
# FINAL INVESTIGATION REPORT ON HARD LANDING INCIDENT INVOLVING M/s AIR INDIA LIMITED AIRBUS A 320-251N AIRCRAFT VT-CIQ ON 20.12.2023 AT DUBAI INTERNATIONAL AIRPORT

**GOVERNMENT OF INDIA**
**O/o DIRECTOR AIR SAFETY, WESTERN REGION,**
**NEW INTEGRATED OPERATIONAL OFFICE COMPLEX,**
**SAHAR ROAD, VILE PARLE (EAST), MUMBAI-400099**

# FOREWARD

This investigation is performed in accordance with The Aircraft (Investigation of Accidents and Incidents) Rules 2017 of India. The sole objective of this investigation is to prevent aircraft accidents and incidents. It is not the purpose of this investigation to apportion blame or liability.

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. Consequently, the use of this report for any purpose other than for the prevention of accidents or incidents could lead to erroneous interpretations.

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# ABBREVIATIONS

| | |
|---|---|
| A/c | Aircraft |
| ADF | Automatic Direction Finder |
| Aircraft | Incident aircraft |
| AME | Aircraft Maintenance Engineer |
| AMM | Aircraft Maintenance Manual |
| AMP | Aircraft Maintenance Programme |
| AMSL | Above Mean Seal Level |
| APU | Auxiliary Power Unit |
| ARC | Airworthiness Review Certificate |
| ASDA | Accelerate Stop Distance Available |
| ATC | Air Traffic Control |
| ATPL | Air Transport Pilot's License |
| CAS | Calibrated Airspeed |
| COK | Cochin International Airport |
| CPL | Commercial Pilot's License |
| CRM | Cockpit Resource Management |
| CSN | Cycles Since New |
| CVR | Cockpit Voice Recorder |
| DFDR | Digital Flight Data Recorder |
| DGCA | Director General of Civil Aviation, India |
| DME | Distance Measuring Equipment |

| | |
|---|---|
| DXB | Dubai International Airport |
| ELT | Emergency Locator Transmitter |
| FCOM | Flight Crew Operating Manual |
| FCTM | Flight Crew Techniques Manual |
| FDM | Flight Data Monitoring |
| FDTL | Flight and Duty Time Limitations |
| FL | Flight Level |
| FMA | Flight Mode Annunciator |
| FMGS | Flight Management and Guidance System |
| FO | Co-Pilot/ First Officer |
| FRTO | Flight Radio Telephone Operator |
| GPS | Global Positioning System |
| IATA | International Air Traffic Association |
| ICAO | International Civil Aviation Organization |
| IFR | Instrument Flight Rules |
| ILS | Instrument Landing System |
| IR | Instrument Rating |
| LDA | Landing Distance Available |
| MEL | Minimum Equipment List |
| MLG | Main Landing Gear |
| NLG | Nose Landing Gear |

| | |
|---|---|
| NOSIG | Non-significant |
| OEM | Original Equipment Manufacturer |
| Operator | AOP holder of the incident aircraft |
| PFR | Post Flight Report |
| PIC | Pilot in Command |
| PPC | Pilot Proficiency Check |
| QNH | Pressure setting to indicate elevation |
| QRH | Quick Reference Handbook |
| RA | Radio Altitude |
| RADAR | Radio Detection and Ranging |
| RESA | Runway End Safety Area |
| ROD | Rate of Descent |
| SLF | Supervised Line Flying |
| TCAS | Traffic Collision Avoidance System |
| THR | Threshold of the runway |
| TOD | Top of Descent |
| TODA | Take-off Distance Available |
| TORA | Take-off Run Available |
| TSN | Time Since New |
| UTC | Coordinated Universal Time |
| VFR | Visual Flight Rules |
| VOR | Very high-frequency Omni Range |

# FINAL INVESTIGATION REPORT ON HARD LANDING INCIDENT M/s AIR INDIA LIMITED AIRBUS A320-251N AIRCRAFT VT-CIQ AT DUBAI INTERNATIONAL AIRPORT ON 20.12.2023

| | | |
|---|---|---|
| **1.** | **Aircraft Type** | Airbus A320-251N |
| **2.** | **Aircraft Nationality** | Indian |
| **3.** | **Aircraft Registration** | VT-CIQ |
| **4.** | **Owner** | M/s CIT Aerospace International Unlimited Company<br>Number One Ballsbridge, Building 1, Shelbourne Road, Ballsbridge, Dublin 4, Ireland |
| **5.** | **Operator** | M/s Air India Ltd |
| **6.** | **Pilot In- Command** | Airline Transport Pilot's License Holder |
| **7.** | **Extent of Injuries** | Nil |
| **8.** | **Date and Time of Incident** | 20/12/2023 08:18hrs |
| **9.** | **Place of Incident** | Dubai International Airport (DXB) |
| **10.** | **Geographical location of site of Occurrence (Lat. Long.)** | 25.2635 N ; 55.352 E |
| **11.** | **Last point of Departure** | Cochin International Airport (COK) |
| **12.** | **Intended Place of Landing** | Dubai International Airport (DXB) |
| **13.** | **No. of Passengers On-Board** | 154 |
| **14.** | **Type of Operation** | Schedule, Passenger |
| **15.** | **Phase of Operation** | Landing |
| **16.** | **Type of Incident** | Abnormal Runway Contact (Hard Landing) |

**All timings in this report are in UTC.**

# SYNOPSIS

On December 20th 2023, M/s Air India Limited Airbus A320-251N aircraft VT-CIQ was involved in an Abnormal Runway Contact (Hard Landing) incident while operating flight no. AI-933 (COK-DXB) at Dubai.

Aircraft VT-CIQ chocked off from Cochin airport at 04:22hrs with total 161 persons on board including 02 cockpit crew and 05 cabin crew. The aircraft was under the command of an ATPL holder with Copilot holding CPL. PIC was Pilot Flying and copilot was Pilot Monitoring. The flight was uneventful during takeoff, cruise and descent. However, when the ATC cleared the aircraft for ILS approach on RWY 12L, the procedure for intercepting ILS was not followed by crew wherein only localizer was captured first and the glide slope was intercepted from above. The aircraft was configured for the landing by 1000ft however it could get stabilized at 826ft RA only.

The Auto Pilot was disengaged at 338ft RA. Subsequently, the PIC gave varied Nose up and down pitch stick inputs and correspondingly the ROD varied significantly from 480ft/m to 928ft/m. PIC initiated flare at 49ft RA by giving backward stick input, however applied a full forward stick order which led to increase in ROD to 864ft/m. The aircraft landed with vertical acceleration (VRTG) of 3.36g. After landing, the aircraft stopped on the taxiway as crew got confused with taxi instructions from the Ground and subsequently was again directed by Ground to the correct taxiway. Aircraft later parked to the assigned bay at Dubai airport. No human injury was reported in the incident.

The Director General of Civil Aviation ordered the investigation of the incident by appointing Investigator In-charge vide order no. DGCA-15018(01)/1/2024-DAS dated 10/01/2024 under Rule 13(1) of The Aircraft (Investigation of Accidents and Incidents) Rules 2017. The incorrect landing technique (pitch control) and poor Aircraft Flight Path Management with manual control led to the incident. Non-adherence to SOP and poor CRM contributed to the incident.

## 1. FACTUAL INFORMATION:

### 1.1 History of Flight:

On December 20th 2023, M/s Air India Limited Airbus A320-251N aircraft VT-CIQ was scheduled to operate flight no. AI-933 (COK-DXB) at 04:10hrs. Aircraft chocked off from Cochin airport at 04:22hrs with total 161 persons on board including 02 cockpit crew and 05 cabin crew. The aircraft was under the command of an ATPL holder with Copilot holding CPL. PIC was Pilot Flying and copilot was Pilot Monitoring. It was a first flight of the day for both the cockpit crew. Aircraft's Take-off weight was 70.9T and fuel on board before departure was 12160 kg.

The flight was uneventful during takeoff, cruise and descent. Cockpit preparation for approach and briefing was carried out at TOD wherein CONF 3 landing was decided. The aircraft got stabilized at 826ft RA. The Auto Pilot was disengaged at 338ft RA and subsequently the aircraft was handled manually by PIC. While landing on RWY 12L in IFR conditions, the aircraft made hard landing with a vertical acceleration (VRTG) of 3.36g. Aircraft landing weight was 62.4T. Aircraft was grounded at DXB requiring maintenance actions.

No human injury was reported in the incident.

After completion of maintenance actions as advised by OEM, M/s Airbus & M/s CFM, and upon obtaining ferry flight permit from DGCA, the aircraft operated a ferry flight from DXB-BOM on 27/12/2023 to accomplish complete maintenance actions for its final release to service.

**1.2 Injuries to Persons:**

| Injuries | Crew | Passengers | Others |
|---|---|---|---|
| Fatal | 0 | 0 | 0 |
| Serious | 0 | 0 | 0 |
| Minor/ None | 0/7 | 0/154 | 0 |

**1.3 Damage to Aircraft:**

The aircraft was initially inspected at DXB and later detailed inspection was carried out at Mumbai as per the advice of M/s Airbus and M/s CFM. No abnormal observations were made during inspection at DXB whereas the fuel seepage was observed from dry bay drain holes of LH inboard wing (inner bay holes) and RH inboard wing (both inner and outer holes) at Mumbai. LH & RH main landing gear Shock Absorber subassemblies were also replaced at Mumbai on the advice of M/s Airbus.

**1.4 Other Damage:** There was no other damage.

**1.5 Personnel Information:**

**1.5.1 Pilot- In-Command (PF):**

| | |
|---|---|
| Age | 39Years (Male) |
| License | ATPL |
| Date of Issue | 19/07/2019 |

| | |
|---|---|
| Valid up to | 18/07/2024 |
| Category | Aeroplane |
| Date of Class I Medical Exam | 25/08/2023 |
| Class I Medical Valid up to | 31/08/2024 |
| Date of Issue of FRTO Licence | 01/08/2011 |
| FRTO Licence Valid up to | 31/07/2026 |
| Date of IR/ PPC | 26/09/2023 |
| Total Flying Experience | 3749:41 hrs (Approx.) |
| Total Flying Experience on Type | 873:15 hrs (Approx.) |
| Total Flying Experience as PIC on Type | 477:09 hrs (Approx.) |
| Total Flying Experience in last 1 year | 544:57 hrs (Approx.) |
| Total Flying Experience in last 6 months | 383:01 hrs (Approx.) |
| Total Flying Experience in last 30 days | 73:18 hrs (Approx.) |
| Total Flying Experience in last 7 days | 17:40 (Approx.) |
| Total Flying Experience in last 24 hours | 00:00 |
| Duty Time last 24 hours | 00:00 |
| Rest before the incident flight | 21:00 hrs |
| Ratings | PIC: A320, PA-34; FO: B747-400 |
| Examiner/ Instructor rating | NIL |

The PIC joined Air India as Trainee Pilot in 2011 and was flying B747-400 as First officer from April 2014 till June 2020 wherein he had completed 2643:38 hours on B747-400. Later, he was subjected to type rating training on A320 and was released as first officer on 27/02/2022. After completing around 170 hours as P2 on A320, he was given command training on A320. He was released as P1 on A320 on 11/04/2023, and to the incident date, he had been flying as PIC in A320.

Performance of PIC was found satisfactory during IR/PPC checks carried out in last one year. No adverse remarks were found to be recorded in his assessment forms. PIC does not have any accident/ incident history with the operator, however he had 02 FDM exceedances (Red level) pertaining to long flare distance during landing, once in August 2023 and once in October 2023.

PIC had adequate rest before he operated flight on 20/12/2023. Upon scrutiny of the records, PIC found to be within limits of FDTL.

**FDM exceedances history:**

i. While flying A320 family aircraft, PIC was involved following FDM exceedances:
   - Red exceedance of 'long flare distance' while operating A321 VT-PPM as AI 698 (HYD-BOM) on 22/08/2023
   - Red exceedance of 'long flare distance' while operating A321 VT-PPW as AI 615 (BOM-HYD) on 24/10/2023

ii. In both the above exceedances, email communication was sent to PIC by Flight Safety Department of M/s Air India Ltd, however, no counselling or other corrective action was carried out.

iii. Handling of aircraft in both of these FDM exceedances was ascertained through DFDR records and it was observed that the PIC applied continued backward stick inputs for a prolonged time during the flare resulting in aircraft floating for the longer period leading to the long flare distance exceedance. The aircraft was found to have been stabilized in both the above FDM exceedance cases. Additionally, the PIC initiated flare at approx. 50ft RA (high flare) while operating AI 615 (BOM-HYD) on 24/10/2023. Also, it was observed for the same flight that the correct MDA was not inserted in the FMGS for landing.

**Review of flights when PIC landed with CONF3:**

Until the incident flight and except the simulator, PIC had done only one CONFIG 3 landing on Airbus A320 family aircraft, which was on A319 aircraft VT-SCV while operating flight no. AI 1664 (GOI-BOM) on 30/09/2023.

DFDR data of VT-SCV was scrutinized to ascertain the handling of aircraft by PIC during landing in CONF3. No significant abnormality w.r.t. handling of the aircraft was observed and the aircraft landed with vertical acceleration of 1.13g.

**1.5.2 First Officer (PM):**

| | |
|---|---|
| Age | 29Years (Female) |
| License | CPL |
| Date of Issue | 12/02/2020 |
| Valid up to | 11/02/2025 |
| Category | Aeroplane |
| Date of Class I Medical Exam | 17/01/2023 |
| Class I Medical Valid up to | 23/01/2024 |
| Date of Issue of FRTO Licence | 12/02/2020 |
| FRTO Licence Valid up to | 11/02/2025 |
| Date of IR/ PPC | 09/12/2023 |
| Total Flying Experience | 358:29 hrs (Approx.) |
| Total Flying Experience on Type | 143:29 hrs (Approx.) |
| Total Flying Experience as PIC on Type | Nil |
| Total Flying Experience in last 1 year | 143:29 hrs (Approx.) |
| Total Flying Experience in last 6 months | 143:29 hrs (Approx.) |
| Total Flying Experience in last 30 days | 42:12 hrs (Approx.) |
| Total Flying Experience in last 7 days | 17:40 hrs (Approx.) |
| Total Flying Experience in last 24 hours | 00:00 |
| Duty Time last 24 hours | 00:00 |
| Rest before the incident flight | 21:00 hrs |
| Ratings | PIC: DA-40, DA-42; FO: A320 |
| Examiner/ Instructor rating | NIL |

The First Officer was given type rating training on A320 at CTE Hyderabad. Subsequent to completion of SLFs, she was released as P2 on A320 on 30.11.2023 and completed approximately 31 hours after release. Performance of First Officer was found satisfactory during IR/PPC checks carried out in last one year. No adverse remarks were found to be recorded in her assessment forms. First Officer does not have any accident/ incident history or FDM exceedance history with the operator.

First Officer had adequate rest before she operated flight on 20/12/2023. Upon scrutiny of the records, First Officer was found to be within limits of FDTL.

**Observations made during past training (SLFs):**

A review of training records of SLFs of the First Officer indicated the following remarks/ salient observations/ needs for improvements made by the trainers:

- Workload management
- Missing ATC/ R/T communications
- Under confident and great improvements required in R/T procedures
- Situational awareness
- Unable to cope up with R/T. Trainee gave up.

## 1.6 Aircraft Information:

### 1.6.1 Aircraft details:

The details provided below are as of prior to the incident flight.

| | |
|---|---|
| Aircraft Registration | VT-CIQ |
| Type of Aircraft | Airbus A320-251N |
| Aircraft Serial No. | 8267 |
| State of Manufacturing | France |
| Manufacturing year | 2018 |
| Owner | M/s CIT Aerospace International Unlimited Company<br>Number One Ballsbridge, Building 1, Shelbourne Road, Ballsbridge, Dublin 4, Ireland |
| Operator | M/s Air India Ltd |
| Certificate of Airworthiness number and issue date | 7021 dated 12/07/2018 |

| | |
|---|---|
| ARC number and Validity | AI/ENGG/NR/ARC/2021/23<br>Valid up to 12/07/2024 |
| A/c TSN / CSN | 18559 hrs/ 9329 |
| Minimum crew necessary | Two |
| Last major check carried out | 3A check on 11/11/2023 in DEL |
| Next schedule maintenance due | 4A check on 06/02/2024 |
| Maximum All Up Weight authorized | 79,000kg |
| Aircraft Take-off Weight | 70,900kg (Approx.) |
| Aircraft Landing Weight | 62,400kg (Approx.) |
| Maximum Landing Weight | 67,400kg |
| Fuel On-board before Flight | 12,160kg |
| Centre of Gravity | Within limits |
| AMP compliance | Satisfactory |

**1.6.2 Snag/ MEL history:**

Following MELs were active as on the incident flight:

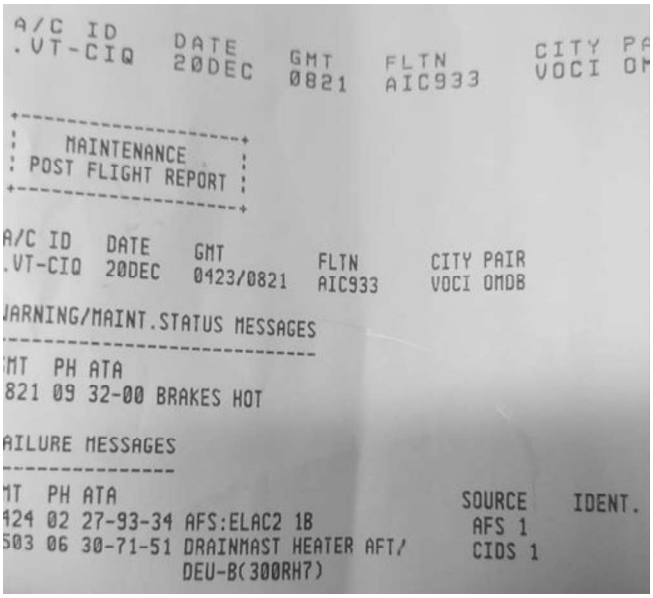
i. MEL 36-12-01A Cat 'C' APU bleed supply system: MEL invoked on 18/12/2023 and revoked on 26/12/2023.

ii. MEL 25-64-01B Cat 'A' FWD First Aid Kit: MEL invoked on 20/12/2023 and revoked on 21/12/2023.

Both the above MELs are not relevant/ not contributory to the incident. The aircraft was considered airworthy.

**1.6.3 Post Flight Report (PFR):**

PFR of the flight reflected a brakes hot message at 08:21hrs in phase 09, which is attributable to the braking of the aircraft after landing. The PFR did not record any system failure that might have been involved in the hard landing.

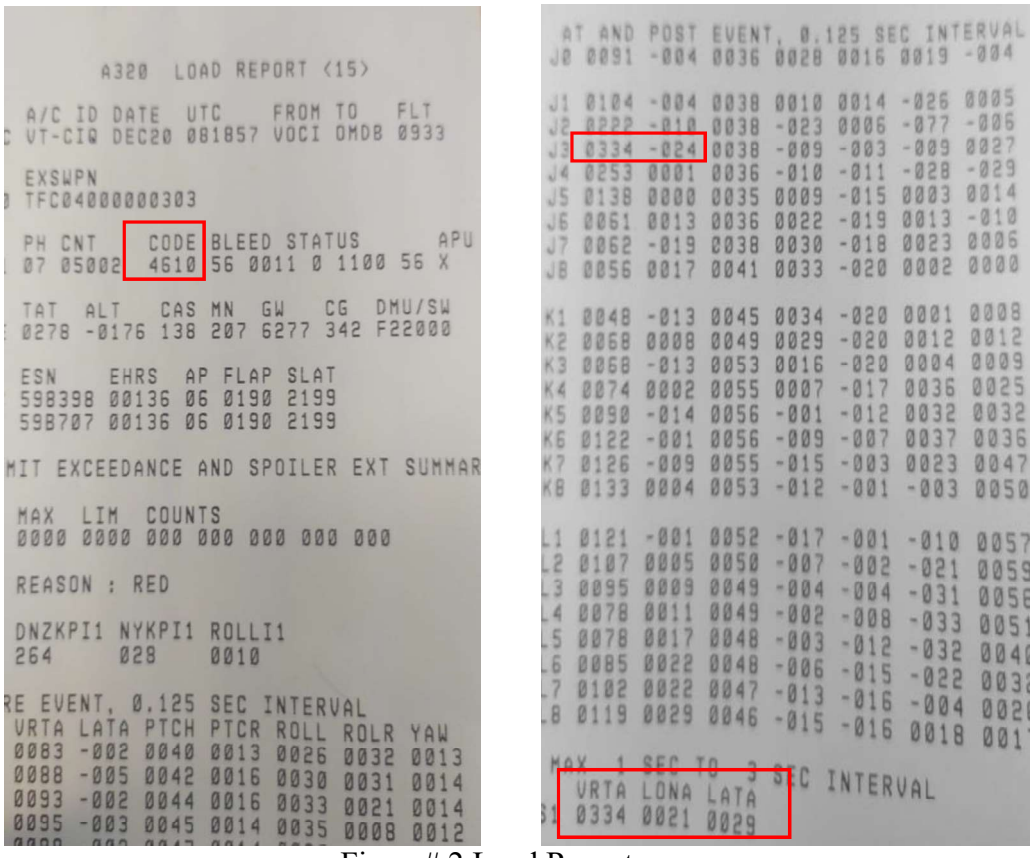


```
A/C ID      DATE     GMT      FLTN       CITY PA
.VT-CIQ     20DEC    0821     AIC933     VOCI OM

+--------------------+
:    MAINTENANCE     :
: POST FLIGHT REPORT :
+--------------------+

A/C ID   DATE    GMT          FLTN      CITY PAIR
.VT-CIQ  20DEC   0423/0821    AIC933    VOCI OMDB

JARNING/MAINT.STATUS MESSAGES
-----------------------------
MT  PH ATA
821 09 32-00 BRAKES HOT

AILURE MESSAGES
---------------
MT  PH ATA                                  SOURCE    IDENT.
424 02 27-93-34 AFS:ELAC2 1B                 AFS 1
503 06 30-71-51 DRAINMAST HEATER AFT/       CIDS 1
                DEU-B(300RH7)
```

Figure# 1 Post Flight Report

### 1.6.4 Load Report:

The load report reflected code 4610 indicating high vertical and lateral loads encountered by the aircraft during landing.



```
          A320  LOAD REPORT (15)

  A/C ID DATE  UTC    FROM TO   FLT
C VT-CIQ DEC20 081857 VOCI OMDB 0933

  EXSWPN
  TFC04000000303

  PH CNT    CODE BLEED STATUS       APU
  07 05002  4610 56 0011 0 1100 56 X

  TAT  ALT   CAS MN  GW   CG  DMU/SW
  0278 -0176 138 207 6277 342 F22000

  ESN    EHRS  AP FLAP SLAT
  598398 00136 06 0190 2199
  598707 00136 06 0190 2199

MIT EXCEEDANCE AND SPOILER EXT SUMMAR

  MAX  LIM  COUNTS
  0000 0000 000 000 000 000 000

  REASON : RED

  DNZKPI1 NYKPI1 ROLLI1
  264     028    0010

RE EVENT, 0.125 SEC INTERVAL
  VRTA LATA PTCH PTCR ROLL ROLR YAW
  0083 -002 0040 0013 0026 0032 0013
  0088 -005 0042 0016 0030 0031 0014
  0093 -002 0044 0016 0033 0021 0014
  0095 -003 0045 0014 0035 0008 0012
```

```
 AT AND POST EVENT, 0.125 SEC INTERVAL
J0 0091 -004 0036 0028 0016 0019 -004

J1 0104 -004 0038 0010 0014 -026 0005
J2 0222 -010 0038 -023 0006 -077 -006
J3 0334 -024 0038 -009 -003 -009 0027
J4 0253 0001 0036 -010 -011 -028 -029
J5 0138 0000 0035 0009 -015 0003 0014
J6 0061 0013 0036 0022 -019 0013 -010
J7 0062 -019 0038 0030 -018 0023 0006
J8 0056 0017 0041 0033 -020 0002 0000

K1 0048 -013 0045 0034 -020 0001 0008
K2 0068 0008 0049 0029 -020 0012 0012
K3 0068 -013 0053 0016 -020 0004 0009
K4 0074 0002 0055 0007 -017 0036 0025
K5 0090 -014 0056 -001 -012 0032 0032
K6 0122 -001 0056 -009 -007 0037 0036
K7 0126 -009 0055 -015 -003 0023 0047
K8 0133 0004 0053 -012 -001 -003 0050

L1 0121 -001 0052 -017 -001 -010 0057
L2 0107 0005 0050 -007 -002 -021 0059
L3 0095 0009 0049 -004 -004 -031 0056
L4 0078 0011 0049 -002 -008 -033 0051
L5 0078 0017 0048 -003 -012 -032 0046
L6 0085 0022 0048 -006 -015 -022 0038
L7 0102 0022 0047 -013 -016 -004 0028
L8 0119 0029 0046 -015 -016 0018 0017

MAX  1 SEC TO  3 SEC INTERVAL
  VRTA LONA LATA
  0334 0021 0029
```

Figure# 2 Load Report

### 1.6.5 Rectification:

The aircraft was released from Mumbai after completing the required maintenance and operated a flight AI-653 (BOM-VTZ) dated 03/02/2024.

## 1.7 Meteorological Information:

Weather information on 20/12/2023 at DXB as per the Met report is as follows:

| Time | 08:00hrs | 09:00hrs |
|---|---|---|
| Wind | 360º / 03knots | 040º / 04knots |
| Visibility | >10km | >10km |
| Clouds | FEW 045 | FEW 045 |
| Temperature | 26 ºC | 26 ºC |
| Dew Point | 09 ºC | 09 ºC |
| QNH | 1020hPa | 1018hPa |
| Trend | NOSIG | NOSIG |

Aircraft landing was performed on Runway 12L of Dubai International Airport. The actual weather conveyed to crew while giving landing clearance at 08:18hrs was Winds: 010º 05knots. The incident occurred in the daytime at 08:18hrs (12:18hrs Dubai local time).

## 1.8 Aids to Navigation:

Aircraft is equipped with navigation aids such as ADF, ILS, GPS, VOR, DME, ATC Transponder Mode S and Weather Radar, Radio Altimeter, TCAS & ELT. All navigational aids were reported to be available.

Runway 12L at Dubai International Airport is equipped with localizer, glide path and CAT-IIIB precision approach lighting system. At the time of incident, navigation aids were functioning normally and no navigation aid difficulties were reported by the crew.

## 1.9 Communication:

Aircraft is equipped with Very High Frequency transmitter & receiver set and High Frequency transmitter & receiver set. There was always two-way communication established between the ATC and aircraft.

## 1.10 Aerodrome Information:

The Dubai International Airport (Reference point 251510N 0552152E) is a licensed airport both for IFR and VFR traffic with IATA location Identifier code as DXB and ICAO location Indicator code as OMDB. The airport is equipped with a Surface Movement Guidance and Control System.

The elevation (AMSL) is 62ft. The airport has two parallel runways made of Asphalt. The details of these runways are as given below: -

- RWY 12R/ 30L - 4447m x 60m
- RWY 12L/ 30R - 4351m x 60m (THR displaced by 450m)

As per the electronic Aeronautical Information Publication (e-AIP) of Dubai International Airport, declared distances for Runway12L are as under:

| Runway | TORA (m) | TODA (m) | ASDA (m) | LDA (m) | RESA (m) |
|---|---|---|---|---|---|
| 12L | 4050 | 4110 | 4176 | 3600 | 240 x 150 |

Aerodrome category for rescue & firefighting is CAT-10.

## 1.11 Flight Recorders:

### 1.11.1 CVR:

The report on CVR readout is as follows (Timings mentioned are CVR elapsed time):

At 01:06:30, cockpit preparation for approach and briefing was started. P2 started briefing and later P1 continued with the same wherein CONFIG 3 was decided to be used for landing.

The aircraft was in contact with Muscat control at 01:15:06 where it was asked to descend to FL240 when ready, to which read back was given by P2 as AI994. The incorrect flight number was immediately corrected by P2 as AI933.

Automated ATIS information for DXB airport was heard at 01:16:55. Subsequently, at 01:22:08, while in contact with UAE control, P2 was heard to have given wrong readback mentioning incorrect frequency, i.e. 135.375 instead of 125.375. The error was pointed out by UAE control and corrected.

Thereafter, at 01:23:15, the arrival instructions were passed by UAE control to AI 933 and subsequently, AI933 started further descending in coordination with ATC. After clearing AI933 up to 13000ft, AI933 was advised to cancel STAR and speed restriction, maintain speed 250, and contact DXB 124.9 with the cleared level. P2 read back the same.

AI933 (P2) contacted DXB ATC and informed that they were passing FL140 for 13000ft to which DXB tower gave them further descent to 12000ft with QNH 1019 and informed them to expect ILS RWY 12L. The instructions were read back by P2 wherein she made an error in mentioning the QNH. Additionally, P2 was also observed using incorrect RT phraseology several times like 'reduce speed to 250kts', 'descend to 8000ft', etc.

Subsequently, the approach checklist was carried out at 01:33:29 wherein the correct QNH was set and read out by P1. Subsequently, AI933 was given descent with different speed restrictions, and the same were correctly read back by P2 and complied with.

At 01:44:28, DXB ATC advised them to turn left heading 210 for base leg which was correctly read back by P2. At 01:45:05, AI933 was cleared for ILS approach RWY 12L. While reading back the P2 missed out to say cleared for ILS approach RWY 12L and instead P2 transmitted '…cleared ILS RWY 12L…'

Subsequently, at 01:46:54, ATC transmitted 'AI933 maintain speed 160knots to 5 NM and you are not reduced'. The information was misunderstood by P2 and she read back as 'will maintain 3000 AI933'. Immediately, ATC again asked 'AI933 next when you are going to reduce please tell me' to which P2 read back as 'roger'. This was a clear miscommunication from P2 to ATC to which P1 subsequently apologized. AI933 was then advised to contact TWR 118.75.

AI933 came in contact with DXB Tower at 01:48:38 and DXB Tower advised AI933 to continue approach Runway 12L and plan to vacate via M7A. Subsequently, Flap3 was deployed and landing checklist was carried out by crew.

A synthetic voice for aircraft passing 1000ft was heard at 01:49:17 followed by 1000 stabilized call from P1. P1 also called out that Missed approach altitude is set

3000. Subsequently at 01:49:38, AI 933 was cleared to land with surface wind information as 010/5kts. P2 acknowledged the landing clearance.

After a synthetic voice of 400ft was heard, P1 announced autopilot off and system audio- triple click for autopilot disconnect could be heard at 01:50:07. Immediately after 4 seconds, a synthetic voice 100above was heard followed by synthetic voice-minimums at 01:50:18. Immediately after the automated minimums call out, P1 called out 'continue'.

From time 01:50:29 to 01:50:31, a synthetic voice 50, 40, 30, 20 – Retard was heard followed by a loud sound of aircraft touch-down (wheels contacting runway surface) at 01:50:32. Subsequently, P2 called out for spoilers, reverse green and decel to which P1 replied as checked. An automated call out of Auto brakes OFF was heard at 01:50:43 indicating that manual brakes were used subsequently. Later, as advised by Tower, AI933 came in contact with ground 121.65 at 01:51:42.

While taxying P1 was heard calling 'Shit… Shit yaar, my aircraft is gone yaar 3.3'. Simultaneously the taxing instructions were being received from Ground and P1 taxied the aircraft under the guidance of P2. The after landing checklist was also being done and meanwhile, after few seconds P1 called out 'Shit 3.3 is grounded' to which P2 replied that 'It was this.. Thaak !'. Later, P1 once again called out 'Grounded …..I should have gone around yaar.'

Subsequently, after landing checklist was completed and Ground gave an additional taxi instructions to AI933, however, while acknowledging the same, P2 asked ground to 'say again' without using call sign of the aircraft. The same was corrected by Ground and later acknowledged by P2. Soon after, the aircraft stopped on taxiway as crew got confused w.r.t. latest taxi instructions from the Ground. Subsequently, AI933 was again directed by Ground to the correct taxiway.

After reaching to the bay C55R, the engines were shut down. P1 informed about hard landing to the engineering personnel on headset and parked the aircraft. Parking checklist was also called out subsequently.

**1.11.2 DFDR:**

Salient observations made from DFDR readout of AI-933 are as follows (Timings mentioned are in UTC):

- AI-933 had a normal start-up on both engines followed by normal take-off, climb and cruise phases.

- Aircraft was cruising at FL340. At 07:47:01hrs, AI-933 started its descent with A/P ON and Auto Thrust Active.
- Aircraft was maintaining 2000ft at 160kts CAS before it got aligned to localizer at 08:15:12hrs. VApp was calculated by FMGS to be 141kts. A/P (only A/P1) and Auto Thrust was engaged.
- At 08:16:20hrs while at 2073ft RA, landing gear lever was selected down.
- At 08:16:44hrs, the aircraft started to descend which led to reduction in pitch angle of aircraft, an increase in CAS and rate of descent (during glide slope interception from above the maximum vertical speed was recorded as -1696 ft/m), and a reduction in both engines' thrust.
- APPR p/b was pushed and glide slope was armed and captured immediately at 08:17:06hrs, 1633ft RA and approx. 5 DME from runway threshold. The target speed shown on FMA was managed to VApp, i.e. 141kts. LS (Landing System) p/b on FCU was pushed at approx. 1615ft RA.
- After 8 seconds of capturing G/S, the CAS had reached to its maximum value 170.5kts and subsequently started decreasing to meet the target speed. Both the engines were producing IDLE thrust as the aircraft was at high speed than desired due to capture of G/S from above. The aircraft was on 3degree glide path at aprox. 4NM and 1300ft RA.
- The flaps were deployed to Configuration 3 at 08:17:25hrs when the aircraft was passing 1286ft RA.
- Passing 1000ft RA at 08:17:43hrs, aircraft was at 150.75kts CAS, V/s of -848 ft/m with pitch of 2.6degree and A/P engaged. Both the engines were still at IDLE thrust with Auto Thrust ACTIVE. At this time, aircraft was at approx. 3.2DME with heading at 118.1degree. The deviation in G/S and localizer were within limits.
- At 08:17:56hrs, both engines were observed spooling up (N1 of both engines increased from IDLE thrust) as the aircraft attained approach target speed at 826ft RA. The aircraft continued its descent under automation up to 338ft RA where A/P was disconnected. Vertical speed during descent from 1000ft to the time where A/P was disconnected was observed to be varying between -656ft/m to -976 ft/m and the pitch attitude was observed to be varying between 2.5degree to 5.3degree. The CAS was maintained within VApp +10kts.
- At 08:18:32hrs, the A/P was disengaged manually by P1. The aircraft was at 1.13DME maintaining heading 119.5 with a CAS of 144.5kts, Vertical speed at -592ft/m and pitch attitude at 3.5 degree. The glide slope and localizer deviation were within limits.
- Subsequent to the disengagement of A/P to till 49ft RA, varying pitch inputs were noticed to be given from P1 sidestick resulting in continuous variation in the pitch attitude of the aircraft (ranging from 2.8degree to 6.4degree) with corresponding significant variation in ROD (ranging from 480ft/m to 928ft/m). The CAS was

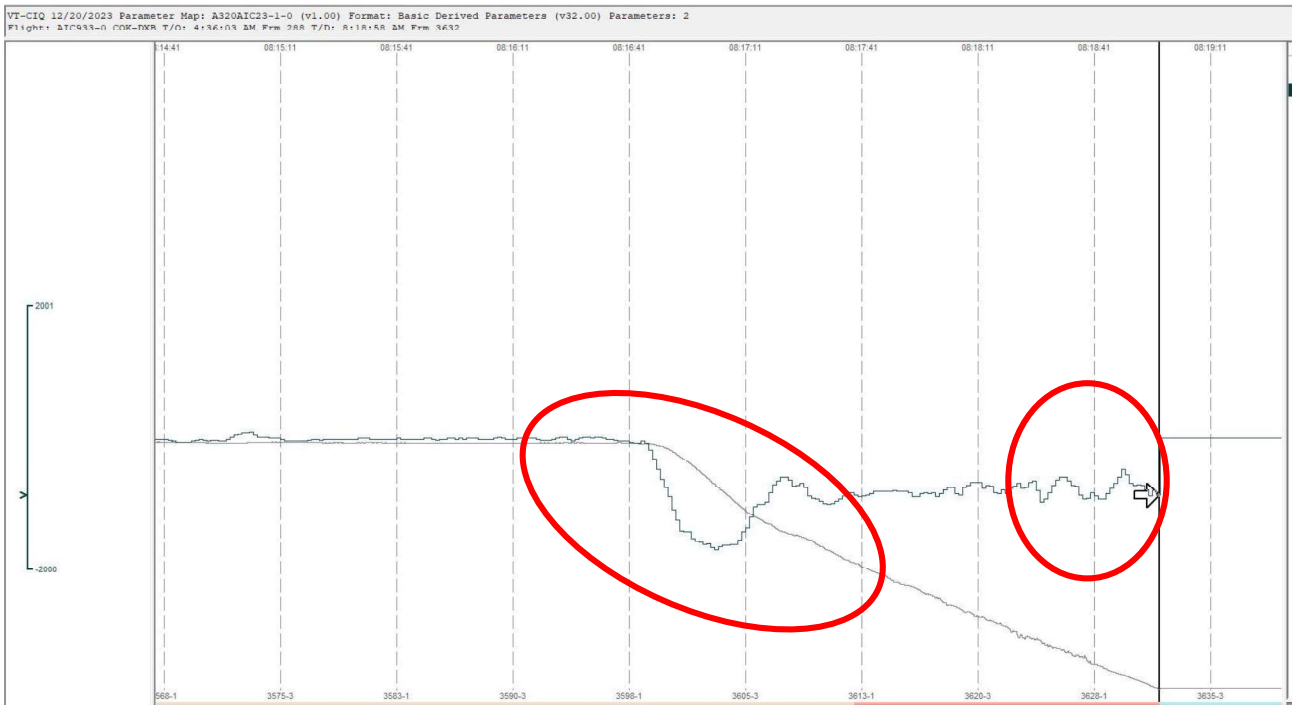
observed within limits, except for 2 seconds when it reduced marginally below VApp at around 160ft RA, with Auto Thrust Active in Speed mode.

- While the pitch of the aircraft was being controlled by the P1 manually, the aircraft went beyond 0.5dot glide slope deviation (below the glide path) at 185ft RA at 08:18:43hrs and remained beyond 0.5dot G/S deviation till 49ft RA where the flare was initiated. The glide slope deviation was 0.857 dot at 08:18:47hrs when the aircraft was at 140ft RA and at 49ft RA, the glide slope deviation was recorded as 0.911dot.
- At 100ft RA, aircraft pitch was 4degree, vertical speed was -688ft/m, and CAS was 140.75kts. Left roll inputs were noticed when the aircraft crossed 100ft RA which resulted in the aircraft being at a heading of 115.8degree at 49ft RA, however, the localizer deviation was recorded within limits after disengagement of A/P to touchdown.
- From 100ft RA to 49ft RA, the nose up and down pitch inputs were observed to have been given by P1 which resulted in a corresponding increase and decrease in the pitch attitude of the aircraft. The pitch of the aircraft increased from 4degree at 100ft RA to 5.6degree at 85ft RA and subsequently, decreased to 4degree when the aircraft reached at 49ft RA. The nose down input given by P1 increased the vertical speed from -688ft/m at 100ft RA to -880ft/m at 33ft RA.
- At 08:18:54hrs when the aircraft was at 49ft RA, the flare was initiated by giving backward sidestick input by P1 which increased aircraft pitch from 4degree to 5.8degree and slightly reduced the ROD to 800ft/m by 08:18:56hrs. However subsequently at approx. 25ft RA P1 applied negative sidestick input while in the flare, lowering the nose down to 2.8 degree in next second and increase in ROD to 864ft/m. At approx.10ft RA, a full back stick order was applied.
- At time 08:18:57hrs, both thrust lever positions were recorded at IDLE detent and Auto thrust was recorded as OFF. One sensor in both MLGs sensed the aircraft had touched down but the RA was still reflecting 7ft. Vertical g was recorded to be 2.24g at this time.
- At 08:18:58hrs, all the sensors of both MLGs detected that the aircraft had touched down with vertical g of 3.36. The NLG sensors reflected compressed after 4 seconds, i.e. at 08:19:02hrs. Aircraft touched down on both main landing gears.
- Varying rudder inputs were noticed during flare, whereas at the touchdown the aircraft heading was 115.7degree- changing towards right side, i,e. towards the runway heading. Roll angle at touchdown was observed to be -1.5degree, i.e. left toll, and lateral g was observed as -0.238g, i.e. aircraft moving towards right side of the track.
- CAS at touchdown was 134kts and aircraft landing weight recorded in the DFDR was 62.78T.
- The winds were observed to be varying in direction (mainly crosswinds from the left side) since disconnection of A/P to touchdown. The wind speed was varying

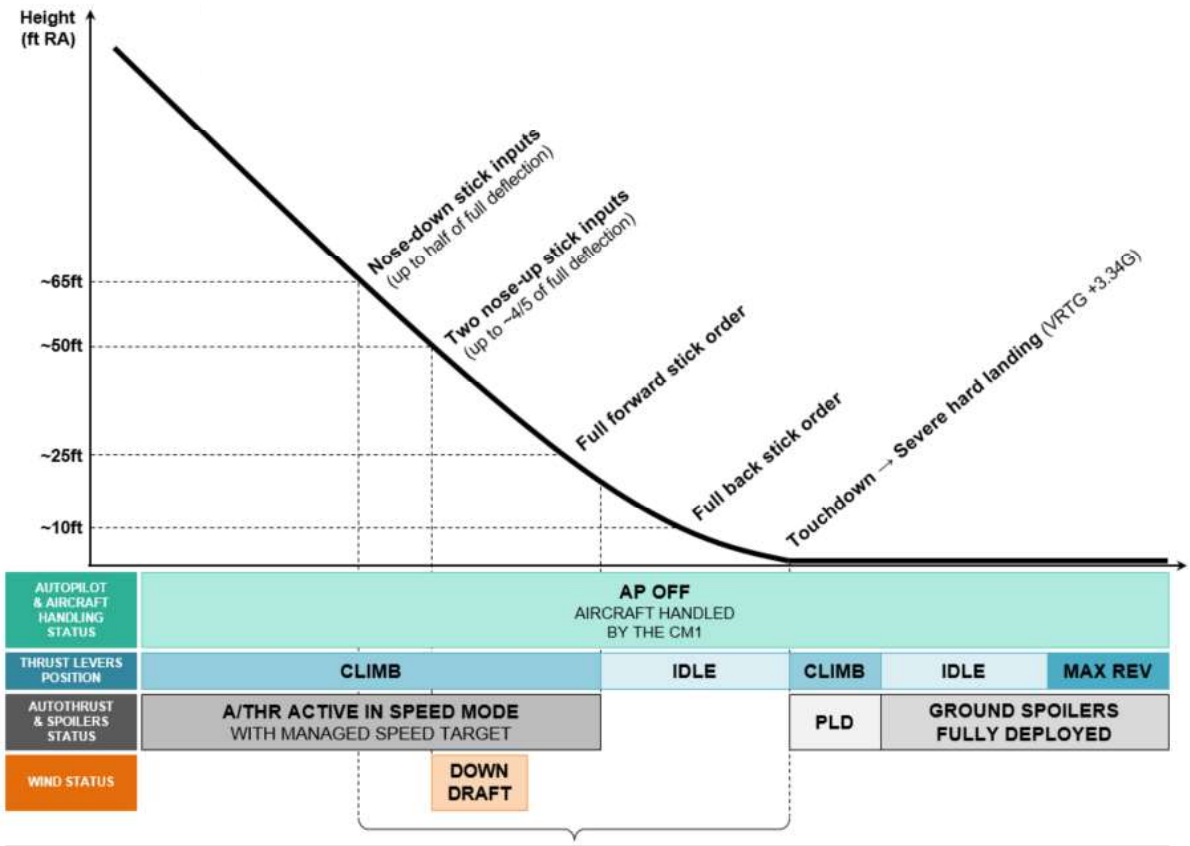
from 1kt to 4kts since disconnection of A/P to 100ft RA and from 3kts to 7kts from 100ft RA to touchdown. Additionally, M/s Airbus has apprised in their report that the aircraft encountered downdraft of wind approximately at 50ft RA.

- At 08:18:59hrs, thrust lever1 and 2 positions were recorded at 21.8degree and 25degree respectively and pitch attitude of the aircraft was recorded to be increased to 5.6degree, however the immediate second both the levers were moved back to 0degree and the pitch attitude was seen to be reduced.
- Thrust reversers on both engines were deployed at 08:19:04hrs and subsequently aircraft taxied on its own power into the bay.


Figure# 3 Aircraft Profile and approach path (glide slope interception from above)




Figure# 4 Vertical speed Vs RA




Figure# 5 Graphical representation of DFDR readout (Ref. Airbus report)

**1.12 Wreckage and impact information:** Nil.

**1.13 Medical and pathological information:**

Both the crew had undergone a Pre-flight medical examination before operating the incident flight at Cochin and tested negative for consumption of alcohol.

**1.14 Fire:** There was no fire before or after the incident.

**1.15 Survival Aspects:** No human injuries were reported in the incident.

**1.16 Tests and research:** Not applicable.

**1.17 Organizational and Management Information:**

Air India is a scheduled airline owned by Tata Group. Air India operates its flights on domestic and international sectors. Air India operates its flights on domestic and international destinations with a fleet of Boeing 777, Boeing 787, Airbus 319, Airbus 320, Airbus 321 and Airbus 350 aircraft. M/s Air India Limited is headquartered at New Delhi. Air India is the largest international carrier of India. Over 40 international destinations are served by Air India spanning cities in Europe, USA, UK, Africa, the Gulf, Asia and Australia. The airline became the member of Star Alliance on 11 July 2014.

**1.18 Additional Information:**

### 1.18.1 FCTM extracts:

- ***FCTM PR-NP-SOP-190-GUI P 1/36 28 NOV 23 (Extract):***

  ***INTERCEPTION OF FINAL APPROACH COURSE***
  *When cleared for the ILS and when on the intercept trajectory for the LOC, the flight crew should press the APPR pb. This arms the approach modes, and LOC and GS are displayed in blue on the FMA. At this stage, the second AP, if available, should be selected.*

  *If the ATC clears for a LOC capture only, the flight crew will press the LOC pb-sw on the FCU.*

- ***FCTM PR-NP-SOP-190-GUI P 2/36 28 NOV 23 (Extract):***

  ***GLIDE SLOPE INTERCEPTION FROM ABOVE***
  *The following procedure must only be applied when established on the localizer. There are a number of factors which might lead to a glide slope interception from above. In such a case, the flight crew must react without delay to meet the stabilization criteria. In order to get the best rate of descent when cleared by ATC and below the limiting speeds, the flight crew should lower the landing gear and select flaps as required (at least CONF 2 should be selected to ensure that the aircraft speed will not increase). Speed brakes may also be used, noting the considerations detailed in the subsection "Deceleration and configuration change" earlier in this chapter.*

***When cleared to intercept the glide slope, the flight crew should:***
*- Press the APPR pb on FCU and confirm G/S is armed and LOC engaged, monitor the vertical interception*
*- Select the FCU altitude above aircraft altitude to avoid unwanted ALT* engagement*
*- Select V/S 1 500 ft/min initially. V/S in excess of 2 000 ft/min will result in the speed increasing towards VFE.*

*The use of V/S mode ensures that the A/THR is in SPEED mode.*

*The flight crew should carefully monitor the rate of descent to avoid exceeding VFE When approaching the G/S path, G/S* will engage. The flight crew should monitor the G/S capture with raw data (pitch and G/S deviation). The go-around altitude should be set on the FCU at G/S*.*

- ***FCTM PR-NP-SOP-250 P 4/18 28 NOV 23 (Extract):***

***PITCH CONTROL***
*When approaching the ground, auto-trim ceases and the flare law activates. During flare, PF will have to apply a progressive and gentle back stick order until touchdown. The flare law technique is thus very conventional.*

*Prior to flare, avoid destabilization of the approach and steepening the slope at low heights in attempts to target a shorter touchdown. If a normal touchdown point cannot be achieved or if destabilization occurs just prior to flare, a go-around (or rejected landing) should be performed.*

*The PM monitors the rate of descent and should call "SINK RATE" if the vertical speed is excessive prior to the flare.*

*From stabilized conditions, the flare height is about 30 ft.*
*This height varies due to the range of typical operational conditions that can directly influence the rate of descent.*

*If the flare is initiated too late then the pitch changes will not have sufficient time to allow the necessary change to aircraft trajectory. Late, weak or released flare inputs increase the risk of a hard landing.*

*Avoid under flaring.*
*- The rate of descent must be controlled prior to the initiation of the flare (rate not increasing)*
*- Start the flare with positive (or "prompt") backpressure on the sidestick and holding as necessary*
*- Avoid forward stick movement once Flare initiated (releasing back-pressure is acceptable)*

## 1.18.2 Air India Operations Manual extract:

- ***Air India OM A para 25.2 (extract):***

***25.2 Conditions Required to Obtain Stabilized Approach***
*i. Aircraft in landing configuration correct flight path.*
*ii. Only small changes in Heading and Pitch are required to maintain the flight path.*
*iii. On profile (ILS glide slope, published non-precision profile, or when a Glide path has been established visually and conditions have been met to allow descent below the DA (DH) or MDA (MDH).*
*iv. Speed within +10/-0 kts of reference speed (V ref)*
*v. Rate of descent not in excess of 1000 fpm (>1000 fpm authorized on a non-precision approach when conditions require) and not less than 400 fpm.*
*vi. Thrust setting in the approach would vary with the approach configuration and the ambient conditions. The correct thrust during the final approach phase, in landing configuration, would result in the appropriate CAS.*
*vii. All briefings and checklists have been conducted.*

viii. *Specific types of approaches are stabilized if they also fulfil the following: Instrument Landing System (ILS) approaches must be flown within one dot of the glide slope and localizer; a Category II or Category III ILS approach must be flown within the expanded localizer band; during a non-precision approach, wings should be level and aircraft aligned with runway center line latest by 300 feet above airport elevation.*

ix. *Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.*

x. *An approach that is not stabilized by 1,000 feet AFE in instrument meteorological conditions (IMC) and by 500 feet AFE in visual meteorological conditions (VMC) requires an immediate Go-around.*

xi. *The landing gear must be down and the landing checklist completed at the latest by 1,000 ft. above airport elevation. Speed brakes must be retracted before 1000 ft (AFE).*

- ***Air India OM A para 25.3 (extract):***

***25.3 Significant Deviation***

*- Rate of descent more than 1000 fpm less than 400 fpm*
*- Approach speed (Vref/Target): +10 Kts - 0 Kts*
*- Localiser: 1 dot deviation*
*- Glide slope: 1 dot deviation*
*- Thrust: Any significant deviation from required thrust setting*

*In case the above-mentioned criteria is not met, then the approach is considered un-stabilized.*

*Note: A precision approach that is not stabilized by 1,000 feet AFE in instrument meteorological conditions (IMC) and by 500 feet AFE in visual meteorological conditions (VMC) requires an immediate Go-around.*

### 1.18.3 Excerpts of PIC statement:

- Before top of descent, destination and alternate weather were checked above minima and performance calculation were done for a CONFIG FULL landing on Runway 12L in Dubai. Vapp for flap Full CONFIG was approximately 123knots.

- As per published speed restriction for arrival into Dubai aircraft are required to maintain 160 knots till 4 NM to touchdown. Since at 4 NM expected height above touchdown is approximately 1200-1300 feet and to be at stabilized at VApp plus 10 knots by 1000 feet from 160 knots was not comfortable. Hence VApp for CONFIG 3 was calculated and it was 143 knots. Since runway was long and no restriction in Dubai for a CONFIG 3 landing, it was decided to perform the same.

- Arrival preparation for CONFIG 3 landing was done. Arrival briefing was done as per company policy with PM(P2) starting the briefing with MSA for planned trajectory, STAR, ILS app 12L, Minima, Go around and extra time and fuel. Briefing was continued by me for guidance for approach, landing flap setting, stop margin, use of reverser and auto-brake, planned exit, taxi route and expected special operations and non-standard operations.

- Descent was initiated with clearance of Muscat ATC and then continued with Dubai ATC.

- Approach phase was activated and flaps 1 and 2 were selected as per sequence. ATC cleared for ILS 12L and altitude given was 2000 feet and speed of 180 knots.

- Upon clearing for ILS 12L PIC armed LOC only and wanted to arm the G/S after establishing on LOC to avoid any chances of false G/S capture. During LOC interception PIC reduced speed to 160 knots since aircraft was approximately 10NM to touchdown. At this time ATC asked crew to inform them when speed was reduced and the PM was unable to understand and read back. PIC replied to ATC with an apology. During this, arming of G/S was missed and aircraft was level at 2000 feet.

- Flaps were CONFIG 2 and gear was down and established on LOC and hence glide slope intercept from above was done by selecting higher altitude and selecting a v/s as per the procedure. Thereafter G/S was armed and captured. Missed approach was selected and CONFIG 3 selected. Due to high workload call out for intercepting glide from above procedure was missed.

- At 1000 feet checked for rate of descent, LOC and G/S deviation, Pitch and speed. PIC could not recollect the exact deviation speed and pitch at that time. Check for thrust setting was missed and stabilized call was given.

- During Final Approach PIC felt light gusty conditions which required constant pitch and roll changes to maintain profile. Hence autopilot was kept on till 350 feet. After disconnecting AP, had given pitch and roll inputs to best maintain the profile and stabilization criteria. PIC checked to cross threshold at approximately 50 feet and ROD of 700-800 fpm.

- At 30 feet flare was carried out but was unable to arrest the rate of descend and felt the aircraft was sinking too fast. At this point thought of go-around arised, but touched down before initiating the same. No callout for go-around was given by PM. Hard landing was felt and continued with landing roll and vacated. Vertical acceleration g value of 3.3 was determined from AIDS display on MCDU. Load report was not generated automatically.

- All standard checklists from cockpit preparation checklist till parking checklist were carried out.

- No injury to passenger or crew was reported. No technical abnormalities were observed in the aircraft during the flight.

**Additional information submitted by PIC (verbatim):**

Additional salient information obtained from PIC during his interview with investigation members are as under:

i. Any lateral control inputs from rudder during finals? Or carrying out decrabbing technique while landing?
Ans: I don't remember any deliberate rudder input or decrabbing being done for landing.

ii. Comment on First Officer performance including call outs and other expected actions as per FCTM/ company procedures.
Ans: First officer had got recently released as P2 and experience was less. Few procedural corrections were briefed. Also required help in RT.

iii. While doing RT, PM were using word to reduce speed to 250 knots, descend to 8000 feet etc. is that correct RT phraseology?
Ans: Not correct RT phraseology. Same couldn't be briefed during flight since we were on approach.

iv. What caused the hard landing as per your understanding?
Ans: Error in energy management during final descent and insufficient flare.

v. Captain duck down and touchdown around 300 feet? Why?
Ans: Unintentional input which resulted in duck down maybe because of change in perception of less performed CONFIG 3 landings.

**1.18.4 Excerpts of First Officer statement:**

- First Officer was not much aware about flap3 landing as per her experience.
- Crew had completed all the briefings till TOD according to company SOP. After that due to traffic and different accent FO was putting more efforts in understanding R/T calls & might got confused in some phraseologies which FO corrected later on.
- Crew were cleared for ILS and keeping eye on aircraft ahead us (B777) FO missed the GS interception & 1000'.
- Winds were also variable & since it was her first time after release to Dubai also with flap 3 landing in day time with traffic. FO was little conscious.
- On finals when speeds were asked to reduce to 180kts, FO gave the readback but due flap 3 landing was acknowledged, she was monitoring with respect to learning.

- Till last FMA FO gave the callout (LAND) & till 50ft everything was okay. Around 30ft FO saw pitch attitude up which was supposed to be flare by captain. But aircraft sank & by the time FO realised or assess the situation aircraft already landed.

- Due to her low experience there was delay to assess and understand what just happened. Also, she was not STOL cleared so FO did not touch controls for further instructions.

**Additional information submitted by First Officer (verbatim):**

Additional salient information obtained from FO during her interview with investigation members are as under:

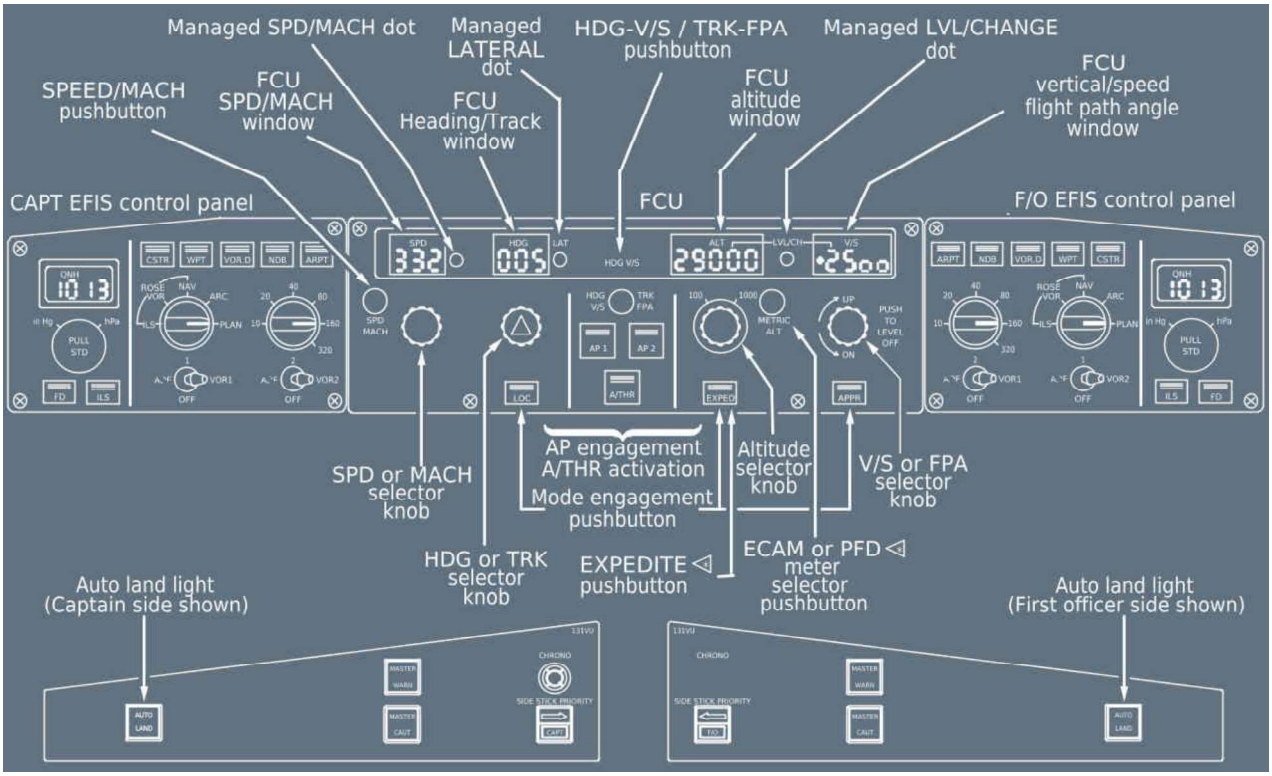
i. While doing the RT, PM were using the word to i.e reduce speed to 250 knots, descend to 8000 feet, etc…), is that the correct RT phraseology?
Ans: Missing correct RT Phraseology & will correct it & practice more.

ii. Aircraft was cleared for ILS before RA alive (around 3000 feet AAL), but the aircraft intercepted ILS from above the Glide slope, Why? Comment vis-a-vis procedures.
Ans: It has been missed due traffic and RT.

iii. Why the no callout from FO side for missing glides lope/ intercepting glide slope from above?
Ans: It has been missed due traffic and RT.

iv. Why there is no callout for No Flare/ Sink rate from PM side?
Ans: From 50' everything happened so fast that due low experience I was not able to assess and react quickly.

### 1.18.5 Flight Control Unit (FCU):




Figure# 6 Flight Control Unit

**1.19 Useful or Effective Investigation Techniques:** None.

## 2. ANALYSIS:

### 2.1 Flight Handling:

#### 2.1.1 Flight handling before 1000ft RA:

**a. Briefing and use of standard checklists:**

Cockpit preparation for approach and briefing was carried out at TOD wherein CONF 3 landing was decided. An approach and landing checklists were also carried out as per the company procedures.

No adverse observations could be made from the CVR readout w.r.t. the approach and briefing procedures and the use of standard checklists for Approach and Landing phase. After landing and parking checklists were also carried out.

**b. Cockpit preparation for descend and approach:**

Cockpit was prepared and the aircraft was configured for descend and approach at appropriate distance and altitude except for the arming of glide slope while cleared for ILS approach, timely selecting LS p/b on FCU and selecting both the A/Ps.

When the ATC cleared the aircraft for ILS approach on RWY 12L, the procedure for intercepting ILS was not followed by crew. Initially, PIC only armed localizer by pressing LOC p/b, whereas the normal procedures in the FCTM describe to arm both approach modes, i.e. LOC and GS, by pressing APPR p/b. By pressing LOC p/b, the aircraft could engage only LOC mode of ILS. FCTM also describes that the LOC p/b should be pressed if the ATC clears the aircraft for LOC capture only.

A relevant extract of the FCTM is placed below:

> ***FCTM PR-NP-SOP-190-GUI P 1/36 28 NOV 23 (Extract)***
>
> ***INTERCEPTION OF FINAL APPROACH COURSE***
> *When cleared for the ILS and when on the intercept trajectory for the LOC, the flight crew should press the APPR pb. This arms the approach modes, and LOC and GS are displayed in blue on the FMA. At this stage, the second AP, if available, should be selected.*
>
> *If the ATC clears for a LOC capture only, the flight crew will press the LOC pb-sw on the FCU.*

During investigation, it was found that subsequent to intercepting localizer, while ATC asked AI933 to maintain 160kts through 5NM, the FO misunderstood and replied incorrect and irrelevant information as reply to ATC which in turn lead the PIC to intervene and ask apologies to ATC. Meanwhile the landing gears were lowered and the aircraft was advised to change over to DXB TWR. After this time when the aircraft was descending to intercept G/s from above, PIC realized and pushed APPR p/b to arm glide slope. PIC submitted in his statement that during R/T confusion he missed to arm glideslope. Poor crew coordination (CRM) and loss of situational awareness led the aircraft to be on localizer without capturing glide slope beyond interception point. Further, the AP2 was not selected by the crew as recommended in the FCTM, leading the aircraft to approach under automation with reduced redundancy.

Upon realizing during descent, PIC armed G/S by pushing APPR p/b on FCU to intercept the glideslope from above. A relevant extract of the FCTM for glide slope interception from above procedure is placed below:

***FCTM PR-NP-SOP-190-GUI P 2/36 28 NOV 23 (Extract)***

***GLIDE SLOPE INTERCEPTION FROM ABOVE***

*The following procedure must only be applied when established on the localizer. There are a number of factors which might lead to a glide slope interception from above. In such a case, the flight crew must react without delay to meet the stabilization criteria. In order to get the best rate of descent when cleared by ATC and below the limiting speeds, the flight crew should lower the landing gear and select flaps as required (at least CONF 2 should be selected to ensure that the aircraft speed will not increase). Speed brakes may also be used, noting the considerations detailed in the subsection "Deceleration and configuration change" earlier in this chapter.*

***When cleared to intercept the glide slope, the flight crew should:***

*- Press the APPR pb on FCU and confirm G/S is armed and LOC engaged, monitor the vertical interception*

*- Select the FCU altitude above aircraft altitude to avoid unwanted ALT* engagement*

*- Select V/S 1 500 ft/min initially. V/S in excess of 2 000 ft/min will result in the speed increasing towards VFE.*

*The use of V/S mode ensures that the A/THR is in SPEED mode.*

*The flight crew should carefully monitor the rate of descent to avoid exceeding VFE When approaching the G/S path, G/S* will engage. The flight crew should monitor the G/S capture with raw data (pitch and G/S deviation). The go-around altitude should be set on the FCU at G/S*.*

Before intercepting G/S from above, the landing gears were lowered as recommended in FCTM however the speed brakes were not used. Flaps were already in CONF2 at this time and A/P1 and A/THR was engaged. In order to capture G/S from above, the aircraft dived with reduction in pitch angle, an increase in CAS and rate of descent (the maximum vertical speed was recorded as -1696 ft/m), and a reduction in both engines' thrust. Subsequently, the APPR p/b was pressed and G/S could be captured at 1633ft RA when the aircraft was approx. 5NM from RWY threshold. The sequence of procedure for the glide slope interception from above was not followed as it was ascertained that crew selected APPR mode subsequent to start of descent. Further, the vertical interception was not monitored during descent as required by FCTM, as LS p/b (indicating G/S and LOC deviation scale) was not selected until the APPR p/b was pushed.

The CAS was increased upto 170.5kts during capturing of G/S from above whereas the speed restrictions as per the approach chart is 160kts. The violation of speed restriction was not intimated to ATC by the crew. The CAS started reducing subsequently and flap3 was deployed. Aircraft reached to the 3degree glide path at approx. 4NM instead of 6NM. Maintaining the same

state of energy, the aircraft descended through 1000ft RA on IDLE thrust in CONF3 where the CAS was 9.75kts higher than the approach target speed and ROD was 848ft/m. The approach target speed was achieved at 826ft RA where both the engines were also started developing appropriate thrust. CAS came to approach speed with appropriate thrust at 826ft, hence it could be derived that the aircraft got stabilized late at 826ft instead of 1000ft. Had the PIC used speed brakes for the G/S interception from above, the approach target speed could have been achieved earlier, giving more time available to aircraft to get stabilized. This indicates that the Cockpit resources were not utilized effectively.

Moreover, callouts for intercepting the glideslope from above were missing and the First Officer (PM) was not aware of the same as the PIC did not callout the same. Also, AI933 did not make any communication with ATC informing that they had missed G/S interception and they had intercepted the glide slope from above. It is therefore considered that there was lack of crew coordination and standard operating procedures for glideslope interception were not followed. Crew reflected poor Aircraft Flight Path Management, with Automation.

### 2.1.2 Flight handling from 1000ft- A/P OFF:

At 1000ft RA, the aircraft was on the correct lateral and vertical flight path in the landing configuration, however the CAS was 9.75kts higher than VApp and the engines were in IDLE thrust. PIC called out stabilized at 1000ft without reviewing the appropriated engine thrust for the phase.

The aircraft was descending with A/P ON (managed speed mode) and the auto thrust ACTIVE. CAS came to approach speed with appropriate thrust at 826ft RA. While in automation, vertical speed was observed to be varying between -656ft/m to -976ft/m and the pitch attitude was observed to be varying between 2.5degree to 5.3degree before the A/P was disconnected by PIC at 338ft RA.

### 2.1.3 Flight handling after A/P OFF to touch down:

A relevant extract of the FCTM on pitch control during landing is placed below:

> ***FCTM PR-NP-SOP-250 P 4/18 28 NOV 23 (Extract)***
>
> ***PITCH CONTROL***
> *When approaching the ground, auto-trim ceases and the flare law activates. During flare, PF will have to apply a progressive and gentle back stick order until touchdown. The flare law technique is thus very conventional.*
>
> *Prior to flare, avoid destabilization of the approach and steepening the slope at low heights in attempts to target a shorter touchdown. If a normal touchdown point cannot be achieved or if destabilization occurs just prior to flare, a go-around (or rejected landing) should be performed.*
>
> *The PM monitors the rate of descent and should call "SINK RATE" if the vertical speed is excessive prior to the flare.*
>
> *From stabilized conditions, the flare height is about 30 ft.*
> *This height varies due to the range of typical operational conditions that can directly influence the rate of descent.*
>
> *If the flare is initiated too late then the pitch changes will not have sufficient time to allow the necessary change to aircraft trajectory. Late, weak or released flare inputs increase the risk of a hard landing.*
>
> *Avoid under flaring.*
> *- The rate of descent must be controlled prior to the initiation of the flare (rate not increasing)*
> *- Start the flare with positive (or "prompt") backpressure on the sidestick and holding as necessary*
> *- Avoid forward stick movement once Flare initiated (releasing back-pressure is acceptable)*

After Autopilot was disengaged, the aircraft was manually flown by the PIC with Auto Thrust active in Speed mode. After A/P disengagement, PIC gave varied Nose up and down pitch stick inputs ranging from 2.8degree to 6.4degree pitch angle with corresponding significant variation in ROD ranging from 480ft/m to 928ft/m. The glide slope deviation was found to be more than 0.5dot from 185ft RA onwards and the deviation was 0.911dot at 49ft RA (aircraft below glide path). Roll inputs were also being given by PIC to keep the aircraft stabilized on the localizer.

At 49ft RA, backward stick input was given by PIC for initiating flare whereas the FCTM recommends initiating flare in stabilized conditions at 30ft RA. At approx. 25ft RA, PIC applied a full forward stick order lowering the nose down to 2.8degree in next second which increased ROD to 864ft/m. Instead of holding the stick or releasing the back pressure from the sidestick, PIC applied forward pressure on the stick which is contrary to the FCTM guidance. Due to this

pitch down input by the PIC while in flare, the ROD of the aircraft could not be arrested even after applying full backward stick input at approx. 10ft RA resulting in the aircraft touching down at VRTG of +3.36. This late stick order applied at approx. 10ft RA could not sufficiently change the aircraft trajectory before touchdown to avoid a hard landing. Hence, it could be concluded that the incorrect landing technique (pitch control) and poor Aircraft Flight Path Management with manual control has led to the incident.

The PIC stated in his statement that after initiation of the flare, he felt that the aircraft was sinking too fast, however before he could initiate go around, the aircraft touched down. The absence of a call out of "SINK RATE" or "GO AROUND FLAP" from PM before or at any time during flare is a clear non-adherence to the FCTM guidelines and reflects a lack of crew coordination.

Increase in ROD during flare, application of forward stick order while in flare and absence of SINK RATE callout from PM were contraventions to the FCTM guidelines.

Although the rudder inputs and aircraft heading suggested the use of the decrab technique to align the aircraft with the runway heading during flare, PIC submitted that he didn't remember any deliberate rudder input or decrabbing being done for landing. The aircraft heading was 115.7degrees at touch down and lateral g was observed as -0.238g, i.e. aircraft moving towards right side of the track.

Immediately after touch down, PIC advanced both thrust levers for 1 second and pulled back without any callouts, indicating that the PIC might have thought for going around at this time however later changed his decision to continue the landing roll.

## 2.2 Compliance to Stabilized approach criteria and understanding of PIC:

Air India OM A para 25.2 is reproduced below for reference:

***Air India OM A para 25.2:***

***25.2 Conditions Required to Obtain Stabilized Approach***

*i. Aircraft in landing configuration correct flight path.*
*ii. Only small changes in Heading and Pitch are required to maintain the flight path.*
*iii. On profile (ILS glide slope, published non-precision profile, or when a Glide path has been established visually and conditions have been met to allow descent below the DA (DH) or MDA (MDH).*
*iv. Speed within +10/-0 kts of reference speed (V ref)*
*v. Rate of descent not in excess of 1000 fpm (>1000 fpm authorized on a non-precision approach when conditions require) and not less than 400 fpm.*
*vi. Thrust setting in the approach would vary with the approach configuration and the ambient conditions. The correct thrust during the final approach phase, in landing configuration, would result in the appropriate CAS.*

*Contd……*

***Air India OM A para 25.2:***

***25.2 Conditions Required to Obtain Stabilized Approach***

*Contd…..*

*vii. All briefings and checklists have been conducted.*
*viii. Specific types of approaches are stabilized if they also fulfil the following: Instrument Landing System (ILS) approaches must be flown within one dot of the glide slope and localizer; a Category II or Category III ILS approach must be flown within the expanded localizer band; during a non-precision approach, wings should be level and aircraft aligned with runway center line latest by 300 feet above airport elevation.*
*ix. Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.*
*x. An approach that is not stabilized by 1,000 feet AFE in instrument meteorological conditions (IMC) and by 500 feet AFE in visual meteorological conditions (VMC) requires an immediate Go-around.*
*xi. The landing gear must be down and the landing checklist completed at the latest by 1,000 ft. above airport elevation. Speed brakes must be retracted before 1000 ft (AFE).*

As per QRH, Vref for CONF 3 for aircraft landing weight 62.4T was 137kts. The VApp (approach target speed) calculated by FMC was 141kts.

The PIC could explain the criteria of the stabilized approach during the interview with the investigation team, wherein he referred the VApp as reference speed to determine the stabilized criteria. Further, when the aircraft was descending passing 1000ft RA, PIC did not realize that both the engines were producing IDLE thrust as the G/S was captured with delay from above. Auto Thrust was active at this time, however the CAS was 150.75kts, which is approx. 10kts higher than the target speed and approx. 14kts higher than Vref.

Further, the approach target speed was achieved at 826ft RA where both the engines were also started developing appropriate thrust. CAS came to approach speed with appropriate thrust at 826ft, hence it could be derived that the aircraft got stabilized late at 826ft instead of 1000ft.

All of the above clearly indicates that the aircraft did not meet stabilization criteria prescribed in OM A para 25.2.

PIC without reviewing the engine thrust parameters gave 1000' stabilized callout. PM also did not check for the stabilization parameters and missed to call out about the stabilization status of the aircraft.

Air India OM A para 25.3 is reproduced below reflecting the actions required to be taken in case of significant deviations during approach:

***Air India OM A para 25.3:***

***25.3 Significant Deviation***
*- Rate of descent more than 1000 fpm less than 400 fpm*
*- Approach speed (Vref/Target): +10 Kts - 0 Kts*
*- Localiser: 1 dot deviation*
*- Glide slope: 1 dot deviation*
*- Thrust: Any significant deviation from required thrust setting*

*In case the above-mentioned criteria is not met, then the approach is considered un-stabilized.*

*Note: A precision approach that is not stabilized by 1,000 feet AFE in instrument meteorological conditions (IMC) and by 500 feet AFE in visual meteorological conditions (VMC) requires an immediate Go-around.*

While in approach from 1000ft to 826ft, the CAS was more than 10kts higher than Vref for CONF 3. Further, after disconnecting A/P, PIC was giving varying pitch UP and DOWN inputs continuously leading to significant variation in ROD (ranging from 480ft/m to 928ft/m) qualifying for significant deviation and unstabilized approach. However, no call out was given by PM to discontinue the approach at any point of time. Aircraft continued approach not adhering to the company SOP.

During the investigation, it had come to the notice of the investigation team that contradicting information w.r.t. reference speed for stabilization criteria is stipulated in M/s Air India OM A para 25.2 and 25.3. On seeking clarification, M/s Air India had replied that OM A Ch.25 'Stabilized Approach Procedures' was revised in Jan 2024 as a corrective measure.

## 2.3 Considerations of 'Go Around' by crew:

At no point during approach till flare height crew perceived that they were unstabilized. First officer submitted in her statement that till 50ft everything was okay but after flaring, aircraft sank & by the time she realized or assess the situation aircraft already touched down. She submitted that there was a delay in the assessment of the situation during flare and touchdown due to her low experience, however the same does not qualify as a valid justification for a qualified line released pilot. She also added that she did not touch controls as she is not STOL (supervised takeoff and landing) cleared which clearly indicates lack of understanding of First Officer with respect to taking over controls for the interest of safety.

Whereas PIC informed in his statement that, during the flare was applied he momentarily thought of discontinuing the approach as he felt that the aircraft was sinking too fast and the ROD could not be arrested, however by the time he initiated GO Around, the aircraft had touched down. He added that there was no callout for go-around given by PM.

PIC's submission is corroborated from DFDR wherein it is found that both the thrust levers were advanced for 1 second immediately after touch down and immediately pulled back, indicating that the PIC might have thought for going around at this time however later changed decision to continue landing roll. In given situation, had there been a timely callout for go around by PM, it might have prompted PIC to go around before touchdown.

The CVR analysis also corroborates that, while taxing-in PIC called 'Grounded …..I should have gone around yaar'

Therefore, it could be inferred that, the PIC at some point of time during approach recognized that the aircraft was not stabilized or he was unable to control the aircraft. However in absence of call out from PM, PIC decided to continue approach and landed contrary to the company SOP.

**2.4 Effect of weather/ winds:**

The winds were observed variable in the direction (mostly cross winds from left side) however the magnitude of the wind is considered to be too low to cause any disruption in handling the flight.

Additionally, M/s Airbus has apprised in their report that all available weather information sources highlight no adverse wind conditions during final approach and the aircraft encountered downdraft of wind approximately at 50ft RA. However, the effect of the downdraft was not considered contributory as the PIC had applied downward sidestick order at approx. 25ft RA during flare increasing the ROD to 864ft/m at touchdown.

**2.5 CRM:**

**Lack of callouts, R/T mistakes and workload management:**

During the flight the First Officer (PM) was using the incorrect RT phraseology (i.e. reduce speed to 250 knots, descend to 8000 feet), incorrect read backs, not using the appropriate aircraft call sign & ILS RWY number while read back etc. Training history of PM also reveals that issues w.r.t. ATC communication/ R/T were highlighted by the trainers as well.

Several times such irregularities were corrected by PM as pointed out by ATC and on one instance (after the aircraft was cleared for approach), P1 had to intervene and sought apologies to DXB ATC as PM seemed confused and was replying with irrelevant information to the matter under communication. This communication issue affected the glide slope interception procedures wherein the glide slope was intercepted by PIC beyond the interception point without communicating with ATC (even though the aircraft speed exceeded the published speed restrictions). Subsequently, PIC did not

use speed brakes while descending to capture glide slope from the above as mentioned in FCTM, which led to the aircraft reaching at target speed at 826ft RA.

Moreover, there was poor communication within the cockpit itself wherein callout like intercepting the glideslope was not issued by PIC leaving PM unaware about the glideslope being captured from above. Also, standard callouts like go around, no flare, sink rate, etc were not issued by PM resulting in aircraft continuing without corrective actions for landing despite being unstabilized in terms of significant ROD and pitch variations. While taxing-in after landing also crew got confused with respect to the taxi instructions and stopped on the taxi way.

The communication issues with ATC and within cockpit as mentioned above had resulted in poor coordination and workload management in the cockpit procedures, reflecting poor CRM.

## 2.6 Flying history of the crew:

### 2.6.1 PIC:

PIC did not have any accident/ incident history with the operator, however was involved in two 'Red' level exceedances of 'long flare distance' while operating Airbus A321 aircraft in August 2023 and October 2023, about which he was sensitized by the Flight Safety Department of M/s Air India Ltd.

Handling as observed in both of these flights did not have a direct bearing on the incident flight.

### 2.6.1 First Officer:

The First Officer did not have any accident/ incident history or FDM exceedance history with the operator, however the past training records of SLFs indicate that the First Officer was facing difficulties on R/T communications and workload management.

Although such deficiencies were not observed during IR/PPC checks carried out in last one year, they were evident in the incident flight. Owing to her less experience and difficulties in R/T communication, the CRM was adversely affected during the approach and landing phase.

## 2.7 Engineering aspects:

Airworthiness Review Certificate of the aircraft was valid up to 12/07/2024. The aircraft was being maintained as per the approved Aircraft Maintenance Programme. Last major maintenance, i.e., 3A check, was accomplished on 11/11/2023 and next major check 4A was due on 06/02/2024. Aircraft Load & Trim sheet was prepared wherein take-off weight, landing weight and Centre of Gravity were found within limits. Aircraft was departed with valid Certificate of Release to Service on 20/12/2023.

There were no open snags, and the active MELs did not have any bearing on the incident. Further, PFR did not indicate any warning/ maintenance status or failure messages which may affect the handling of the aircraft or have any contribution to the incident.

In view of the above discussion, the aircraft was considered airworthy before the incident flight and the maintenance of the aircraft is not a contributory factor to the incident.

## 3. CONCLUSION:

### 3.1 Findings:

- Airworthiness Review Certificate of the aircraft was valid up to 12/07/2024. Take-off weight, landing weight and Centre of Gravity were found within limits. Aircraft was departed with valid Certificate of Release to Service on 20/12/2023.
- The aircraft was maintained in accordance with the approved maintenance programme.
- The aircraft was considered airworthy before the incident flight and the maintenance of the aircraft was not a contributory factor to the incident.
- Both crew members had valid licenses while operating incident flight. Medical fitness & FDTL was not a factor to this incident.
- PIC was PF and FO was PM.
- Weather was not a factor in this incident.
- There was lack of crew coordination and standard operating procedures for glideslope interception were not followed. Crew reflected poor Aircraft Flight Path Management, with Automation.
- PIC called out stabilized at 1000ft without reviewing the appropriated engine thrust for the phase. The aircraft got stabilized late at 826ft instead of 1000ft. Aircraft did not meet stabilization criteria prescribed in OM A para 25.2.
- Despite significant deviation from the stabilized approach criteria, no call out was given by PM to discontinue the approach.
- When the flare was applied, the PIC recognized that the aircraft was not stabilized or he was unable to control, however, in absence of call out from PM, he decided to continue and landed contrary to the company SOP.
- Increase in ROD during flare, application of forward stick order while in flare and absence of SINK RATE callout from PM were contraventions to the FCTM guidelines.
- Aircraft landed on RWY 12L of DXB airport with a vertical acceleration (VRTG) of 3.36g.
- The communication issues with ATC and within cockpit had resulted in poor coordination & workload management, reflecting poor CRM.

- R/T difficulties faced by the First Officer and her low experience adversely affected CRM during the approach and landing phase.
- No human injury was reported in the incident.

**3.2 Causes:**

The incorrect landing technique (pitch control) and poor Aircraft Flight Path Management with manual control led to the incident. Non-adherence to SOP and poor CRM contributed to the incident.

## 4. SAFETY RECOMMENDATIONS:

4.1 Corrective action to cockpit crew as deemed necessary by DGCA Hqrs.

Prashant Nagale
Prashant Nagale
Mumbai
2024.10.03
17:41:31+05'30'

(Capt. Prashant Nagale)
Member, Investigation VT-CIQ

Pathik Vaghela
Pathik Vaghela
Mumbai
2024.10.03
17:42:33+05'30'

(Pathik Vaghela)
Investigator-In-Charge, VT- CIQ

Date: 03.10.2024
Place: Mumbai

------END OF REPORT-----