1901/116/AIB

ORIGINAL

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AIRCRAFT INCIDENT INVESTIGATION REPORT

PIA BOEING 737 AP-BCD
ISLAMABAD INTERNATIONAL
AIRPORT
ON
25TH JULY, 1990

CIVIL AVIATION AUTHORITY

KARACHI, PAKISTAN

AIRCRAFT ACCIDENT INVESTIGATION REPORT

LANDING INCIDENT AT ISLAMABAD INTERNATIONAL AIRPORT ON 25TH JULY 1990 INVOLVING PIA BOEING 737 AIRCRAFT REG. MKS. AP-BCD WHILST OPERATING SCHEDULED DOMESTIC PASSENGER FLIGHT PK-388 FROM LAHORE TO ISLAMABAD

Authority: Director General, Civil Aviation Authority
Memorandum NO.HQ.CAA/1901/116/AIB
Dated 26th July, 1990 (App. **'A'**)

COMPOSITION OF INVESTIGATION TEAM

1. Mr.Mohammad Ali Siddiqui — Investigator-in-Charge
Ops.Investigator

S Y N O P S I S

Flight PK-388 aircraft B-737 Reg.Mks.AP-BCD from Lahore to Islamabad attempted to land on Runway 12 but had to go around due to poor visibility and heavy rain.

2. The aircraft made second approach and managed to land on Runway 12. However after landing, the aircraft could not stop on the runway. It crossed the runway and finally came to a halt in the Kutcha 120' from the end of the stopway and 30 feet off set to the north of extended Runway centre line.

3. Rescue and fire fighting services were immediately scrambled.

4. All passengers were evacuated through emergency escape exists no injury was caused during the emergency.

5. Ten approach lights of R/W 30 were damaged and the airfield remained closed till the aircraft was towed away at 0600 hrs on 27.7.90.

1. AIRCRAFT INFORMATION

1.1. Registration Marking	:	AP-BCD
1.2. A/c type and Maker's Sl.No.	:	Boeing 737-300
1.3. Engine types, airframe positions and maker's Sl.No.	:	CFM 56-3BZ
1.4. Certificate of Registration No. and Validity	:	No.579, Issue date 25.6.1985
1.5. Certificate of Airworthiness No. and date of expiry, and flight manual No.	:	No.532, 24.6.1991
1.6. Certificate of Safety date and time (GMT) of issue and period of validity	:	"C" of "M"
1.7. Date of construction of airframe.	:	22.6.1985
1.8. Name and Address of Owner	:	PIAC Head Office Karachi Airport
1.9. Gross weights, maximum permitted by C of A for this flight, at the time of accident	:	61235 Kgs
1.10. Loading,Centre of gravity limits in C of A and centre of gravity position at the time of accident and commencement of flight.	:	-
1.11. Airframe history. (Give flying times since manufacture, last overhaul and last periodic check. List also essential modifications completed.)	:	Flying hrs on 25.7.90 - 11175 Check - 'C' on 20.4.90 Check - 'B' on 18.7.90
1.12. Engine history. (Give flying time since manufacture, last overhaul and last periodic check. List also essential modifications completed).	:	No.1 engine

/1.13.Accessory

1.13. Accessory history. (Give details of operating life and operating time since manufacture and overhaul)	:	-
1.14. Defects. (List and remarks upon any technical defects in airframe engines or assessories, discovered during investigation).	:	PK-388/260790 - Nil- defects (Also witnessed by Sr.Airworthiness Surveyor CAA Islamabad Airport

2. CREW INFORMATION

2.1. Pilot-in-Command

2.1.1. Name	:	Capt.Laeeq-ur-Rehman
2.1.2. Position in the Cokcpit	:	Captain
2.1.3. Date of Birth	:	24.12.1950
2.1.4. Type of Lic and No.	:	ALTP No.514
2.1.5. Medical date with status	:	4.4.90 fit for renewal ALTP Lic subject to use of corrective glasses.

2.1.6. **Rating:-**

2.1.6.1. Type(s) hld	:	F-27, B-707/720B, B-747 (P-2) and B-737
2.1.6.2. Type current	:	B-737
2.1.6.3. Assist/Flight Instructor rating	:	-
2.1.6.4. Flight Engineer Instructor rating	:	-
2.1.6.5. Check rating	:	-

2.1.7. **Flying Experience:-**

2.1.7.1. Grand total	:	8325.45
2.1.7.2. Total-in-Command	:	2780.00
2.1.7.3. Total-in-Command/ Co-Pilot/Flight Engr on the type Accident/Incident Occurred	:	1963
2.1.8. Where trained	:	PIAC
2.1.9. Date of Joining Organization	:	-

2.2. **CO-PILOT**

2.2.1. Name	:	F/O Kifaait H.Awan P-46590
2.2.2. Position in the Cockpit	:	Co-Pilot
2.2.3. Date of Birth	:	13.12.1949
2.2.4. Type of Lic and No.	:	Commercial Pilot Lic No.1432
2.2.5. Medical date with status	:	6.3.90. Fit for renewal of CPL subject to use of corrective glasses for distance vision.

2.2.6. **Rating:-**

2.2.6.1. Type(s) held	:	F-27, DHC-6, B-737
2.2.6.2. Type current	:	Boeing 737
2.2.6.3. Assist/Flight Instructor rating	:	Nil
2.2.6.4. Flight Engineer Instructor rating	:	Not applicable
2.2.6.5. Check rating	:	"

2.2.7. **Flying Experience:-**

2.2.7.1. Grand total	:	6131 Hrs
2.2.7.2. Total-in-Command	:	6131 Hrs
2.2.7.3. Total-in-Command/ Co-Pilot/Flt.Engr on the type accident/incident occurred	:	28.28 Hrs
2.2.8. Where trained	:	PIAC
2.2.9. Date of joining the Orgn	:	-

3. **WEATHER**

3.1. Chaklala had a weather warning for thunder storm/rain moderate to severe turbulence winds NE/SE 15 Kts gusting to 25 Kts. Visibility 1-3 Km with 1-2/8 Cumulo nimbus clouds at base 3500' AGL weather at Appendix 'L_2 '.

4. INVESTIGATION

4.1. Boeing 737 AP-BCD operating PK-388/250790 landed at Islamabad Airport at 0635 hrs local time. After landing on runway 12, it crossed end of RW 30, over run 30 and went into Kutcha about 200 feet from end of the over run. The aircraft sustained damage to its both main landing gears outer wheels tyres which were found burst. As a result of the above incident one over run central line light, one over run end light and 7 approach lights towards RW 30 were damaged.

4.2. The aircraft was pulled back from the Kutcha through to cabin with tugmaster at 06 hrs next day (27.7.90). The aircraft was washed off mud from all the gears, main wheel well bay area and fuselage. The following inspections were carried out at Islamabad.

4.2.1. High Drag/side load landing as per its MM 05.51.51 (Phase-I).

4.2.2. All four main gear wheels and 2 nose wheels replaced.

4.2.3. Nose landing gear wheel well for buckling, flaking paint, cracks, pulled rivits, missing fastners in the web of the nose wheel well, found OK.

4.2.4. Rigging of nose landing gear mechanism checked, no abnormality noticed.

/4.2.5.Visual

4.2.5. Visual inspection of both engines, accessories intakes exhaust cowls for any damage, ingestion of foreign object checked found OK.

4.2.6. Both engines inspection for hard landing as per MM (05-51-61) carried out, found OK.

4.2.7. Both engines chip detectors, press filter, scavange filters checks found OK.

4.2.8. Both engines performance checked, all parameters and systems found normal.

4.2.9. Landing gears retraction checked found no abnormality.

4.2.10. Steering system checked for physical/operational condition found no abnormality.

4.2.11. Brakes were checked for physical/operation condition found satisfactory.

4.2.12. Nose wheel steering operation with rudder padals checked, found normal.

4.2.13. High speed taxi check was carried out found satisfactory.

4.2.14. The following components were replaced due ingress of moisture:-

(a) Fire Control Unit.

(b) Both Audio selector box.

/(c) Both

(c) Both VHF Com Control Panels.

(d) Both NAV control units.

(e) Both HF control panels.

(f) Both ADF control panels.

(g) ATC control panel.

(h) W/R indicator and TR unit.

4.2.15. DFDR and CVR were replaced. Old units were sent to Karachi for read out.

4.3. The aircraft was ferry flown to Karachi on 28.7.90 with landing gears down and safety pins installed.

5. DISCUSSION OF EVIDENCE

5.1. Chaklala weather reported at the time of incident was sky overcast, visibility 1—3 KM and the winds 15 Kts gusting to 25 Kts cumulonimbus clouds 2 to 3 Oktas with low cloud base were reported in the north, north western sector. Runway in use was RW 12 which is not an instrument runway.

5.2. The aircraft on approach at Chaklala Airfield, was handed over by Cherat Approach Control to Chaklala Radar. After positive indentification on the radar scope, Chaklala radar cleared PK-388 to descend and vectored the aircraft onto the final approach of runway 12.

/5.3.In the

5.3. In the meantime it started to rain heavily which further reduced the visibility. The aircraft although was brought in line with the centre line of the runway on the first approach, yet the pilot could not sight the runway till he was over the runway threshold high and decided to go around. After go around he climbed to 6500 ft and decided to hold till the visibility improved. After holding for several minutes, the pilot decided to make another attempt at landing. The second approach was again radar vectored, however it is evident from the call given by the Co-pilot (ATC Transcript (Appendix 'E'). That the visibility had not improved much.

5.4. The aircraft was again positioned onto finals of runway 12. The Pilot sighted the runway slightly earlier this time and decided to put the aircraft down. The touch down was long at 2700' with higher speed (DFDR read out Appendix 'N') than recommended. The runway being wet and slippery did not produce enough friction and drag to the aircraft. Although the pilot had selected. Auto brakes level '3' which under dry conditions are extremely effective.

5.5. There was a technical entry in the aircraft technical log regarding No.1 engine lagging when reversers were selected. This being in the mind of the Pilot, he opted to select the reversers late to avoid directional control problems. This further aggravated the situation and made it difficult for the pilots to stop the airplane in the remaining runway.

/5.6.At Chaklala

5.6. At Chaklala, if Runway 12 is used for landing, there is a slight hump abeam taxiway, 'ALPHA' and a gradual downward gradient till the end of the runway. This again adds to the problem if sufficient deceleration is not achieved before taxiway ALPHA.

5.7. Moreover the runway has over a period of time accumulated rubber deposit between 1000' to 3000' from the beginning of Runway 30. This alongwith combination of moisture does not give much traction to the tyres to necessitate required deceleration. Rubber was removed last in Nov - Dec 1989.

5.8. **APPROACH - I:** The Pilot when making the first approach, could not sight the runway till he was on the threshold and placed high. He therefore decided to go around which was a correct decision. He should have, however diverted to his alternate as it was raining heavily. Besides Runway 12 was in use which is not an instrument runway.

5.9. An instrument runway equipped with an Instrument Landing System, provides both localizer information which brings an aircraft in line with the centre line of runway including a glide path information with a controlled descend between 550' to 650' pm with a glide angle between 2.7^{o} - 3^{o}.

5.10. In this case, this information was not provided. Although the aircraft was not in the clouds on the final approach,

/the visibility

the visibility was so low due to heavy rain that the runway was not visible. Moreover on a non precision approach, the pilot has to have visual contact with the runway right from the time he starts his descend on the final approach. If the runway is sighted late and the pilot decides to land, it poses problems like landing long and at high speeds. The very fact that the pilot had to go around on the first approach, shows the prevailing conditions alongwith poor visibility. This should have prompted the pilot to divert to his alternate.

5.11. **APPROACH - II:** On the second approach, the aircraft was again radar vectored on the finals of R/W 12. It was still raining heavily the pilot decided to land even though his touch down was going to be beyond 1000' which is against the standard operating procedure for wet runway (App.'M') landings. The SOP very clearly states that the pilot must go around if the touch down is likely to be beyond 1000'.

5.12. The additional speed that the pilot was maintaining caused the aircraft to float longer at the flare. The DFDR read out shows that the aircraft touched down at a higher speed than recommended.

5.13. **TOUCH DOWN:** The aircraft touched down at a distance of 2700' and at approximately 16 Kts higher speed. The landing roll of the aircraft with the existing load configuration

/and on

and on wet runway surface is 5950'. The aircraft should have barely stopped in the remaining runway (total 9000') if not for higher speeds and late selection of the reversers.

5.14. **LANDING ROLL:** The pilot touching late and at higher speeds further aggravated the emergency by selecting the reversers late. In a total time of 22 seconds during which the aircraft touched and came to a complete halt, the reversers were selected 9 seconds after the aircraft landed. This 9 seconds of crucial delay did not help in providing the deceleration which was necessary to stop the aircraft in the existing adverse conditions.

5.15. On a wet runway surface, even if there is no aqua-planing, due to moisture there is very little friction between the runway surface and the aircraft tyres. This hampers the deceleration rate of the aircraft and also makes the brakes virtually ineffective. Under these conditions reversers are the most effective factor in stopping the aircraft. Since these (reverser) were selected late, the landing roll calculated for wet runway with immediate selection of reversers increased which caused the aircraft to cross the runway, over-run and lodge itself in the Kutcha.

5.16. **RUBBER DEPOSIT:** The rubber deposits on R/W 30 between 1000' to 3000' also made the last part of the landing roll deceleration wise less effective. During the landing

roll, the Pilots felt that the aircraft was not decelerating. This was due to hydroplaning since it was raining heavily and the runway condition was wet. This is also evident from the flat spots on the tyre which eventually burst (App.'B_5 - B_6') This was caused as the rubber on the flat spots due to friction thinned off and the tyre could not hold the internal air pressure.

5.17. Aqua-planing started approximately 7000' down runway 12 as evident from the riverted rubber tyre marks (App.'C'). However this does not absolve the pilot from the mistakes of touching down late and at high speeds.

5.18. **HYDROPLANING ITS CAUSES AND REMEDIES:** Tyre aquaplaning or hydroplaning is technically described as "a condition in which hydrodynamic lift force developed between the tyre footprint and the fluid covered runway surface equals or exceeds the vertical reaction of the aircraft mass acting tyre, resulting in loss of directional stability or braking effectiveness". This means that the contact between the tyre and the runway is lost as the tyre rides on the film or water. The co-efficient of friction which is as high as 0.8 on a dry runway will decrease to 0.3 at slow speeds and 0.0 at high speeds aquaplaning/hydroplaning. Such conditions will increase the stopping distance during landing. Once aquaplaning starts the Pilot has only the aerodynamic braking and reverse thrust available for stopping the aircraft since wheel brakes become ineffective.

/5.19. The

5.19. The type of runway surface will determine the amount of fluid (Water, slush, etc) necessary for hydroplaning, the rougher the surface, the more fluid necessary to sustain hydroplaning.

5.20. There are three known types of hydroplaning. Dynamic hydroplaning occurs when there is standing water on the runway one-tenth of an inch or more in depth. The water acts to lift the tyre off the runway. Tests have shown that the minimum speed for complete dynamic hydroplaning is approximately nine times the square root of the tyre inflation pressure. This speed is for the onset of dynamic hydroplaning and it should be remembered that once hydroplaning has started it can continue to a much lower speed. Changing the weight on the tyre has little effect on this speed as the size of the footprint changes with weight.

5.21. The second type of aquaplaning is viscous hydroplaning which occurs when the runway is damp, and results from the viscous properties of the fluid. A thin film of fluid a thousandth of an inch or so thick cannot be penetrated by the tyre and it rolls on top of the film. This type of hydroplaning occurs at lower speeds than dynamic hydroplaning, however, viscous hydroplaning requires a smooth surface. Rubber deposits on a runway surface if not removed periodically can result in making the surface smooth, and would therefore contribute to this type of aquaplaning.

/5.22.REVERTED

5.22. **REVERTED RUBBER:** Hydroplaning is the third type. This type requires a prolonged skid, reverted rubber, and a wet runway surface. Reverted rubber is a condition in which the rubber takes on an uncured appearance. It is sticky and tacky due to the heat generated by friction between the tyre footprint and the wet runway. This reverted rubber acts to seal the water between the tyre and the runway. The water trapped in the tyre footprint area is heated and converted into steam which supports the tyre above the runway surface. The condition of the tyre surface effected by the heat generated by such aquaplaning is easily distinguishable. No such marks of heating appear on tires subjected to dynamic and viscous type aquaplaning. Also since a prolonged skid is necessary for reverted rubber aquaplaning, this type of aquaplaning does not usually occur to aircraft fitted with serviceable anti skid braking systems if the system is in operation, but can occur if touch down is made at a spot where no wheel spin up occurs, thereby initiating reverted rubber skid.

5.23. **RUNWAY SURFACE:** One of the causes of hydroplaning can be due to surface of the runway. The surface from use over a long period may cause reduction in co-efficient of friction. It can be further reduce if the rubber deposits of tyre accumulate over a period of time and particularly so if the runway is wet. This effect can be further aggravated if the touch down is made smoothly by the aircraft instead of afirm touch down.

/5.24.RUNWAY

5.24. **RUNWAY BRAKING CONDITION:** The co-efficient of friction of tyres on a runway is a function of many factors. Runway surface condition and texture, rubber composition, tread pattern and depth, inflation pressure, surface friction, shearing relative slip speed, etc are all factors which affect the co-efficient of friction. The application of wheel brakes supplies a torque which tends to retard the wheel rotation. When braking torque is equal to rolling torque the wheel experiences no acceleration in rotation and the equilibirium of a constant rotational speed is maintained thus the application of brakes develops a retrading torque and causes an increase in friction force between the tyres and the runway surface.

5.25. A common problem in braking technique is application of too much brake pressure which creates a braking torque greater than maximum possible rolling torque. In this case the wheel loses rotational speed and locks, thus subjecting the tyre surface to a full slip condition with a marked decrease in the co-efficient of friction.

/5.26. In order

5.26. In order to measure the braking co-efficient of the runway surface friction measuring equipment known as MU Meter is needed. Three MU Meters were imported by CAA. These meters located at Karachi, Lahore and Islamabad are used to check the runway braking condition for wet and dry runway surface conditions. This meter is used to assess the following:-

5.26.1. Friction of dry runway surface.

5.26.2. Friction of wet runway surface.

5.26.3. Slipping tendency of runway during rain.

5.26.4. To determine the effect on friction taken there are patches of water on runway.

5.26.5. To obtain friction effect and braking action on ice-snow covered runway.

5.26.6. The braking condition caused due to rubber deposits on runway.

5.26.7. Special tests before giving surface treatment to runway.

/6.FINDINGS

6. FINDINGS

6.1. The crew members were properly certificated and qualified for the flight.

6.2. The aircraft Boeing 737 Reg.Mks AP-BCD was certificated, equipped and maintained in accordance with CAA requirements.

6.3. The aircraft was correctly refueled and properly loaded with passengers and cargo for the subject flight. The C.G position and landing weight were within limits.

6.4. The weather was cloudy with wind gusting and heavy rain on finals with few CB cells in the vicinity of the airfield.

6.5. The aircraft touched down well beyond the recommended distance as given in the standard operating procedure for wet runway landing technique there by violating rules 155(a) and 251(g) of CAR-1978

6.6. The aircraft failed to decelerate and stop on the main runway due to approach at high speed, and aquaplaning.

6.7. Flat spots on the tyres were found from where they eventually burst during the landing roll.

6.8. Reverted rubber tyre marks were found 7000' down the Runway 12 till the end of runway indicating that the aircraft aquaplaned in the last part of the landing roll.

6.9. The aircraft took 22 seconds from touch down to a complete halt beyond the end of R/W in the Kutcha.

/6.10.The

6.10. The reversers were applied 9 seconds after the touch down.

6.11. There is heavy rubber deposits between 1000' to 3000' on runway 30 at Chaklala. Last removal done in Nov - Dec 1989.

6.12. All the passengers evacuated the aircraft through emergency evacuation exits.

6.13. All the passengers evacuated the aircraft without any injury.

6.14. Cost of damage to M/s.PIAC due to the incident is 45,463.36 U.S.Dollars.

6.15. Crash fire and rescue personnels reacted promptly and reached the scene of accident immediately after the aircraft came to halt. They also helped in evacuation of passengers.

7. CAUSE

7.1. From the foregoing findings, after consideration of all available evidence, the Investigator is of the opinion that the probable causes for failure of the aircraft to stop on the runway was that the Pilot-in-Command failed to ensure that the procedures laid down in the B-737 Operations and PIA Standard Operating procedures manual for landing in wet runway conditions were employed.

7.2. Contributing factors were aquaplaning caused by wet runway conditions aggravated by rubber deposits on runway.

/8.RECOMMENDATIONS

8. RECOMMENDATIONS

8.1. Action may be taken against the capt. for not following proper procedure for landing on wet runway as per Operations & PIA standard operating procedures mannual.

8.2. Captain Laeeq-ur-Rehman should undergo a complete refresher course of Boeing 737 with special emphasis to the instrument and emergency procedures.

8.3. Capt.Laeeq-ur-Rehman should be detailed for simulator course on B-737 and under supervision flying for 25 hrs after which he should be flight tested by a CAA appointed Flight Inspector.

8.4. PIA Training and recurrent training programme be reviewed to ensure that adequate flying and technical knowledge with specific stress on emergency procedures is imparted to the flight crew.

8.5. PIA Management to take proper steps to ensure adherence to standard operating procedures and flying techniques of aircrew is maintained at all times.

8.6. CAA should consider the advisability of grooving the existing runways used for Civil Air Carrier operations to make them more skid resistant.

8.7. CAA should consider removal of rubber deposit from runways before the rainy season sets in.

APP 'B1'

APP 'B2'

APP. B3

APP. B4

APP. "B5"

APP. "B6"