# Vertical Drop Test of an ATR-42 Regional Transport Airplane

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# TEST OBJECTIVE

Conduct a vertical drop test of a high wing, regional transport airplane, to determine its impact characteristics to a severe, but survivable, crash.

Particular attention was placed on the reaction of the floor tracks, seats, and occupants.

# BACKGROUND

The FAA has been conducting full-scale vertical drop tests of commuter airplanes to develop seat dynamic performance standards for small commuter category airplanes.

To date the FAA has conducted tests on the Metro III and Beechcraft 1900C (both 19 passenger) as well as a Shorts 3-30 (30 passenger) commuters.

# TEST FACILITY

- 30,000 pound (13,607 kg) lift capability

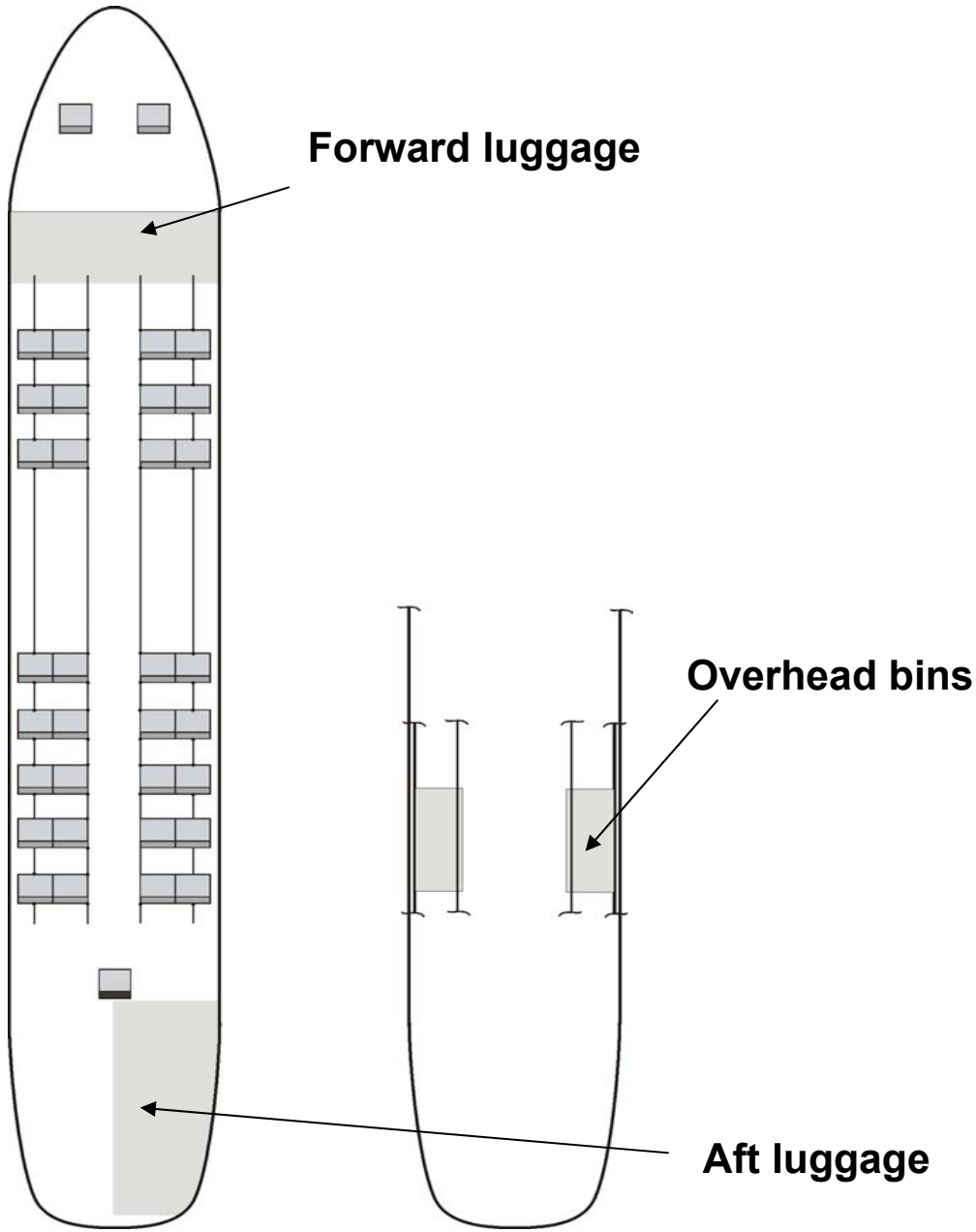
- Onboard and ground based data acquisition systems

# TEST ARTICLE

- ATR 42-300 airplane
- 42 to 50 passengers
- Weight 33,200 lb
- Fuel load - 8700 lb
- Luggage - 2189 lb
- 21 Passengers, 2 Crew
  - 16 mannequins
  - 7 anthropomorphic test dummies

# TEST ARTICLE

- 32 Passenger seats
- 2 Overhead stowage bins
- Forward & aft luggage areas



# VIDEO

# POST-TEST

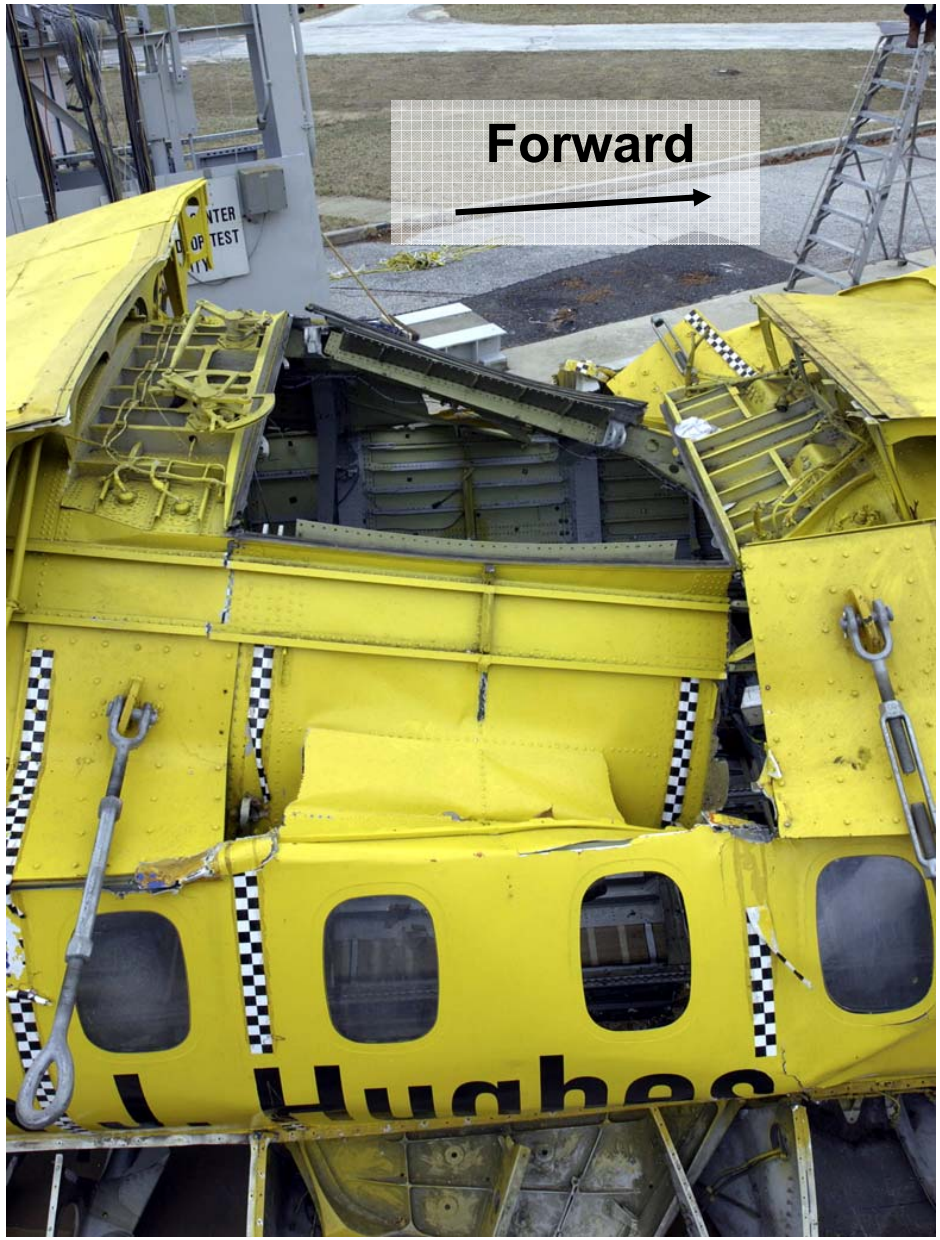
- Fuselage penetrated by wing
- Right rear service door operable

# POST-TEST

Severe fuselage deformation at wing intersection

# POST-TEST

Severe tearing of fuselage skin at wing intersection



# POST-TEST

Engines impacted ground

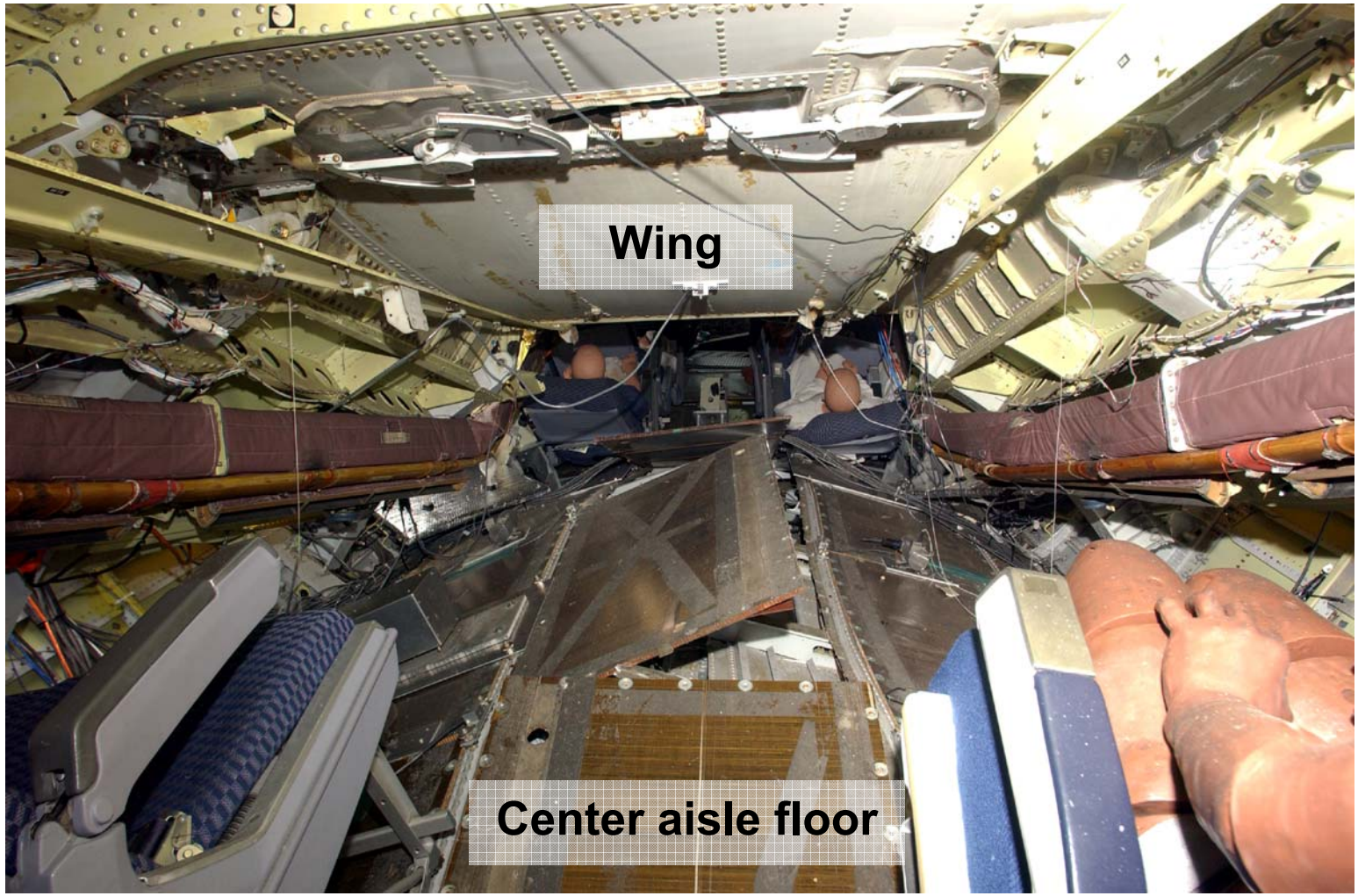
# POST-TEST

Left wing fuel tank leak

# POST-TEST

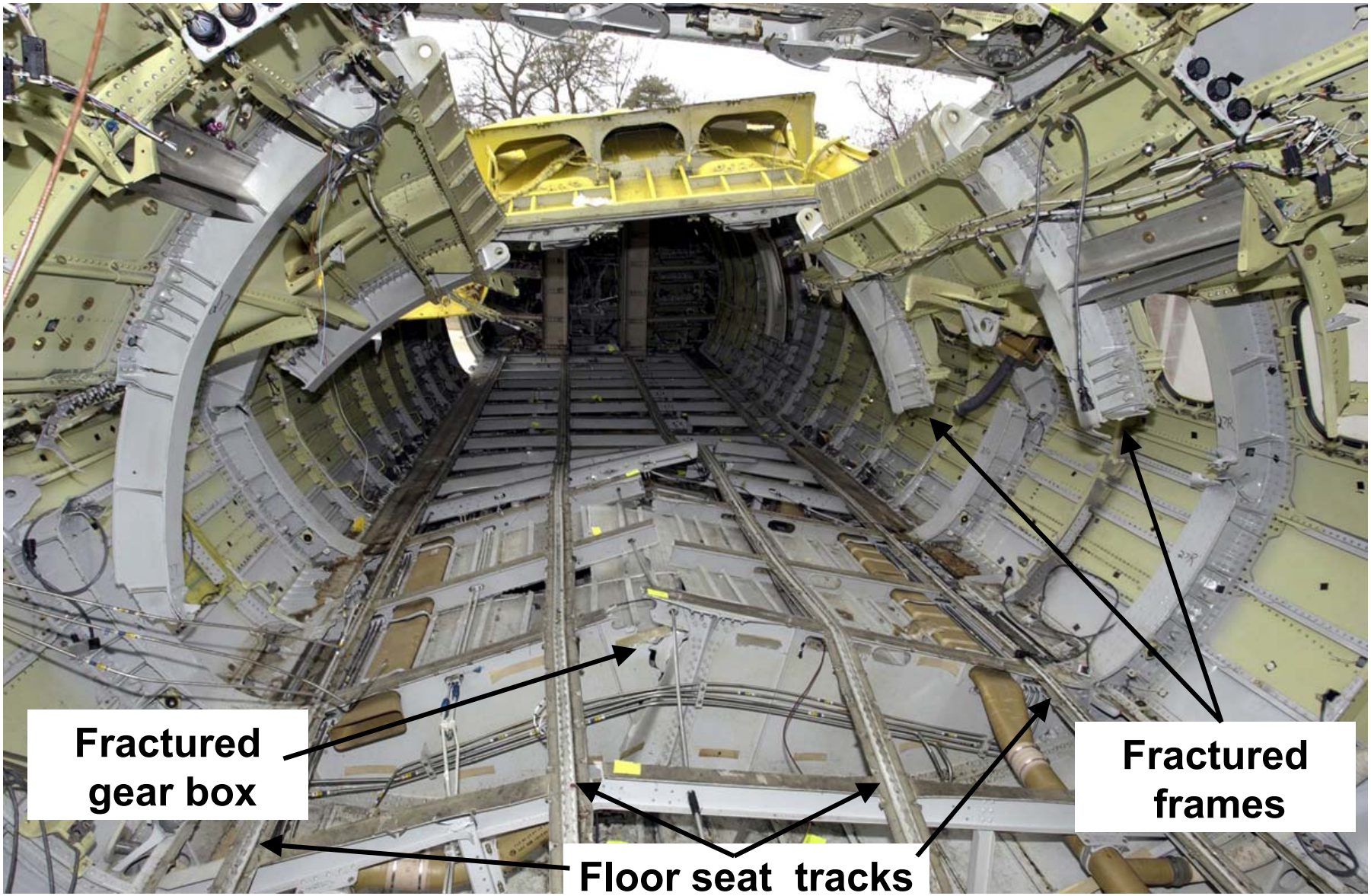
Severe crushing of fuselage at wing intersection

# POST-TEST




Loss of habitable environment

# POST-TEST



# POST-TEST

Typical seat failures

# POST-TEST

Typical seat rear cross tube failure

# POST-TEST

Modified dynamically certified seat

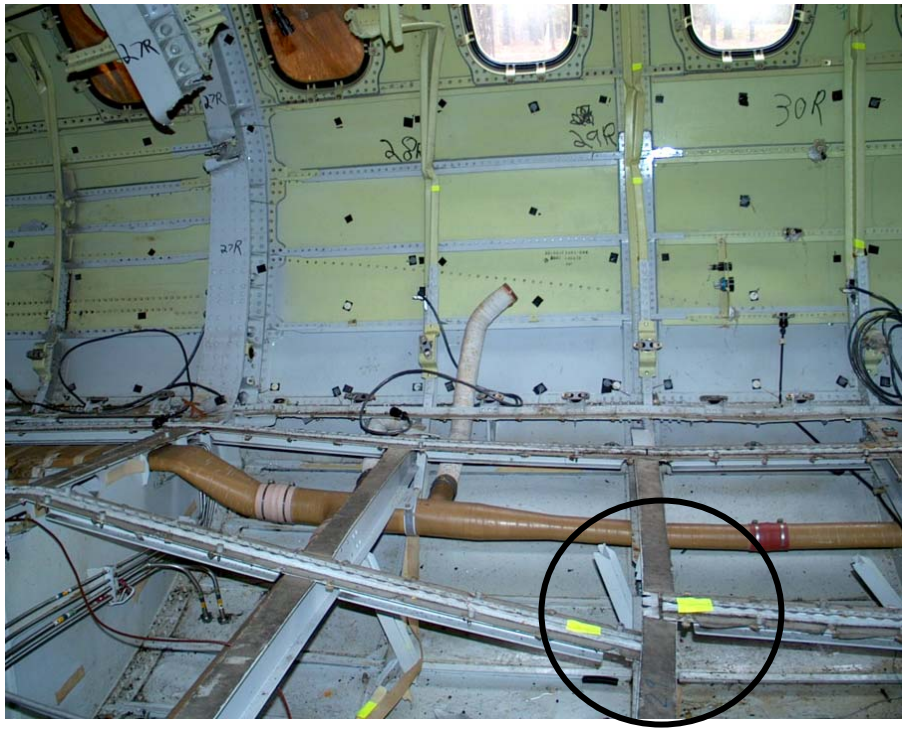
(little to no damage)

# POST-TEST

Modified dynamically certified seat

(little to no damage)

# POST-TEST

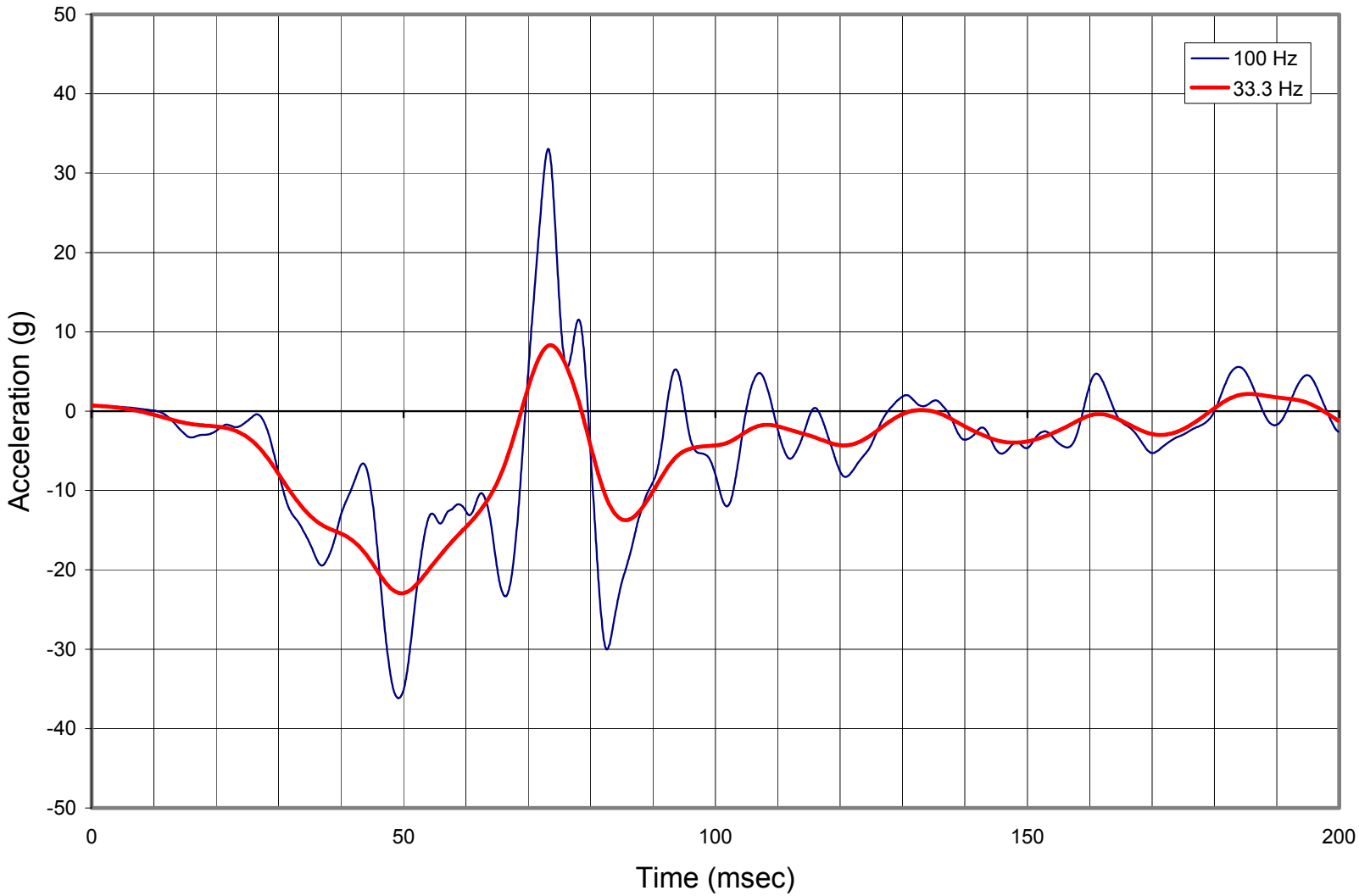


Floor seat track failures

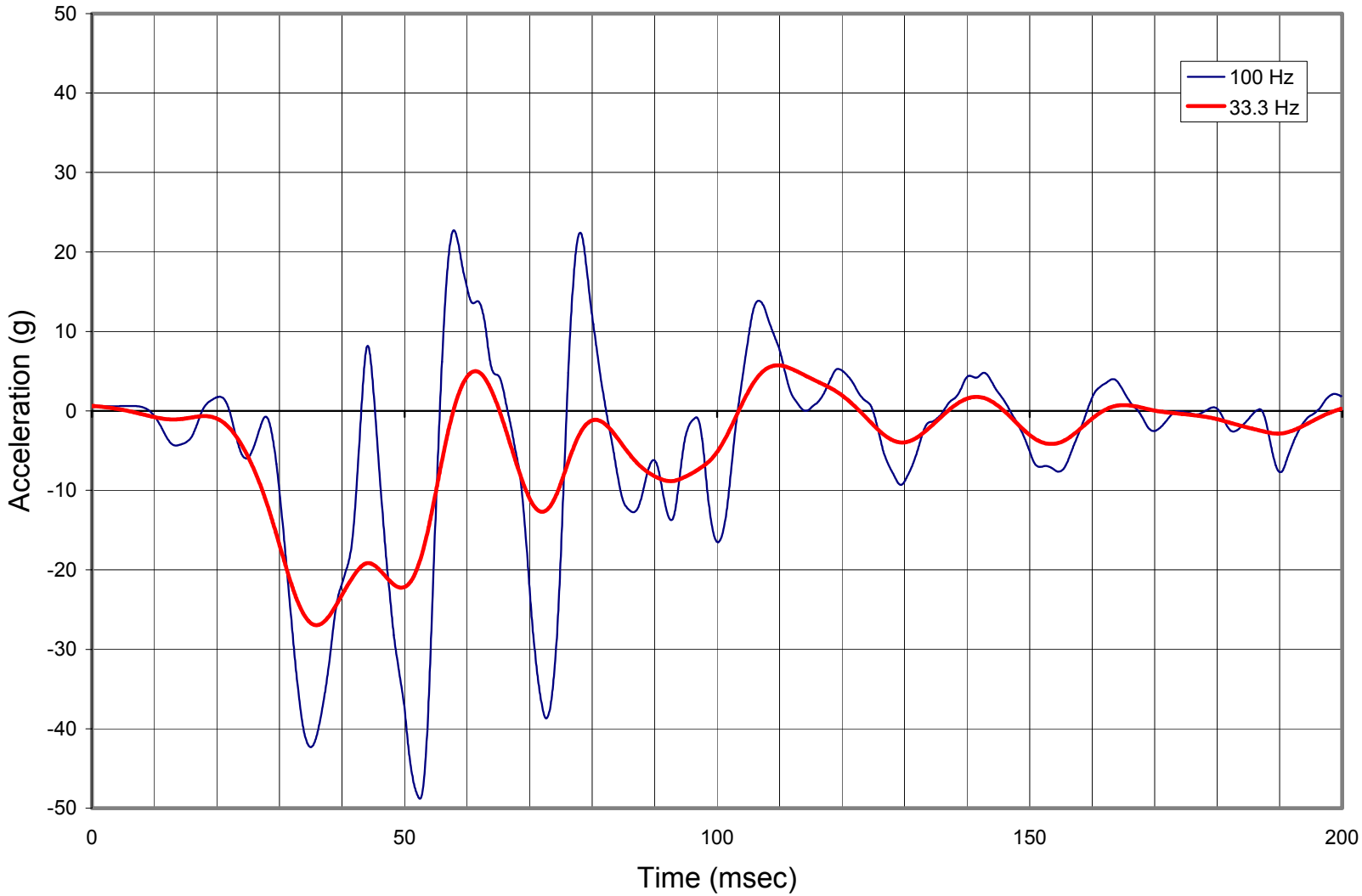
# POST-TEST DATA

- Extensive high-speed film, video, and photographic coverage
- 127 Data Channels
- Extensive floor track and lower fuselage sidewall accelerometer data
- Overall fuselage acceleration was 20 g
- Significant lower fuselage crushing

# TYPICAL VERTICAL SIDEWALL ACCELERATION



# TYPICAL FLOOR TRACK ACCELERATION



# CONCLUDING REMARKS

- The fuselage impact was 30 ft/sec (severe, but survivable).
- The fuselage crush was approximately 12 inches.
- The fuselage (floor tracks) experienced an average deceleration of 20g with a pulse duration of approximately 85 msec.
- This low acceleration value is the result of significant crash pulse energy absorption by the fuselage subfloor.

# CONCLUDING REMARKS (cont'd)

- As expected, the occupied standard cabin seats failed (a modified dynamically certified seat did not).
- Substantial structural damage occurred throughout the airplane, however, the greatest damage occurred at the wing/fuselage intersection.
- A habitable environment was not maintained for many of the occupants. The wing and gear box penetrated the cabin.

# CONCLUDING REMARKS (cont'd)

- The cabin right rear service door and cockpit ceiling emergency escape hatch were operable. The passenger door, cargo door, and the two emergency window exits were inoperable
- The overhead stowage bins experienced no major structural damage and remained attached
- A fuel leak occurred on the leading edge of left wing near the engine attachment location due to engine impact with the ground. A similar impact on right side did not result in a leak

The End

Questions?