Decompression of B-737 of Aloha Airlines by Separation of Upper Fuselage

April 28th, 1988, near Maui Island, Hawaii

KOBAYASHI, Hideo (Yokohama National University)
TERADA, Hiroyuki (Japan Aerospace Technology Foundation)

(Summary)

On April 28th, 1988, a B-737 operated by Aloha Airlines left Hilo, Hawaii Island bound for Honolulu, Oahu. When it approached the cruising height of 7,200m near Maui Island, a sudden decompression occurred in the cabin just behind the cockpit. A large part of the cabin structure was lost. Although one cabin attendant was sucked out, the aircraft succeeded in making an emergency landing at the airport in Maui, because fortunately one hydraulic system had survived.

1. Component

Fuselage panel structure

2. Event

A B-737-200 operated by Aloha Airlines left Hilo, Hawaii Island bound for Honolulu, Oahu. When it approached the cruising height of 7,200m near Maui Island, a sudden decompression occurred at 13:46 local time in the cabin just behind the cockpit. The maximum hoop stress is exerted on the fuselage at the cruising altitude because of the pressure difference between the inside and outside of the cabin is largest.

A part of the cabin structure measuring several meters in length was torn off. One cabin attendant was sucked out of the aircraft and was not found, but the aircraft succeeded in making an emergency landing at the airport in Maui, because fortunately one hydraulic controlling system had survived.

The B-737-200 was an aging aircraft that had been operating for almost nineteen years and suffered from wide spread fatigue damage.

The existence of a crack more than 120 mm in length had been visually recognized by a passenger at the moment of embarkation. The reason why this crack had been overlooked by Aloha Airlines was that they did not conduct the maintenance inspections specified in the manuals because of economic reasons.

3. Course

The aircraft was fabricated in 1969 and had been in service for almost nineteen years. It had experienced 89,600 flight cycles before the accident. The single lap joint of the fuselage panel structures was manufactured by cold-bond process using scrim cloth and rivets. It was known that the cold-bonded joints have not enough durability in thermal and humid cycle condition. As a matter of course, fastener joints received heavy corrosion damage during 19-years operations. Under the thermal and humidity cycle conditions due to operation, the fuselage structure was subjected to Wide-spread Fatigue Damage (WFD),

including Multiple-Site Damage (MSD). Moreover, the operator has not conducted the periodical inspection and maintenance of the structure required by Regulations even under such deteriorated condition. As a result, the operator overlooked cracks that were long enough to be found visually by passengers.

4. Cause

○ Direct cause

Unstable propagation of multiple site cracks induced by corrosion fatigue took place at the fuselage panel structure. Because the single lap joint had been manufactured using scrim cloth by the cold bonding process, the scrim cloth and adhesives absorbed water and became brittle over the years of operation.

○ Indirect cause

Aloha Airlines neglected to conduct the periodical maintenance that was specified by Manuals and Regulations. It was just a matter of time that a crack longer than 100 mm that was easily visible from outside the aircraft would occur that was overlooked by the operator.

5. Countermeasure

(1) In order to prevent the water absorption of the bonded joints, which is the main cause of joint degradation, the bonding process was changed from cold bonding to hot bonding.

(2) The Federal Aviation Administration (FAA) directed Aloha Airlines to observe the maintenance manuals strictly in order to maintain the airworthiness of the aircraft.

6. Knowledge

The accident investigation authority revealed that Aloha Airlines had deliberately neglected to conduct the maintenance and inspection in order to reduce operation expenditures. The maintenance manuals and rules are essential for safe operation, so operators should not neglect them for any reason.

7. Background

Because of the company's poor economic condition and high priority given to profits, Aloha Airlines had customarily ignored even the minimum necessary maintenance at the time of the accident. Therefore, they overlooked large cracks that even a passenger could visually recognize at the moment of embarkation.

8. Sequel

Until the time of this accident, the FAA had also been involved in supervision of the aircraft manufacturers in regard to various items such as design for durability and production management of the aircraft besides the primary role of the supervision of aviation safety issues. However, concern was raised after this accident that the FAA might not be able to provide sufficiently strict supervision to the manufacturers when critical safety problems occur related to design, manufacture, maintenance, and management of aircraft. Therefore, the policy of the FAA was changed to supervise only items related to safety evaluation and not to commit to items related to design and manufacture.

If a similar incident were to occur in Japan, some people would criticize the responsibility of the regulating government authorities and, opposite to the United States, call for those authorities to become even more involved in supervising safety design and manufacturing, for unlike. This case is a highly suggestive example of how much responsibility and authority should be given to government administration.

9. Social Impact

The problems of the structural integrity of aging aircraft became the focus of much interest all over the world. The irresponsible attitude of the airline company regarding the safety management was strongly denounced.

10. Information Source

(1) Aviation Week and Space Technology, vol. 128 (May 16, 1988).

11. Primary Scenario

01. Organizational Problems
02. Poor Management
03. Poor Work Management
04. Ignorance
05. Insufficient Knowledge
06. Durability of Cold-bonded structure
07. Usage
08. Maintenance/Repair
09. Negligence of Inspection
10. Malicious Act
11. Ethics Violation
12. Profit Oriented Policy
13. Usage
14. Transport/Storage
15. Air Transportation
16. Bad Event
17. Chemical Phenomenon
18. Bonded Joint of Composites
19. Material Deterioration
20. Failure
21. Large-Scale Damage
22. Flapping of Fuselage structure
23. Emergency Landing

24. Loss to Organization
25. Social Loss
26. Loss of Credit

Fig. 1 B-737 Made an Emergency Landing with Large-scale Peeling of Fuselage.

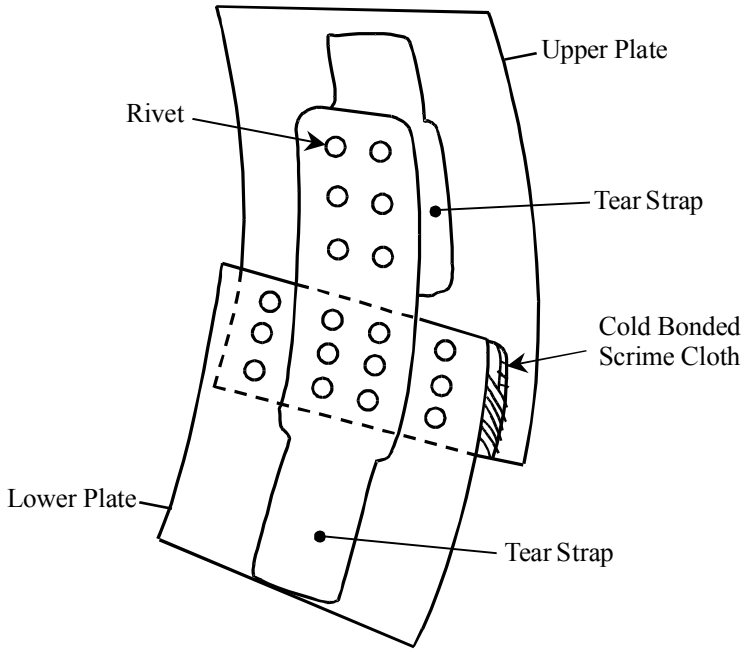

Fig. 2 Bonded and Riveted Lap Joint of B-737 Fuselage.

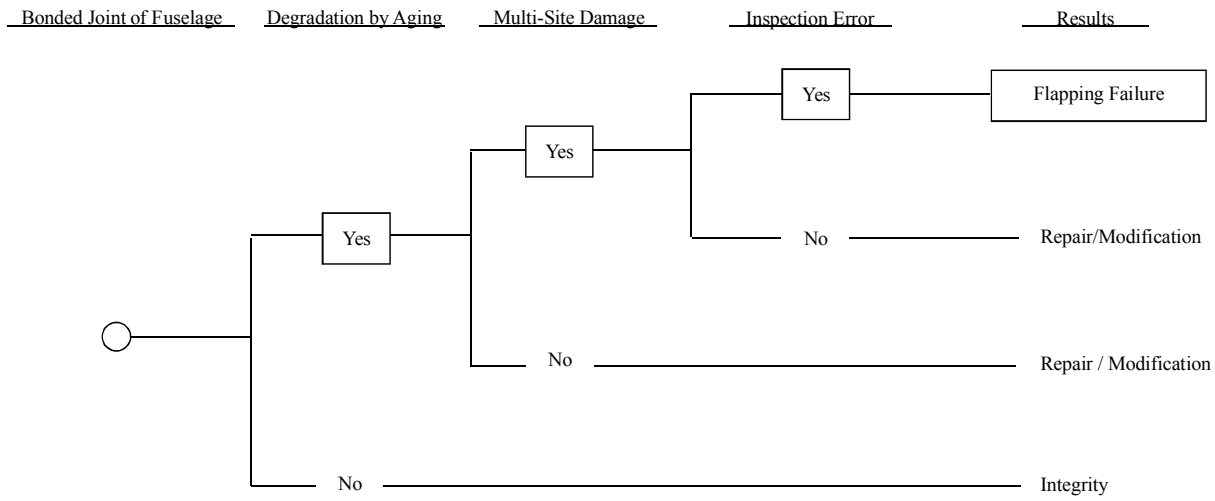

Fig. 3 Event Tree.

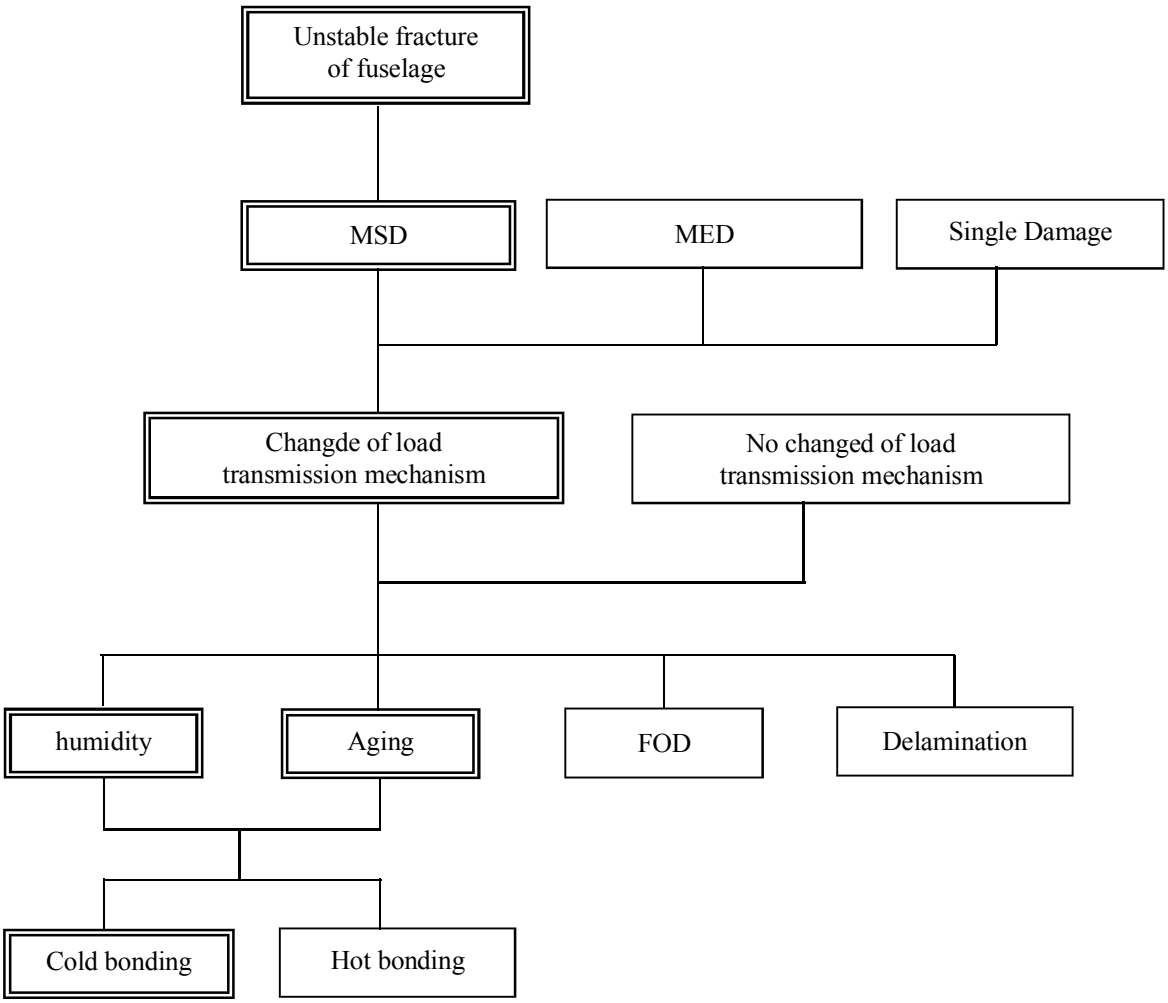

Fig. 4 Fault Tree.