



**FINAL INVESTIGATION REPORT OF  
SERIOUS INCIDENT TO M/S JET AIRWAYS  
LTD. B737-800 AIRCRAFT VT-JTD  
AT DHAKA ON 22/01/2017**

**AIRCRAFT ACCIDENT INVESTIGATION BUREAU  
MINISTRY OF CIVIL AVIATION  
GOVERNMENT OF INDIA**

## **FOREWORD**

This document has been prepared based upon the evidences collected during the investigation and opinion obtained from the experts. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 11 of Aircraft (Investigation of Accidents and Incidents), Rules 2012 of India. The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this incident which may help to prevent such future incidents.

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## **SYNOPSIS:**

On 22.01.2017, M/s Jet Airways Ltd. B737-800 aircraft VT-JTD while operating flight 9W-276 (Mumbai to Dhaka) was involved in a serious incident at Dhaka on 22.01.2017 during landing.

The aircraft took off from Mumbai at around 0345 UTC and landed at Dhaka airport at around 0556 UTC. At the time of landing First officer was the pilot flying and PIC was the pilot monitoring. As the aircraft approached close to the runway, PIC observed that they were high on glide and immediately the corrective actions were taken by the First officer. On initial touchdown the aircraft bounced with nose-up attitude higher than the normal. Thereafter, PIC took over the controls aircraft touchdown in second attempt. Thereafter thrust reversers were deployed and aircraft exited the runway, taxied to the parking bay. After engines were shut down, AME was informed about the suspected hard landing. During the post flight walk around inspection at Dhaka, rubbing marks were observed on the tail skid and underbelly of the aircraft.

Ministry of Civil Aviation constituted a Committee of Inquiry to investigate the cause of the incident under Rule 11 of Aircraft (Investigation of Accidents and Incidents) Rules 2012.

**FINAL INVESTIGATION REPORT OF SERIOUS INCIDENT TO  
M/S JET AIRWAYS B737-800 AIRCRAFT VT-JTD AT DHAKA  
ON 22.01.2017**

|     |                               |                                     |
|-----|-------------------------------|-------------------------------------|
| 1.  | Aircraft Type                 | B737-800                            |
| 2.  | Nationality                   | INDIAN                              |
| 3.  | Registration                  | VT - JTD                            |
| 4.  | Owner                         | M/s AerCap Ireland Ltd              |
| 5.  | Operator                      | Jet Airways Ltd                     |
| 6.  | Pilot – in –Command           | Holder of ATPL                      |
| 7.  | Co-Pilot                      | Holder of CPL                       |
| 8.  | Place of incident             | Dhaka                               |
| 9.  | Co-ordinates of incident Site | 23°50'47.81"N,<br>90°24'9.44"E      |
| 10. | Last point of Departure       | Mumbai                              |
| 11. | Intended place of Landing     | Dhaka Airport                       |
| 12. | Date & Time of incident       | 22 <sup>nd</sup> Jan 2017, 0556 UTC |
| 13. | Passengers on Board           | 160                                 |
| 14. | Extent of Injuries            | NIL                                 |
| 15. | Crew on Board                 | 08 (02+06)                          |
| 16. | Extent of Injuries            | NIL                                 |
| 17. | Phase of Operation            | Landing                             |
| 18. | Type of Incident:             | Tail Strike during landing          |

(ALL TIMINGS IN THE REPORT ARE IN UTC)

## **1.0 FACTUAL INFORMATION.**

### **1.1 History of the flight:**

Jet Airways Ltd. B 737-800 aircraft VT-JTD while operating flight 9W-276 (Mumbai to Dhaka) was involved in a serious incident at Dhaka on 22.01.2017 while landing. The aircraft was under the command of Captain holding ATPL with First officer holding CPL. There were a total of 160 passengers and 08 crew members including a supernumerary First Officer undergoing observation flight on board the aircraft. There was no fire and no injury to any of the occupants onboard the aircraft.

The aircraft took off from Mumbai at around 0345 UTC and landed at Dhaka airport at around 0556 UTC. The enroute flight was uneventful. The weather at Dhaka at the time of landing was fine with visibility approx 1900 meters and winds 360/04 kts.

At the time of landing First officer was the pilot flying and PIC was the pilot monitoring. First officer was carrying out assisted landing and both (PF & PM) were authorized for the above purpose. As per PIC, aircraft was stabilized by 1000 ft AFE in VMC on runway 14 with all checks completed. Also the landing clearance was obtained from Dhaka ATC. As the aircraft approached close to the runway, PIC observed that they were high on glide and immediately the corrective actions were taken by the First officer. On initial touchdown the aircraft bounced with nose-up attitude higher than the normal. Thereafter, PIC took over the controls and added thrust with simultaneous increase in pitch attitude. After thrust was added, takeoff configuration warning light was flashed followed by horn and aircraft touch down in second attempt. Thereafter thrust reversers were deployed and aircraft exited the runway, taxied to the parking bay. After engines were shut down, AME was informed about the suspected hard landing.

During the post flight walk around inspection at Dhaka, rubbing marks were observed on the tail skid and underbelly of the aircraft was found damaged. Aircraft was grounded at Dhaka and next flight 9W-275 (Dhaka - Mumbai) was cancelled.

After the incident at Dhaka, an engineering team from Mumbai visited Dhaka for the damage assessment and repair of the aircraft as Jet Airways Dhaka station is approved only for transit inspection and M/s Jet Airways has contract with (Biman) Bangladesh Airlines for all support of ground handling for the transit inspection. At Dhaka preliminary damage assessment was carried out by Jet Airways team and the damage report was provided to M/s Boeing Company with a request to provide temporary repair scheme for an unpressurised ferry flight to a suitable base for permanent repair.

Temporary repair scheme was suggested by M/s Boeing Company, wherein doublers were installed on the damaged skin area and after that aircraft carried out an unpressurised ferry flight to Mumbai for permanent repair.

**1.2 Injuries to persons:**

| <b>INJURIES</b>   | <b>CREW</b> | <b>PASSENGERS</b> | <b>OTHERS</b> |
|-------------------|-------------|-------------------|---------------|
| <b>FATAL</b>      | Nil         | Nil               | Nil           |
| <b>SERIOUS</b>    | Nil         | Nil               | Nil           |
| <b>MINOR/NONE</b> | 08          | 160               |               |

**1.3 Damage to the Aircraft:**

- **External Damages : Following are the external damages observed in the aircraft**
  - On Fuselage skin Deep Scratch/Gouge marks observed for a total length of 79 inch, the Gouge marks were located between STA (station) 867 and STA 927.

Deep Gouge were starting from 14 inch forward of STA 867 and ending at 3.8 inch just aft of STA 927,

- All the Gouge marks were located between STR (stringer) 27L & 27R, The skin scrap was deep and skin material was found missing at 3 frame stations.
- At STA 927 frame location, skin deep scrap observed with more than 1/3rd of skin material missing
- At STA 907 frame location skin was missing between stringer 27 L & R. Material missing which was 8.27 inch in length and 1.7 inch in width. Also dent observed between station 887 & 907 is 0.6 inch deep.
- At STA 887 frame location skin was missing between stringer 27 L & R. Material missing which was 8.2 inch in length and 0.8 inch in width.

➤ **Internal Damages : Following are the internal damages observed in the aircraft**

- At STA 867 STR 27L stringer clip found buckled
- At STA 887 between STR 27L & R the shear Tie bend & twisted on the skin attachment leg, also at STR 27L& R stringer clip was found buckled and skin Splice strap twisted
- At STA 907 between STR 27L & R the shear Tie to frame attachment fastener sheared off , also at STR 27L stringer clip found buckled and shear tie was damaged.





**Exploded  
View of Rub  
Markings**

**1.4 Other Damage:**

Nil

**1.5 Personnel Information:** The following information regarding licenses, experience etc of the flight crew was provided by the operator.

**1.5.1 Pilot – in – Command:**

|                                              |                           |
|----------------------------------------------|---------------------------|
| Age                                          | 39 years                  |
| License                                      | ATPL holder               |
| Date of Issue                                | 21.08.2015                |
| Valid up to                                  | 20.08.2020                |
| Class                                        | Single/Multi Engine, Land |
| Category                                     | Aeroplane                 |
| Endorsements as PIC                          | B73-700/800/900           |
| Med. Exam valid upto                         | 23.08.2017                |
| FRTTO License.                               | Valid                     |
| Total flying experience                      | 5584:39 hours             |
| Experience on Type                           | 1444:33 hours             |
| Last flown on type                           | 21.01.2017                |
| Total flying experience during last 180 days | 364:44 hours              |
| Total flying experience during last 30 days  | 39:38 hours               |
| Total flying experience during last 07 Days  | 10:46 hours               |
| Total flying experience during last 24 Hours | 02:30 hours               |
| Rest Before Duty                             | 24:50 hours               |

### 1.5.2 Co-Pilot:

|                                              |                           |
|----------------------------------------------|---------------------------|
| AGE                                          | 47 years                  |
| License                                      | CPL holder                |
| Date of Issue                                | 29.05.2014                |
| Valid up to                                  | 28.05.2019                |
| Class                                        | Single/Multi Engine, Land |
| Category                                     | Aeroplane                 |
| Date of Med. Exam.                           | 12.05.2016                |
| Med. Exam valid upto                         | 11.05.2017                |
| FRTTO License                                | Valid                     |
| Total flying experience                      | 3329:56 hours             |
| Total flying experience on type              | 3042:32 hours             |
| Last flown on type                           | 18.01.2017                |
| Total flying experience during last 180 days | 337:26 hours              |
| Total flying experience during last 30 days  | 39:38 hours               |
| Total flying experience during last 07 Days  | 07:03 hours               |
| Total flying experience during last 24 Hours | 02:30 hours               |
| Rest before duty                             | 12:25 hours               |

None of the crew was involved in any Serious Incident or accident earlier.

### 1.6 Aircraft Information:

The aircraft manufactured by M/s The Boeing Company on 13<sup>th</sup> Jan 2008 and is powered with CFM56-7B26/3 type of engines. The aircraft has a seating capacity of 176 persons including cockpit crew. The Aircraft has a total fueling

capacity of around 26045.4 liters and a total endurance of about 2935 nautical miles or 5440 Kms. Aircraft was registered with DGCA under category 'A' and the Certificate of Registration No. 4680 was issued on 25<sup>th</sup> July 2016.

The aircraft is certified in Normal category, for day and night operation under VFR & IFR. The last Certificate of Airworthiness was issued on 26<sup>th</sup> July 2016 by DGCA which was valid on the day of incident. The Aircraft was holding a valid Aero Mobile License A-006/050/WRLO-10. The Aircraft had flown 30589:36 airframe hours since new and 2004:41 airframe hours since the issue of last C of A. The left Engine had logged 2253 Hrs since last shop visit and 30590hrs since new. The right Engine had logged 8476 Hrs since last shop visit and 28578 Hrs since new. There was no defect report on the engine on the previous flight. Last layover of the aircraft was done on 21.01.2017 at 30586:12 TSN / 11289 CSN.

The aircraft and its Engines are being maintained as per the maintenance programme approved by DGCA consisting of calendar period/ flying Hours based maintenance. Accordingly, the last major inspection "A20 check" was carried out at 29661:25 TSN/ 10840CSN on 06.11.2016. Subsequently all lower inspections (Preflight checks, 50 FH Inspections) were carried out as and when due before the incident.

Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine has been complied with as on date of event. Prior to the incident flight there was no pending/repetitive defect.

### 1.7 Meteorological information:

Following is the snap shot of the ATIS taken from the OFP for Dhaka.

| *****LANDING DATA***** |       |           |                    |           |          |
|------------------------|-------|-----------|--------------------|-----------|----------|
| FLT NO.                | 276   | AIRPORT   | VGHS               | ATIS/TIME | K 0500 Z |
| RWY                    | 15 14 | T. LVL    | 6000               | WIND      | 260/4    |
| WX                     |       | CLDS      | Sd 900 ft 3200 070 | VIS/RVR   | 1900 m   |
| TEMP                   | 24 C  | DEW POINT | 18 C               | QNH       | 1020     |
| REMARKS                |       |           |                    |           |          |

**1.8 Aids to Navigation:**

Not Applicable

**1.9 Communication:**

There was always two way communications between the ATC and the aircraft.

**1.10 Aerodrome information:**

The runway information as per the Jeppesen Aerodrome Chart (10 -9) is given below:

| RWY |                                               | USABLE LENGTHS |                               | TAKE-OFF | WIDTH |
|-----|-----------------------------------------------|----------------|-------------------------------|----------|-------|
|     |                                               | Threshold      | Landing Beyond<br>Glide Slope |          |       |
| 14  | HIRL (60m) CL (30m) HIALS SFL TDZ PAPI -L RVR |                | 9527' 2904m                   |          | 148'  |
| 32  | HIRL (60m) CL (30m) ALS PAPI -L (3.0°) RVR    |                |                               |          | 45m   |

**1.11 Flight Recorders:**

**CVR:**

This aircraft did not have the CVR Auto switch. The crew did not complete the “**SHUTDOWN PROCEDURE**” as per company standard operating procedure which requires that the CVR CB be pulled out for airplanes not equipped with CVR ‘Auto switch.’ The CVR conversation was over written by the ground talks. The relevant CVR conversation was not available.

**DFDR:**

DFDR was removed after the incident and the readout of parameters was analysed. The parameters pertaining the relevant portion of flight are as below:

- **From 100 FEET to Flare Height**

| GMT      | AIR GND | VERT G | BARO ALT | RAD ALT | MAX PITCH | ROLL  | VERT SPD | N11   | N12   | CAS | HDG | FLA P | SPD BRK    | AUTO BRAKE APPLIED | AUTO PILOT | WND SPD | WND DIR |
|----------|---------|--------|----------|---------|-----------|-------|----------|-------|-------|-----|-----|-------|------------|--------------------|------------|---------|---------|
| 05:56:09 | AIR     | 1.05   | 106      | 109     | 2.11      | -0.53 | -705     | 60.5  | 59.63 | 155 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 7       | 320     |
| 05:56:10 | AIR     | 1.04   | 95       | 99      | 2.11      | -2.46 | -735     | 60.5  | 59.63 | 157 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 7       | 320     |
| 05:56:11 | AIR     | 1.03   | 85       | 84      | 1.76      | -2.29 | -750     | 60.5  | 59.63 | 157 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6       | 320     |
| 05:56:12 | AIR     | 1      | 74       | 73      | 1.41      | -1.76 | -741     | 60.5  | 59.63 | 155 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6       | 309     |
| 05:56:13 | AIR     | 0.98   | 59       | 55      | 1.05      | -1.05 | -732     | 60.5  | 59.63 | 154 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6       | 309     |
| 05:56:14 | AIR     | 0.97   | 43       | 45      | 0.7       | 1.05  | -729     | 60.38 | 59.5  | 155 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6       | 309     |
| 05:56:15 | AIR     | 1.05   | 24       | 30      | 1.05      | 1.41  | -642     | 60.38 | 59.5  | 156 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6.5     | 309     |
| 05:56:16 | AIR     | 1.07   | 5        | 20      | 2.11      | 1.93  | -563     | 60    | 59.5  | 153 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6.5     | 310     |
| 05:56:17 | AIR     | 1.16   | -12      | 11      | 4.04      | 1.93  | -459     | 59.38 | 57.75 | 153 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6.5     | 310     |

- **From Flare Height to Touchdown**

| GMT      | AIR GND | VERT G | BARO ALT | RAD ALT | MAX PITCH | ROLL  | VERT SPD | N11   | N12   | CAS | HDG | FLA P | SPD BRK    | AUTO BRAKE APPLIED | AUTO PILOT | WND SPD | WND DIR |
|----------|---------|--------|----------|---------|-----------|-------|----------|-------|-------|-----|-----|-------|------------|--------------------|------------|---------|---------|
| 05:56:16 | AIR     | 1.07   | 5        | 20      | 2.11      | 1.93  | -563     | 60    | 59.5  | 153 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6.5     | 310     |
| 05:56:17 | AIR     | 1.16   | -12      | 11      | 4.04      | 1.93  | -459     | 59.38 | 57.75 | 153 | 144 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6.5     | 310     |
| 05:56:18 | GND     | 1.55   | -7       | 0       | 4.57      | 0.35  | -339     | 59.38 | 64.38 | 153 | 145 | 30    | NO APPLIED | NO AUTO BRK        | NO AP ON   | 6.5     | 310     |
| 05:56:19 | AIR     | 1.33   | -7       | 2       | 4.04      | 1.23  | -227     | 64.88 | 63.75 | 153 | 145 | 30    | APPLIED    | NO AUTO BRK        | NO AP ON   | 8       | 310     |
| 05:56:20 | AIR     | 0.99   | -7       | 1       | 2.11      | 1.93  | -153     | 58.25 | 55.25 | 152 | 145 | 30    | APPLIED    | NO AUTO BRK        | NO AP ON   | 8       | 310     |
| 05:56:21 | GND     | 2.79   | -7       | 0       | 6.5       | -0.88 | -80      | 48.88 | 45.75 | 146 | 145 | 30    | APPLIED    | AUTO BRK           | NO AP ON   | 8       | 310     |
| 05:56:22 | GND     | 1.88   | 32       | 0       | 9.67      | -0.53 | 0        | 40.38 | 37.38 | 144 | 145 | 30    | APPLIED    | AUTO BRK           | NO AP ON   | 8       | 310     |
| 05:56:23 | GND     | 1.5    | 30       | 0       | 9.32      | 0.35  | -12      | 34.38 | 32.88 | 144 | 145 | 30    | NO APPLIED | AUTO BRK           | NO AP ON   | 9.5     | 310     |

### 1.12 Wreckage and impact information:

The aircraft bottom portion has rubbed with the runway surface during landing. However, it had gone to the bay under its own power normally.

### 1.13 Medical and pathological Information:

The preflight medical was carried out prior to the flight for both the cockpit crew members including breath analyzer test and found satisfactory.

### 1.14 Fire:

There was no fire.

### **1.15 Survival aspects:**

The incident was survivable.

### **1.16 Tests and research:**

Nil

### **1.17 Organizational and management information:**

The aircraft was operated by an SOP holder holding a valid SOP with the aircraft endorsed. The maintenance of the aircraft is carried out under CAR 145 approval. Routine Line maintenance is carried out in house and major maintenance is outsourced. The transit inspection at Dhaka is outsourced to Biman Bangladesh Airlines Ltd.

### **1.18 Additional information:**

#### **1.18.1 Training Records of the crew**

##### **1.18.1.1 PIC**

The Captain's training records were analyzed comprising of Command upgrade training simulator; Command upgrades RHS SLF; Command upgrades LHS SLF; Command PIC route checks; Recurrent IR/PPC checks; Corrective training after Training Review Boards. The Captain was found consistent on all stages of training with some deficiencies in Situational Awareness, handling of aircraft (on manual as well as automation assisted) and certain inconsistencies of procedures, FCTM and CRM techniques.

##### **1.18.1.2 First Officer**

The First officer's training records were analyzed comprising of P2 SLF, Corrective training after IR/PPC checks. The First officer was found with deficiencies in instrument scan during Manual ILS approaches and situational Awareness.

Scrutiny of the files in both the cases as above have not revealed any details of training profile for corrective training

### **1.18.2 Flare & Touchdown**

As per the Flight Crew Training Manual (FCTM), for B-737 NG aircraft,

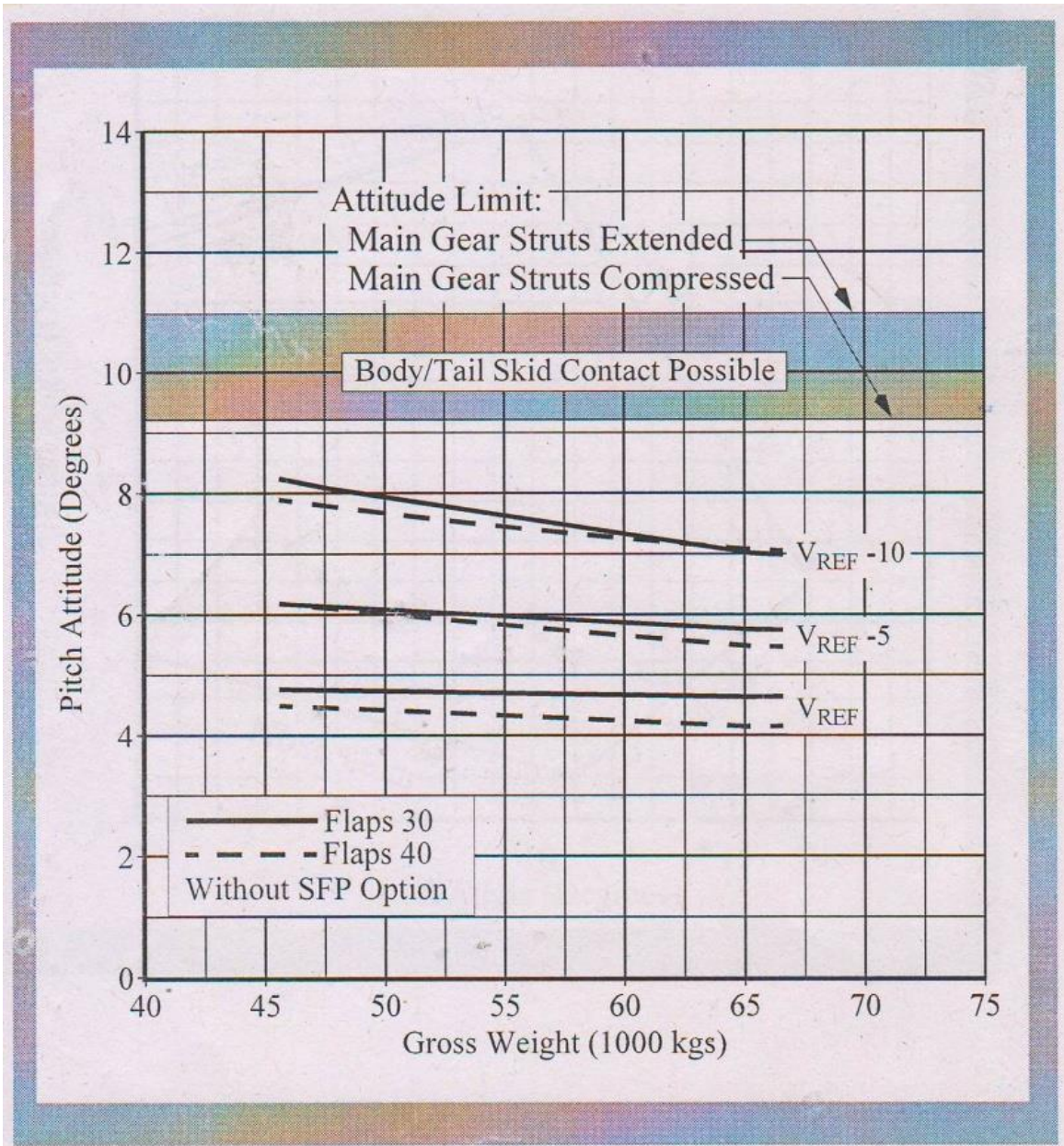
Unless an unexpected or sudden event occurs, such as windshear or collision avoidance situation, it is not appropriate to use sudden, violent or abrupt control inputs during landing. When a manual landing is planned from an approach with the autopilot connected, the transition to manual flight should be planned early enough to allow the pilot time to establish airplane control before beginning the flare. The PF should consider disengaging the autopilot and disconnecting the auto-throttle 1 to 2 nm before the threshold, or approximately 300 to 600 feet above field elevation.

Flare should be initiated when the main gear is approximately 20 feet above the runway by increasing pitch attitude approximately 2° - 3°. This slows the rate of descent. After the flare is initiated, smoothly retard the thrust levers to idle, and make small pitch attitude adjustments to maintain the desired descent rate to the runway. A smooth thrust reduction to idle also assists in controlling the natural nose-down pitch change associated with thrust reduction. Hold sufficient back pressure on the control column to keep the pitch attitude constant. Ideally, main gear touchdown should occur simultaneously with thrust levers reaching idle.

### **1.18.3 Normal Touchdown Attitude**

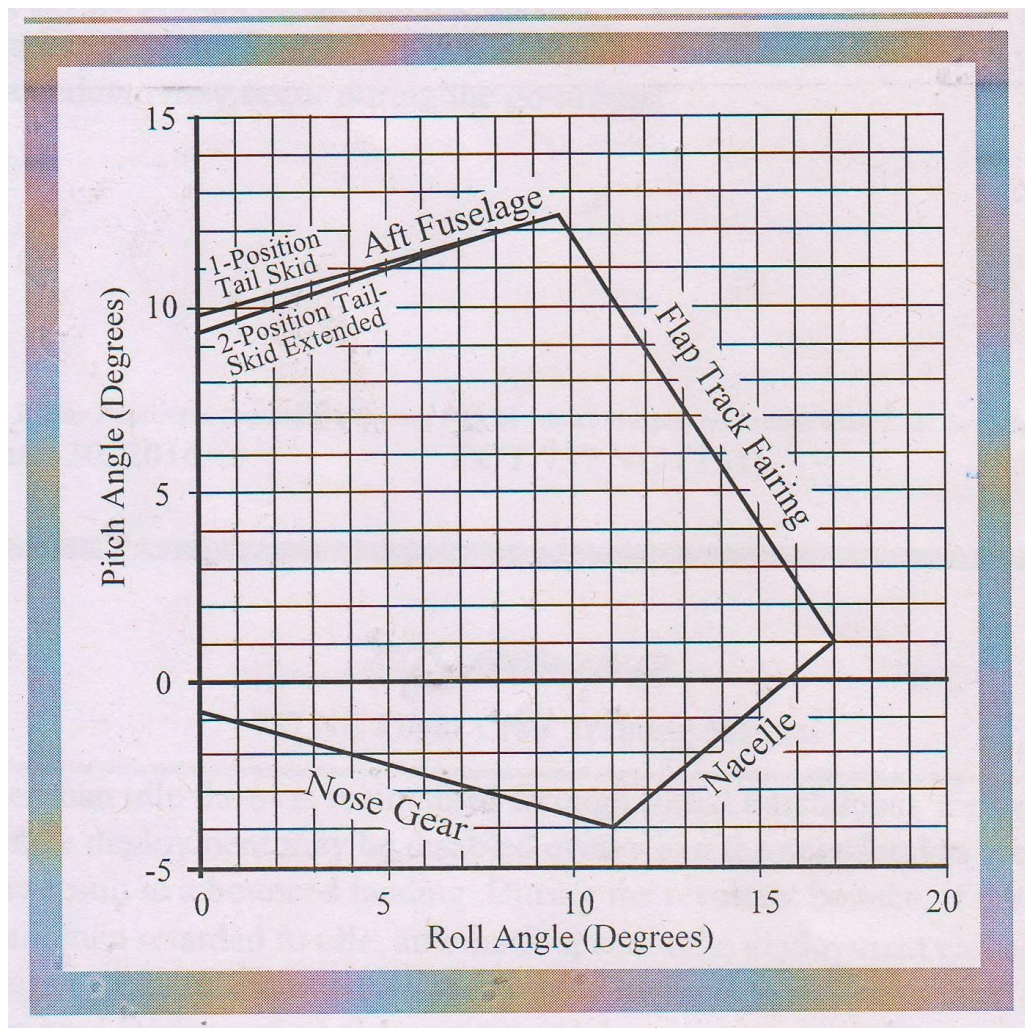
Airspeed effects airplane attitude at touchdown. Following is the chart from Flight Crew Training Manual (FCTM) for B-737-800 aircraft illustrating this effect.





It shows airplane attitude at a normal touchdown speed ( $V_{REF}$  to  $V_{REF} - 5$  knots) for flaps 30 and flaps 40. It also show that touchdown at a speed below normal touchdown speed, in this case  $V_{REF} - 10$  knots, seriously reduces aft body-runway clearance.

### 1.18.4 Ground Contact Angles - Normal Landing (737-800)



The line labeled “1-Position Tail Skid” is for airplanes without the Short Field Procedure (SFP) option and airplanes with the SFP option and a 1 position tail skid. The line labeled “2-Position Tail Skid Extended” is for airplanes with the SFP option and a 2 position tail skid.

### 1.18.5 Bounced Landing Recovery

As per the Flight Crew Training Manual (FCTM), for the type of aircraft,  
“If the airplane should bounce, hold or re-establish a normal landing attitude and add thrust as necessary to control the rate of descent. Thrust need not be added for a shallow bounce or skip. When a high, hard bounce occurs, initiate a

go-around. Apply go-around thrust and use normal go-around procedures. Do not retract the landing gear until a positive rate of climb is established because a second touchdown may occur during the go-around.

If higher than idle thrust is maintained through initial touchdown, the automatic speed brake deployment may be disabled even when the speed brakes are armed. This can result in a bounced landing. During the resultant bounce, if the thrust levers are then retarded to idle, automatic speed brake deployment can occur resulting in a loss of lift and nose up pitching moment which can result in a tail strike or hard landing on a subsequent touchdown.”

**1.19 Useful or Effective Investigation Techniques:**

Nil

## **2. ANALYSIS**

### **2.1 General:**

Both the operating crew were appropriately licensed and qualified to operate the flight. The aircraft had a valid Certificate of Airworthiness at the time of incident. The Aircraft held valid Certificate of Release to Service which was issued at the airport of departure. The Aircraft was holding a valid Aero Mobile License. Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications has been complied with. Transit inspections were carried out as per approved transit inspection schedules and all the higher inspection schedules including checks/inspection as per the manufacturer's guidelines as specified in Maintenance Programme and approved by the Quality Manager.

The weather at the airport at the time of incident was fine and is not a contributory factor to the incident.

### **2.2 DFDR Analysis:**

The DFDR parameters (pitch angle, height, thrust, 'g' etc.) were analysed from 100 feet AFE till touchdown and roll out. Following was observed vis-à-vis time:

- DFDR Parameters – From 100 FEET to Flare Height
  - 05:56:14 Pitch Angle was lowered to 0.7 Degrees from 1.41 Degrees at 45 Ft. AFE
  - 05:56:15 Maximum Pitch Angle was 1.05 Degrees at 24 Ft. AFE
  - 05:56:16 Maximum Pitch Angle was 2.11 Degrees at 20 Ft. AFE
  - 05:56:17 Maximum Pitch of 4.04 Degrees at 11 Ft. AFE
- DFDR Parameters – From Flare Height to touchdown
  - 05:56:18 First Touchdown with a Maximum pitch – 4.57 Degrees, Thrust – 59.38% N<sub>1</sub>, Vert 'g'- 1.55



- 05:56:19 Aircraft has bounced 02 Ft. AFE for 2 seconds, Pitch – 4.04 Degrees, thrust increased to 64.88% N<sub>1</sub>, Speed brake- UP
- 05:56:20 Pitch 2.11 degrees, Thrust reduced to 58.25 % N<sub>1</sub> at 01 Ft. AFE
- 05:56:21 Speed brake UP, a Second Touchdown, Vert G- 2.79 'g', Pitch – 6.5 Degrees, Thrust – 48.88% N<sub>1</sub>
- 05:56:22 After the Second Touchdown, Pitch was abruptly increased by more than 3 degrees to a maximum of 9.67 Degrees, Thrust was 40.38% N<sub>1</sub>

(The Landing (first touchdown) was normal two point landing on main wheels)

From the above following was observed:

- The aircraft had an initial Power- On touchdown of 1.55 'g' with a pitch attitude of 4.57 Degrees causing the aircraft to bounce for 2 feet in air, and Speed Brakes Deployed (air ground sensor sensing ground).
- There was an increase in thrust of 64.88% followed by momentarily lowering the pitch attitude upto 2.11 degrees, with the speed brakes still being deployed.
- The aircraft landed with a second touchdown of 2.79 'g' and pitch attitude of 6.5 degrees.
- After touchdown, there was continuous increase in pitch attitude from 6.5 Degrees to 9.67 Degrees.

### **2.3 Circumstances leading to the incident:**

The crew carried out normal ILS DME approach for runway 18. After the approach was stabilized, PF initiated flare at the recommended Flare height but the thrust lever was not retarded to idle as required by the FCTM for landing, so it was a power on landing. The PF was not cautioned by the captain who was supervising the landing. On initial touchdown with a pitch attitude of 4.57 Degrees, 'g' of 1.55 was experienced causing the aircraft to bounce for 02 feet in air. Speed Brakes got deployed as the system sensed aircraft on ground. At this moment, Captain took over controls and increased thrust commanding 64.88% N<sub>1</sub> to recover from bounce, this could have been avoided for small skip (As per the FCTM). The pitch was also lowered to 2.11 degrees and DFDR data shows speed brake to be still

up. The aircraft touched down on wheels for the second time with a vertical acceleration of 2.79 'g' and pitch attitude of 6.5 Degrees, speed brakes still up. A pitch up trend @ 3.42 degrees/ second continued with a maximum pitch angle of 9.67 degrees.

Probably the main landing gear oleo strut which got compressed during the first touchdown might not have gone back to a fully extended position as it takes time, whereby reducing the distance between the bottom of fuselage of the aircraft and the ground at the time of second touchdown.

The aircraft attitude due to the combination of all the above at the time of second touchdown resulted in the fuselage bottom rubbing the ground as observed after the incident.

### **3.0 CONCLUSION**

#### **3.1 Findings**

##### **3.1.1 General**

- The Certificate of Registration, Certificate of Airworthiness and the Certificate of Flight Release of the aircraft was valid on the date of incident. The maintenance of the aircraft was being done as per the approved maintenance programme.
- Both the pilots were appropriately licensed and qualified to operate the flight.
- The weather has not contributed to the incident in any manner.
- First Officer (PF) was qualified to perform supervised Take – off and landing. Captain (PM) was cleared for and had the required experience to effect supervised take-off and landing.
- The crew performed stabilized ILS DME approach at the destination.
- During the “SHUTDOWN PROCEDURE” as per company standard operating procedures, the crew did not pull the CVR CB out as required for aircraft not equipped with CVR ‘Auto switch.’ The relevant CVR recording was over written and was unavailable for investigation.
- During Post flight walk around damage to the underside of the belly was observed indicating Tail/ AFT Fuselage Strike.

- During Post Event Actions, the AME could have timely performed the action of preserving the CVR.

### **3.1.2 Organizational influences**

- Processes and procedures followed by the training department to assess crew proficiency do not have system of addressing specific deficiency.

### **3.1.3 Unsafe supervision**

- Captain who was supervising the landing did not caution the PF at the time of flaring about the thrust lever not retarded to idle as recommended in the FCTM

### **3.1.4 Preconditions for unsafe acts**

- Absence of documented training profiles to remove deficiencies observed during assessment of crew proficiency.

### **3.1.5 Unsafe Acts (active)**

- On initial Power On touchdown with a pitch attitude of 4.57 Degrees, 'g' of 1.55 was experienced causing the aircraft to bounce for 2 feet in air. The Speed Brakes got deployed as the system sensed aircraft on ground.
- PF initiated flare at the recommended Flare height but the thrust lever was not retarded to idle as recommended in the FCTM in order to achieve a smooth touchdown, resulting in a power on landing.
- The Captain took over controls and increased thrust commanding 64.88% N1 to recover from bounce. This is recommended to be avoided for small skips which was the case. The pitch was also lowered to 2.11 degrees and DFDR data shows speed brake to be still up. The above action was probably taken by the captain to attain a smooth touchdown and reduce the rate of descent on touchdown however; it exacerbates the pitch up tendency of aircraft.
- The aircraft touched down for the second time with a vertical acceleration of 2.79 'g' and pitch attitude of 6.5 Degrees with speed brakes still up. The aircraft continued a pitch up trend @ 3.42 degrees/ second with a maximum pitch angle

of 9.67 degrees which is more than the pitch attitude limit for body/ tail skid contact.

- The main landing gear oleo strut which got compressed during the first touchdown might not have gone back to a fully extended position as it takes time, whereby reducing the distance between the bottom of belly of the aircraft and the ground at the time of second touchdown. This resulted in the forward portion of aircraft belly bottom rubbing the ground with consequential structural damage.
- The first officer who became PM after the handover of control to the captain could have warned the PF about the excessive pitch.

### **3.2 Probable Cause of Tail Strike**

Bottom of fuselage rubbed with runway surface as

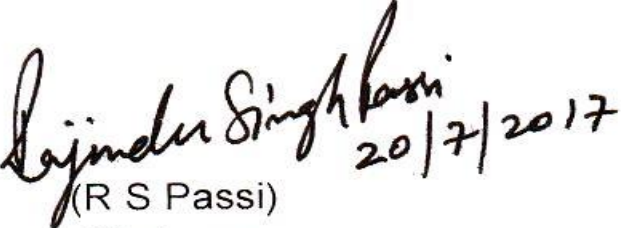
- The First officer (PF) initiated flare but the thrust lever was not retarded to idle resulting in Power-On landing causing an aircraft skip of around 2 feet.
- The Captain (PM) who was supervising the landing had not cautioned the PF to retard thrust levers to idle.
- In view of the skip, the Captain took over controls (became PF) and initiated recovery procedure by increasing the thrust which should have been avoided for small skip.
- As the aircraft system sensed the aircraft on ground, the speed brakes got deployed.
- The Captain (PF) raised the nose further to smoothen the second touchdown, which resulted in insufficient fuselage clearance thereby causing the rubbing of fuselage with runway surface.
- The First officer (now PM) did not caution PF about the aircraft's pitch attitude.



#### 4.0 RECOMMENDATIONS

The operator may

- Review the flight crew training processes & procedures to address the flight crew proficiency which should include specific training profiles tailored to address specific deficiencies of the crew.
- Reiterate the requirements to ensure the availability of relevant CVR recordings after an occurrence.
- The responsibility of preserving data after such occurrences to the engineering & maintenance personnel about may be reiterated.

  
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Place: New Delhi

Date: 20.07.2017