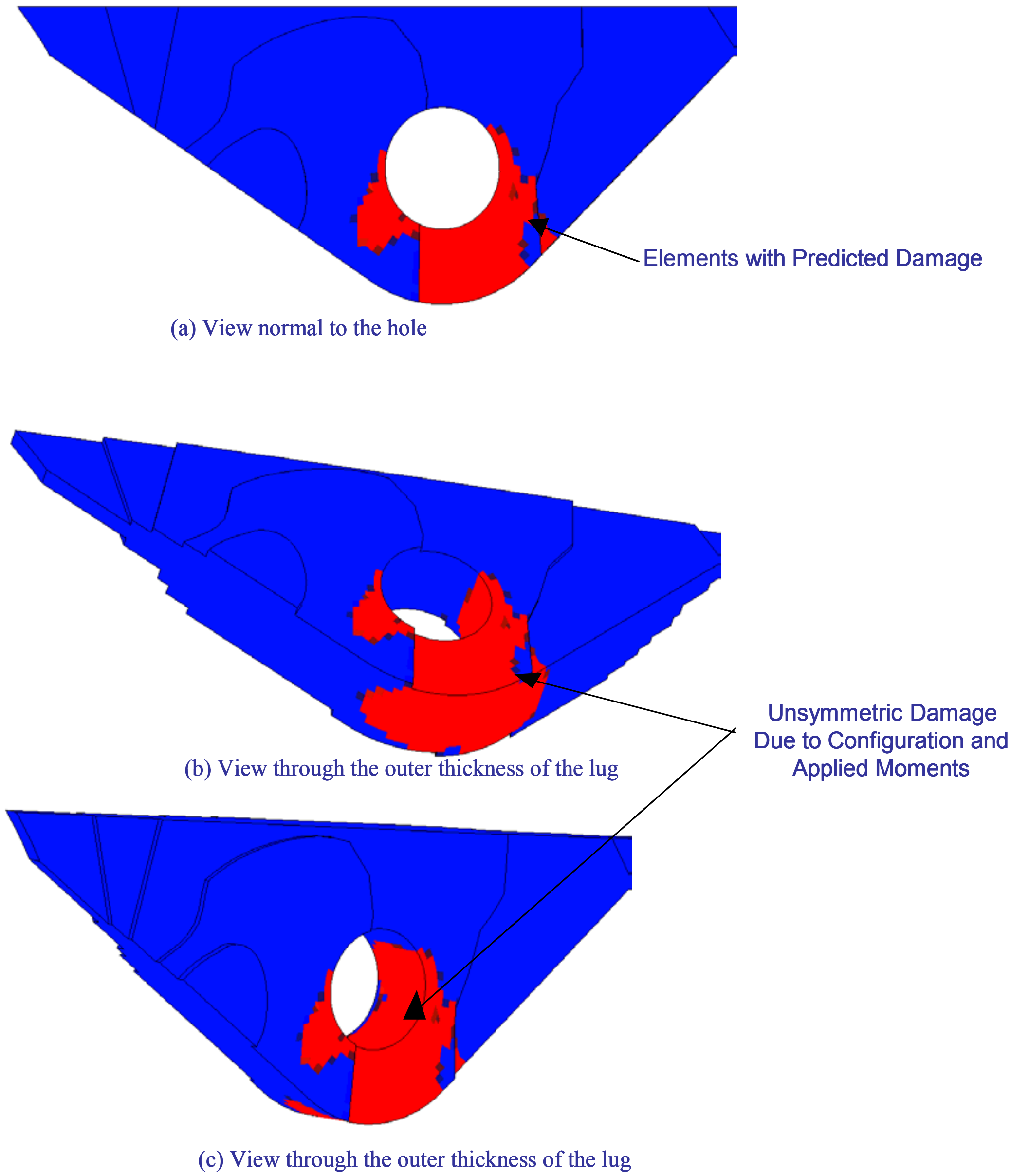

Figure A.2. Damage Prediction for Full Scale Test case from PFA

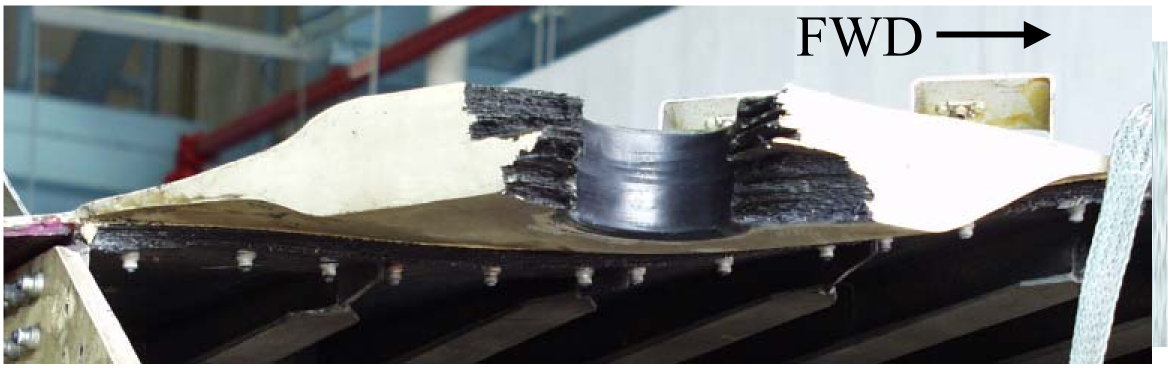

Figure A.3. AA 587 Right Rear Lug – Observed Failure

References

Unknown, TNTE541- 2804/85, Airbus, 1985.

Raju, I.S., Davila, C.G., Glaessgen, E.H., Krishnamurthy, T. and Mason, B.H., "NASA Structural Analysis Report on the American Airlines Flight 587 Accident – Part 3," NASA Langley Research Center, December 2003.

Young, R. D., Hilburger, M., Moore, D., and Lovejoy, A. E., "NASA Structural Analysis Report on the American Airlines Flight 587 Accident– Part 2," NASA Langley Research Center, December 2003.