GOVERNMENT OF INDIA

CIVIL AVIATION DEPARTMENT

FINAL INVESTIGATION REPORT

HARD LANDING INCIDENT TO M/S INDIGO A321 NEO AIRCRAFT VT-IUM AT COIMBATORE ON 17th MAY 2022

Office of Director of Air Safety (WR)

Integrated Operational Office Complex, Sahar Road,

Vile Parle (E), Mumbai – 400099

FOREWARD

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 13(1) of the Aircraft (Investigation of Accidents and Incidents), Rules 2017.

The investigation is conducted not to apportion blame or to asses individual or collective responsibility. The sole objective is to draw lessons from this incident which may help to prevent such future incidents.

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Contents

FINAL REPORT ON HARD LANDING INCIDENT TO M/S INDIGO A321 NEO AIRCRAFT VT-IUM AT COIMBATORE ON 17th MAY 2022

a.	Aircraft Manufacturer	: Airbus
	i. Model	: A321 Neo
	ii. State of Registry	: India
	iii. Registration	: VT-IUM
b.	Name of the Owner	: M/s GY Aviation Lease, Ireland
c.	Name of the Operator	: M/s Interglobe Aviation (Indigo)
d.	Pilot – in – Command	: ATPL Licence holder
e.	Co-pilot	: CPL Licence holder
f.	Passengers:-	
	a. No. of Persons on board	: 218
	b. Extent of injuries	: nil
g.	Place of incident	: Coimbatore (ICAO: VOCB)
h.	Date & Time of Incident	: 17th May 2022; 10:51 Hrs IST (05:21 Hrs UTC)
i.	Last point of departure	: Chennai (ICAO: VOMM)
j.	Point of intended landing	: Coimbatore (ICAO: VOCB)
k.	Nature of Operation	: Scheduled - Commercial
l.	Phase of Operation	: Landing
m.	Type of incident	: Abnormal Runway contact
n.	Aircraft Damage	: nil

(All timings in the report are in UTC unless or otherwise specified)

SYNOPSIS

On 17th May 2022, Indigo A321 Neo aircraft VT-IUM was scheduled to operate flight 6E-299 from Chennai to Coimbatore. The First Officer was Pilot Flying and PIC was Pilot Monitoring for this sector.

Take-Off from Chennai, cruise, approach & descent to Coimbatore was uneventful. During landing at Coimbatore, the aircraft landed hard on the runway with vertical load of 3.26 G, and bounced again with 1.6 G.

The incident took place at 05:21 Hrs UTC.

The Director General of Civil Aviation instituted the investigation by appointing an Investigation-in-Charge vide Order No: DGCA-15018(06)/12/20222-DAS dated 19-05-2022 under Rule 13(1) of The Aircraft (Investigation of Accidents and Incidents) Rules 2017.

The investigation concluded that, the late initiation of flare maneuver by the crew, coupled with incorrect landing technique (pitch control), resulted in the incident. Weather conditions also contributed to the incident.

FACTUAL INFORMATION

1.1. History of the flight.

Indigo Airlines Flight 6E-299 was scheduled to operate sector Chennai – Coimbatore on 17-05-2022 on Airbus A321 Neo aircraft VT-IUM. The block time for the flight was 1:05 Hrs. The flight was operated by a set of crew commanded by a Pilot in-command (PIC), who is an Airline Transport Pilot Licence (ATPL) holder along with a First Officer (FO), who is a Commercial Pilot Licence holder (CPL) – herein termed as P1 & P2 respectively

Transit inspection was carried out by a certified Engineer at the departure station. Aircraft was released with 5500 Kgs of fuel on-board and nil defect/ MEL.

The crew cleared Pre-flight medical check at Chennai as per DGCA requirements. The crew carried out remote briefing regarding flight plan, NOTAMs, weather, fuel calculation. During briefing it was decided that the flight will be operated by P1 as Pilot Monitoring, and the P2 as Pilot Flying. As per weather forecast, weather was clear at Departure and arrival aerodrome.

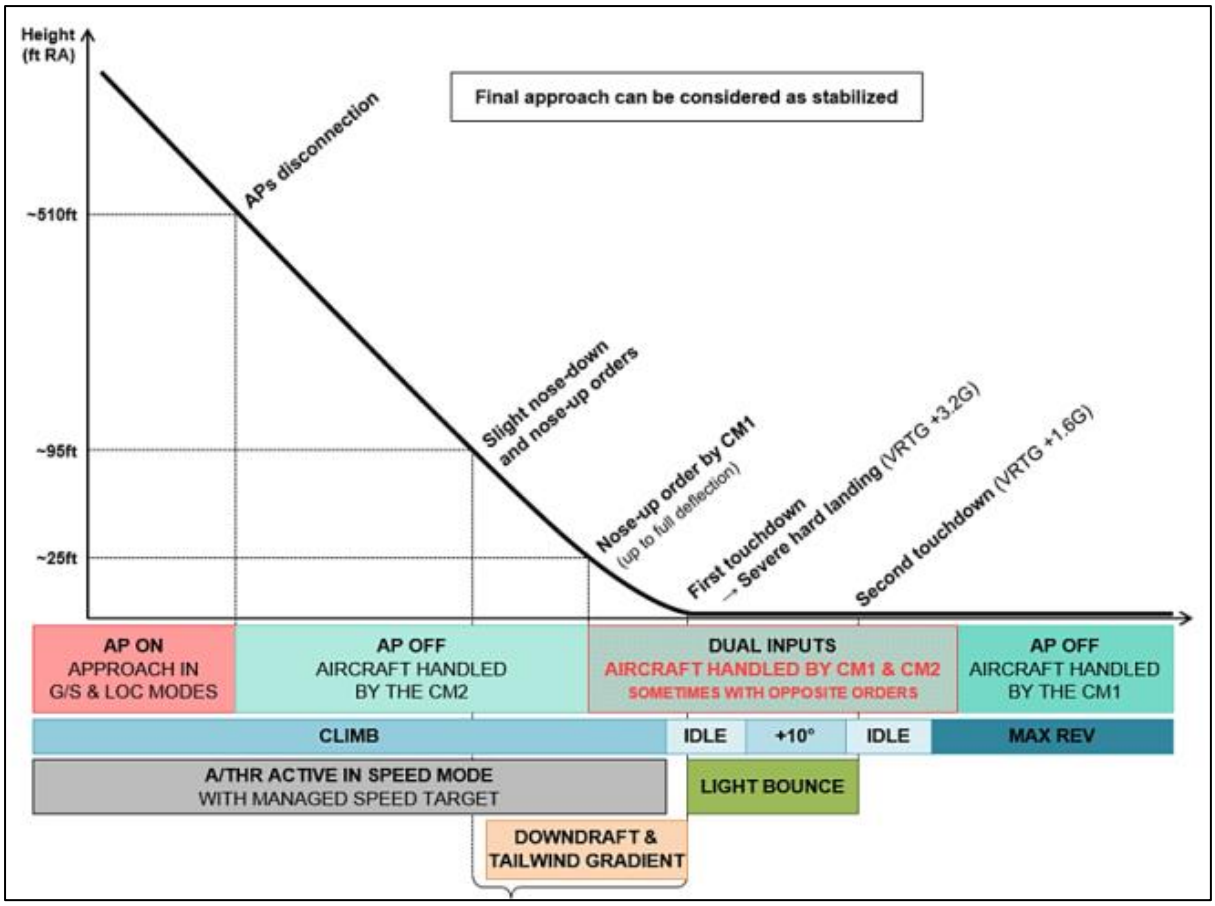
Aircraft Flight recorders such as Cockpit Voice Recorder, Flight Data Recorder, Air traffic services transcripts, inputs from crew and Airbus report were available for investigations.

The aircraft took off from Chennai with 218 Passengers at 04:42 Hrs UTC. Take-off, climb and cruise was uneventful. Aircraft approached for ILS approach to Runway 23 at Coimbatore airport. At around 510 ft Radio Altitude (RA), both the Autopilots were disengaged manually. Final approach was manually handled by the P2 with Auto Thrust active in Speed mode. The visibility reported at CBE airport was 5000m, with wind at 190^{o}/08 Kt.

At around 95 ft Radio Altitude (RA), a slight nose-down input applied by the crew, combined with a vertical gust (downdraft), led the rate of descent of the aircraft to increase up to around 1000 ft/min prior to flare.
Landing clearance was issued by Coimbatore ATC along with weather information, which was calm.
During landing at Coimbatore, at around 25ft RA, flare was initiated by P1, dual inputs were found recorded from P1 & P2 side during final phase of landing.

Aircraft landed on Runway 23 with high Vertical Acceleration (VRTG) of +3.2G. This is considered as ‘Severe hard landing’ by M/s Airbus. After first touchdown, aircraft bounced and touched down again with VRTG of +1.6G, landed and taxied on its own power to the bay. There was no injury reported to any of the passengers and crew on board the aircraft.

The incident was promptly reported by the crew for further maintenance and data recovery action.



The incident took place at Coimbatore Airport at time 1051 Hrs IST with day light condition.

1.2. Injuries to persons.

There were no injuries reported by the passengers as well as the crew.

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor/None	Nil/07	218	

1.3. Damage to aircraft

Following the hard landing incident, damage was assessed through the following inspections:

(a) Hard landing inspections as per the Aircraft Maintenance Manual (AMM)

(b) Severe hard landing inspections as per advice of the Aircraft Manufacturer (M/s Airbus)

No damage was observed to any part of the aircraft.

1.4. Other damage

Nil

1.5. Personnel information

1.5.1. Pilot In-Command (PIC)-P1

The PIC-P1 was occupying the left seat. He was the 'Pilot Monitoring' and has permitted First Officer to be Pilot Flying (PF).

Age	34 YEARS
Male/Female	MALE
License	ATPL
Date of Issue	15/02/2010
Valid up to	28/02/2027
Category	Aeroplane
Date of Class I Med. Exam.	10/09/2021
Class I Medical Valid up to	11/09/2022
Date of issue FRTOL	15/02/2020
IR rating and instructor rating	15/10/2021
FRTO License Valid up to	14/02/2025
Total flying experience {Experience on type}	5197: 07
Total flying experience during last 1 year	473:09
Total flying experience during last 6 Months	295 36
Total flying experience during last 30 days	50 42
Total flying experience during last 07 Days	15:14
Total flying experience during last 24 Hours	NIL
Duty time last 24 hrs	NIL
Rest before the flight	44:52

As per Indigo NOTAC No: 02BU regarding 'Supervised Take-Off and Landing', the PIC has been authorised by the airline for permitting supervised flying by the First Officer. He was not involved in any serious incident/ accident previously. The crew had undergone Pre Flight medical check at Chennai which revealed that he was not under the effect of alcohol.
There was no training due at the time of incident.

1.5.2. Co-Pilot-P2

The Co-Pilot (P2) was occupying the right seat. He was the 'Pilot Flying' for this sector.

Age	35
Male/Female	MALE
License	CPL
Date of Issue	27/10/2017
Valid up to	26/10/2022
Category	Aeroplane
Date of Class I Med. Exam	11/06/2021
Class I Medical Valid up to	10/06/2022
Date of issue FRTOL	18/05/2022
IR rating and instructor rating	IR-16/02/2022
FRTO License Valid up to	17/05/2027
Total flying experience {Experience on type}	598:09
Total flying experience during last 1 year	347:20
Total flying experience during last 6 Months	209:28
Total flying experience during last 30 days	53:28
Total flying experience during last 07 Days	23:31
Total flying experience during last 24 Hours	nil
Duty time last 24 hrs	Ground Class (7:15 Hrs.)
Rest before the flight	15:35

As per Indigo NOTAC No: 02BU regarding 'Supervised Take-Off and Landing', the FO has been authorised by the airline to undertake supervised flying. He was not involved in any serious incident/ accident previously. The crew had undergone Pre Flight medical check at Chennai which revealed that he was not under the effect of alcohol. There was no training due at the time of incident.

1.6. Aircraft information:

1.6.1. Airworthiness and Maintenance:

Aircraft Manufacturer : Airbus Industries
Aircraft Type and registration : A321- Neo; VT-IUM
Aircraft S.No. : 9112
Year of Manufacturing : 2020
Certificate of Registration : Valid up to 16-02-2026

Certificate of Airworthiness	: Issued on 21-02-2020; Validity – Lifetime, subject to valid ARC
Airworthiness Review Certificate	: Issued on 21-02-2020, extended twice, valid up to 20-02-2023
Minimum crew required	: 02
Maximum All Up Weight	: 97,000 Kg
Total time since C of A	: 4874:28 Hrs
Last Major Inspection	: 7500 FH/ 24 months inspection on 21-12-2021
Last Inspection	: Weekly inspection carried out on 16-05-2022 at 4869 FH
Repetitive Snags (last 15 Days)	: nil
Major Snags reported	: nil
Aircraft length	: 44.51m (146ft) – 6.94m longer than A320

There were no defects on the aircraft and no MEL were invoked at Departure station.

1.6.2. Aircraft load:

Maximum certified take-off weight	: 81,077 Kgs
Actual Take-Off weight	: 72,321 Kgs
Maximum landing weight	: 79,200 Kgs
Actual landing weight	: 70,444 Kgs

CG with Index at Zero fuel weight was 56.8 % of datum (Limit: 30.45% -86.87%).
CG with Index for Take Off weight was 51.5 % of datum (Limit: 20.34% - 77.81%)

The aircraft landed with vertical G loads of +3.2G, which is considered as 'Severe hard landing' as per the manufacturer.

1.7. Meteorological information:

Half hourly weather report is available from Coimbatore MET office. Weather information was available to the pilot during approach and landing.

Weather Report at VOCB - 0530 Hrs UTC

Wind direction: 190^o		Wind Speed	: 08 KT
Visibility	: 5000m	WX	: HZ
Cloud 1	: Scattered 1200 ft	Cloud 2	: Broken 8000 ft
Temp	: 30^o C	Dew Point	: 22 ^{o} C
QNH	: 1007 hPa	QFE	: 0961 hPa

A specific wind reconstruction was computed by M/s Airbus to determine the influence of wind of the aircraft behaviour during final approach.

Between 750ft RA (05:20:17 UTC) and 200ft RA (05:20:56 UTC), the average wind came from 180° (variable between 139° and 202°) at 5kt (with gusts up to 8kt):

- Mean headwind component increased from ~2kt to ~4kt.
- Mean left crosswind component increased from ~5kt to ~8kt.
- Several vertical gusts were encountered.

In the last 75ft, a vertical gust of ~6kt and a tailwind gradient of ~6kt were encountered by the aircraft.
The incident took place at day light conditions.

1.8. Aids to navigation

VOCB airport is equipped with following navigational aids DVOR, DME, NDB. Runway 23 is CAT –I runway with high intensity approach lighting system.
There were no faults reported in the navigational aids and no reports of lack of their effectiveness.

1.9. Communications.

Aircraft was in constant radio contact with the ATC of departure, en-route and destination aerodrome, along with RADAR visibility during the entire duration of flight.

1.10. Aerodrome information.

Coimbatore Airport (VOCB) is operated by M/s Airports Authority of India (AAI), which also provides ATC services. The Airport has Runways 05/23 with RWY 05 having simple approach lighting and no landing aids, whereas RWY 23 has high intensity approach lighting system with CAT-I. CAT-VII Firefighting services are provided by the aerodrome operator. There was no damage to any airport related structures.

1.11. Flight recorders.

1.11.1. Cockpit Voice Recorder

Part No: 980-6022-001, Serial No: CVR120-15263

CVR was downloaded and the recordings were available for the flight.
The salient points recorded in the CVR is appended below:
Normal checklists were initiated by P2 and read by P1. Flight was uneventful until approach phase. Approach briefing was carried out by both the crew, there was no briefing/ discussion regarding difference in flare and landing technique of A321 NEOs.

At around 5600 ft RA, P2 asks P1 for Flaps 2, P1 informs that it's too early and advises him to wait.
At around 4100 ft RA, P2 asks P1 for Landing gear extension, P1 informs that it's too early and advises him to extend at 3100 ft.
Landing clearance was issued by ATC for RWY 32 with wind 200/08 knots. During flare, auto callouts of altitude were heard, from 50 ft to 20 ft. The hard impact of aircraft landing on ground was heard in the CVR. P1 asked P2 reason for not pulling up and also informs that P2 had pushed it down further than pulling up. Immediately, aural caution 'dual input' was heard. P1 asked whether he remembers flare in A321 and when the last time he landed A321 before was, P2 replied 'long-time'.

1.11.2. Flight Data Recorder

Part No: 980-4750-002, Serial No: FDR-06134

The FDR data of the flight was analysed along with Manufacturer (M/s Airbus) analysis report and following are the salient points:

At 1000ft RA (05:19:56 Hrs UTC), aircraft was in CONFIG 3 (Slats at 20^{o}, Flaps at 30 ^{o}). Both autopilots and Flight Directors were engaged in G/S (vertical) and LOC (lateral) modes. Landing gear was selected down and locked. P2 is Pilot Flying and P1 is the Pilot Monitoring.

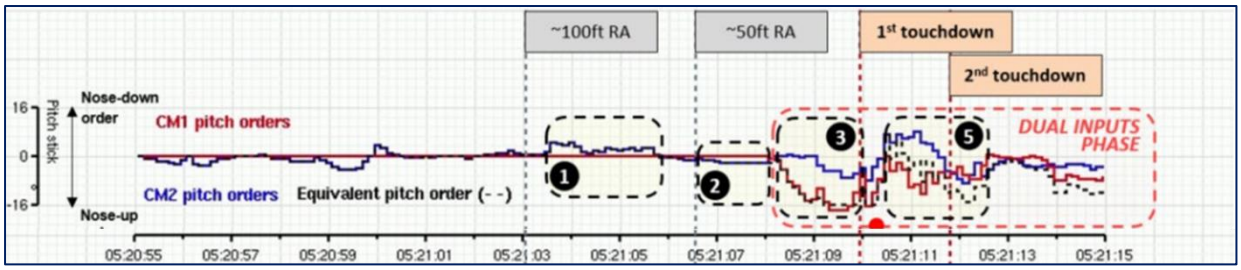
<u>From 1000ft RA to ~95ft RA:</u>

- At 05:20:35 UTC - Both the Autopilots (APs) were disengaged at around 500 ft RA, and the aircraft was manually flown by the Co-Pilot (P2) with Auto Thrust active in Speed mode
- After APs disengagement, P2 gave varied roll angle inputs between -4^{o} and +2^{o}. No significant rudder pedal inputs were recorded.
- Rate of descend varied between ~1000 ft/min and ~500 ft/min. Aircraft was on localizer.

<u>From ~95 ft RA to touchdown (05:21:03 Hrs UTC):</u>

- From ~95ft RA to ~25ft RA, P2 applied slight nose-down then slight nose-up inputs, due to which Pitch angle progressively decreased from +2.5° to +1.5° then slightly increased up to +2°. Rate of descent increased from ~650ft/min to ~1000ft/min.
- At 05:21:07 Hrs. UTC, ~25ft RA, flare was initiated by P1 with a progressive full nose-up order. In the last 15ft, P2 applied a half of full nose-up order (dual inputs). Due to this Pitch angle increased from +2° to +4.5°.
- At 05:21:08 Hrs UTC, At ~10ft RA, thrust levers were progressively retarded to the IDLE detent leading to A/THR disconnection just after first touchdown.
- At 05:21:15 Hrs., UTC, Side stick inputs were simultaneously recorded on both P2 & P1 sides without activation of 'takeover priority push button'.

- In the last 15ft RA, P1 applied right deflection. A dual side stick input occurred for 8 seconds.
- In the last 75ft RA, a vertical gust of ~6kt and a tailwind gradient of ~6kt were encountered by the aircraft. CAS decreased from 148 kt to 140 kt



First touchdown:

- At (05:21:10 Hrs UTC) Aircraft touched down on both the main landing gears with Vertical load factor +3.2G.
- During touchdown, pitch angle was +4.5°, +0.5° roll angle and drift angle of +1.5°

Between first touchdown and bounce (05:21:10 Hrs and 05:21:12 Hrs UTC):

- RA increased up to +2ft.
- Main Landing Gears were uncompressed for ~1s.
- Dual opposite inputs were recorded on the sidestick
    - P2 applied a nose-down order up to half of deflection. At the same time, **dual inputs with opposite sidestick** nose-up order were applied by P1.
- Thrust levers were briefly pushed to +10° (between IDLE and CLIMB detent) before being pulled back to IDLE detent prior to second touchdown

Second touchdown:

- At 05:21:12 Hrs UTC, Aircraft touched down on right main landing gear with Vertical load factor +1.6G.
- During touchdown, pitch angle was +4°, +4° roll angle.
- ~2s after second touchdown, MAX REV thrust was selected for ~13s then REV IDLE thrust was selected for ~16s.
- ~18s after second touchdown, manual braking was applied leading to autobrake deactivation.

1.12. Wreckage and impact information.

Not relevant as there was no damage to the aircraft nor to any of the airport structures

1.13. Medical and pathological information.

Not relevant as there was no injury sustained to any persons on board.

1.14. Fire.

There was no evidence of smoke or fire before and after the incident.

1.15. Survival aspects.

The incident was survivable

1.16. Tests and research.

Not applicable

1.17. Organizational and management information.

M/s Indigo is a Scheduled passenger airline licenced by DGCA, India in 2006. Airline operates various domestic and international routes with around 300 aircrafts. Their fleet comprises of A320 family and ATR 72-600 aircraft. The airline started operating A321 aircrafts since 2019.

1.17.1. Airline Operations Notice to aircrew

M/s Indigo has issued Operational Notice (69A) titled: *Flare and Landing on A320 NEOs dated 1st April 2022*. The notice provides brief knowledge about the difference between A320 and A321 NEOs in regard to Flare and landing technique, aircraft performance at flare altitude.

--Quote--
Every flare in A321NEO, due to ground effect and thrust reduction, the aircraft has an additional tendency to pitch nose down which needs to be compensated for by the pilot. This translates to an anticipation of a larger stick movement requirement (as compared to an A 320) to achieve the flare resulting in desired pitch attitude change.

Two key words for the Flare Technique are: - Stabilisation and Piloting Typically, from Stabilized Conditions:

- Maintain pitch and thrust (if manual thrust) between 100 ft and 50 ft.
- Passing 50 ft, be prepared to manually compensate for the natural pitch down due to the ground effect by suitable back pressure on the stick to maintain the pitch attitude and flightpath.

- Passing 30 ft, backward stick input while reducing thrust levers to idle.

In addition to all the elements of a good flare and landing on A320, the key to a good flare and landing of an A321 NEO lies in anticipation of the pitch down as the aircraft enters Ground effect as well as of Thrust reduction and countering the same with needful stick input.

--Unquote—

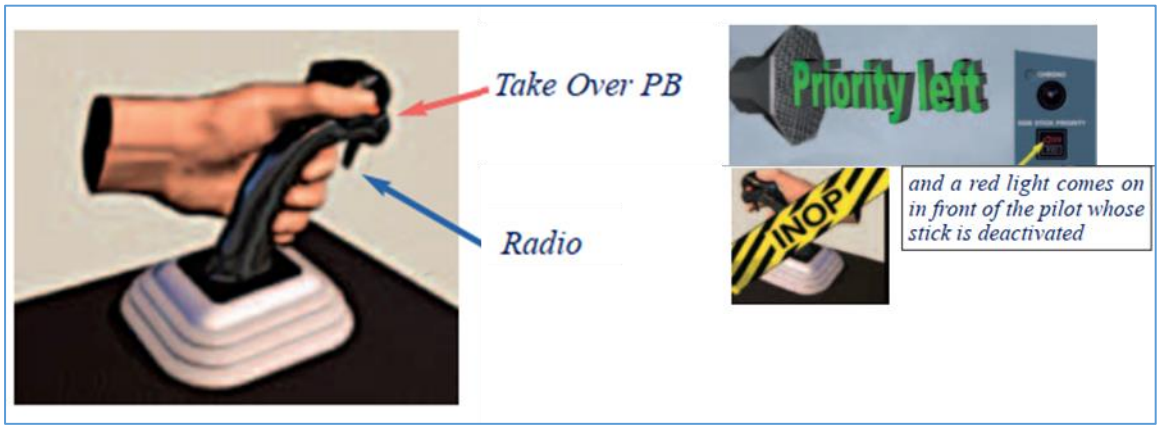
Supervised take-off and landing

The airline has issued NOTAC No: 02BU (dated 13-05-2022) regarding 'Supervised Take-Off and Landing', wherein responsibilities and minimum experience criteria for each crew are detailed. The circular is issued for all pilots of A320 family. The airline did not establish any specific requirements regarding Supervised Takeoff and landing in A321 aircrafts.

1.18. Additional information.

Dual Side Stick Inputs

A 'Safety First Article' published by Frederic COMBES, M/s Airbus wherein types of side stick inputs, operation of side stick and associated warnings and alerts are discussed.



Types:
Spurious – inadvertent small movements by Pilot Monitoring, which will not impact aircraft behaviour.

Comfort – Short interventions by Pilot Monitoring to improve aircraft's attitude or trajectory, this has to be avoided as the Pilot Flying may not be aware and may counteract PM's inputs.
Instinctive - Typically due to a "reflex" action on the part of the PM on the stick. His instinctive reaction may come about when an unexpected event occurs, like for example an AP disengagement, an overspeed situation or a dangerous maneuver.

What Happens when both the Sticks are moved simultaneously: The system adds the signals of both pilots algebraically. The total is limited to the signal that would result from the maximum deflection of a single sidestick.

To avoid both signals being added by the system, a priority P/B is provided on each stick. By pressing this button, a pilot may cancel the inputs of the other pilot. An audio signal will indicate which sidestick has priority

In airline FCTM, same is illustrated "Only one flight crew flies at a time"

1.19. Useful or effective investigation techniques.

Nil

2. ANALYSIS

2.1. Serviceability of the aircraft

As on date of incident, the aircraft had flown 4874:28 Hrs. The certificate of Registration, certificate of Airworthiness and ARC were valid. Last major inspection carried out on the aircraft was '7500 FH/ 24 months'. Subsequently all lower inspections were carried out as and when it was due.
There were no issues observed in the technical log, maintenance. There was no evidence that the aircraft was not maintained or certified in accordance with the current regulations.
The investigation found no evidence of a technical defect having been causal or contributory to the incident.

2.2. Weather

Aircraft experienced downdraft during last 75ft RA, which had led to increase in rate of descent. During flare, tailwind gradient encountered which led to CAS decrease from 148 to 140 kts. Both meteorological conditions had merely reduced the flare effectiveness.
Therefore, meteorological conditions are contributory to the incident.

2.3. Flight Operations

2.3.1. Conduct of flight:

In respect to crew handling of the aircraft, the crew action while in final approach and landing (from 1000 ft RA till touchdown) phases have been analysed.

The airline had given P1 and P2 permission to permit and carry out supervised takeoff and landing, respectively.

At around 500 ft RA both the crew voluntarily disconnected Autopilot and the aircraft was manually flown by P2 with speed target managed during final approach.

Aircraft was in landing configuration with correct lateral and vertical flight path. There was no excessive flight parameter deviation recorded and the final approach can be considered as stabilized.

At around 95 ft RA, P2 applied slight nose down order due to which pitch angle progressively deceased from +2.5^{o} to +1.5 ^{o} and subsequently Rate of Descent starts increasing from 650 ft/min. As per Indigo NOTAC, A321 Neo aircraft experiences ground effect below 50 ft RA and the aircraft starts to pitch down with no action from crew. The NOTAC advice pilots to manually compensate for the natural pitch down of the aircraft, which in this case, was not taken into consideration by the P2. This was not discussed during the inflight briefing by P1 also.

As per wind data, aircraft encountered a vertical gust (downdraft) which led to RoD to continue to increase up to 1000 ft/min prior to flare.

At around -25 ft RA, as per P1, he noticed that the aircraft was sinking, so he gave full nose-up order thereby initiating flare. P1 did not activate take over priority push button nor announced ‘I have controls’, which has to be avoided as per manufacturer and Airline FCTM.

At 15 ft RA, a dual side stick input phase occurred and lasted for approx. 8 seconds while P2 also applied nose up order. At the same time, aircraft encountered tailwind gradient leading to decrease in CAS.

Aircraft touched down with pitch angle of +4^{o}, VRTG recorded was +3.2 G. P1 asked P2 the reason for not pulling up for flare and also told that he had pushed it further down than pulling up. Only after hard landing, P1 is being aware that P2 did not undertake landing in A321 Neo recently.

The energy of the severe hard landing partially restored by shock absorbers caused a light bounce that led to second touchdown at +1.6 G. Dual inputs with opposite sidestick orders occurred during this phase.

2.3.2. Flare and landing technique:

As per aircraft manufacturer, A321 aircraft belongs to A320 family and there no difference in Flare and landing techniques between A320 & A321 aircrafts. The length of A321 aircraft is 6.94m longer than A320. The airline has iterated in their NOTAC dated 01-04-2022 that flare mode of both the variants are different and provides guidance on flare technique in A321. The crew was unaware of the A321's flare mode, and no attention was paid to the landing technique.
From CVR recordings of landing phase, it was observed that P2 did not pull-up (nose-up order) at the right time during landing and flare. Also, he failed to use the correct landing technique, and pitch control.

The conditions mentioned in Flare and landing procedures of FCTM weren't followed:

1. *Flare to be started at ~30 ft RA from stabilized condition with positive (or 'promt') backpressure on sidestick and holding as necessary* – flare started by P1 (instead of P2) at ~25 ft RA which is too Late flare because (a) Approach slope was steeper (compared to nominal 3^o) (b) pitch up order was given by P2 at a very low altitude will, by design doesn't change aircraft trajectory as there is no sufficient time.
2. *Rate of descent (RoD) must be controlled prior to initiation of flare (rate not increasing*) – Even though the RoD has increased due to vertical downdraft, the RoD was not controlled. Also, a high RoD requires early flare.

3. CONCLUSIONS

3.1. Findings

1. The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.
2. There was no evidence of any defect of malfunction in the aircraft that could have contributed to the accident.
3. The mass and centre of gravity of the aircraft were within prescribed limits.
4. The flight crew was properly licenced, medically fit and adequately rested to operate the flight.
5. Weather at landing airport was fine at the time of occurrence.
6. The flight was flown by P2 as Pilot Flying and P1 as Pilot Monitoring, which is in accordance with company procedures.
7. Takeoff, climb, cruise and approach were uneventful.
8. Airline issued a NOTAC in April 2022 states that the A321's flare rule differs from the A320's, and it provides pilots with guidance on the proper landing procedure.
9. At around 95 ft RA, P2 applied slight nose down order due to which pitch angle progressively deceased from $+2.5^o$ to $+1.5^o$ and subsequently Rate of Descent started increasing from 650 ft/min.

10. Aircraft encountered a vertical gust (downdraft) which led to RoD to continue to increase up to 1000 ft/min prior to flare.
11. The flare was to be started by the flying pilot (P2) at a height of roughly 30 feet, but he did not. P1 began the flare at 25 feet RA, however it was too late.
12. At 15 ft RA, a dual side stick input phase occurred and lasted for approx. 8 seconds without activation of Takeover priority pushbutton nor announce 'I have controls'.
13. Aircraft encountered tailwind during flare led to decrease in CAS from 148 to 140 kts.
14. The aircraft made a first touchdown with a high vertical load factor of +3.2G and a bounce landing of +1.6G.
15. This was categorized as severe hard landing by the aircraft manufacturer.
16. There was no injury to any persons on board. There was no smoke/ fire.

3.2. Cause/ Probable Cause:

The late initiation of the flare maneuver by the crew, coupled with the incorrect landing technique (pitch control), resulted in the incident. Weather conditions also contributed to the incident.

4. SAFETY RECOMMENDATIONS

1. Corrective training to both the crew pertaining to finding, as deemed fit by DGCA HQ.

Veeraragavan K
Investigator In-charge: VT-IUM

SYMBOLS AND ABBREVIATIONS

Symbols

° – Degree (Ex: °C (temperature) and 1 ° (angle)

% - Percentage

Abbreviations

AGL – Above Ground Level
ATC – Air Traffic Control
ATS – Air Traffic Services
ARC – Airworthiness Review Certificate
ATPL - Airline Transport Pilot Licence
C – Degrees Celsius
CAS- Calibrated Air Speed
CG – Centre of Gravity
C of A – Certificate of Airworthiness
C or R – Certificate of Registration
CPL - Commercial Pilot Licence
CVR – Cockpit Voice Recorder
DGCA – Director General of Civil Aviation
DFDR – Digital Flight Data Recorder
FCOM – Flight Crew Operations Manual
FCTM – Flight Crew Training Manual
FDAP – Flight Data Analysis Program
FL – Flight Level
ft – foot (feet)
ft/min – Feet per minute
g – Normal Acceleration
h, Hrs – Hour(s)
kg – Kilogram
kt – Knot(s)
ILS – Instrument Landing System
L – Litre(s)
m – metre(s)
MEL – Minimum Equipment List
MET – Meteorological Services
min – Minute(s)
NOTAM – Notice to Airmen
NOTAC – Notice to Air Crew, provided by airline to all the crew.
QAR – Quick Access Recorder
RA – Radio Altitude
TWR – Aerodrome Tower controller
UTC – Coordinated universal time

Appendix – A

CVR Transcript

UTC	From	Transcript
05:16:16	PF	Flap 2 capt.
05:16:23	PM	You want it know? Wait for sometime
05:16:36	PM	Establishing localizer informing ATC
05:16:54	PM	Speed 160 Knots
05:17:50	PF	Will take Landing gear down?
05:17:52	PM	Too early
05:18:01	PM	Will take gear down around 3100 ft
05:18:04	PM	Established on ILS IGO299
05:18:04	ATC	ATC issued landing clearance to IGO 299: wind 200/08 kt, RWY 23 clear to land
05:18:54	PF	Gear down capt., speed managed.
05:19:02	PF	Flaps 3
05:19:09	PM	Flaps 3
05:19:16	PF	Landing checklist complete
05:19:24	PF	I Will use max autopilot until minimum and disconnect
05:19:38	PM	If you want you can disconnect now or 1000 ft, whenever
05:19:51	PM	PM says, 1000 ft stabilized
05:20:35	PF	Disconnect Autopilot
05:21:06	Auto calls	Radio altitude - 50, 40, 30, 20 retard
05:21:12	PM	You dint pull up
05:21:14	PF	NO
05:21:15		Aural warning - Dual input
05:21:19	PM	Why dint you pull up
05:21:20	PF	PF says 'forgot capt.'
05:21:34	ATC	IGO 299, vacate via TXY B, stand No.2
05:21:50	PF	It was a very hard landing
05:21:56	PM	What happened, why did't you flare at all? You pushed it down further instead of pulling up. Its gone be huge
05:22:33	PM	Do you remember the flare for 321? Have you landed in 321 before?
05:22:36	PF	Long time captain