

**FINAL REPORT ON RUNWAY EXCURSION INCIDENT
TO
M/s. INTERGLOBE AVIATION LIMITED AIRBUS A 320 AIRCRAFT,
VT-IFN
ON 12.09.2022 AT AHMEDABAD**

**GOVERNMENT OF INDIA
OFFICE OF DIRECTOR AIR SAFETY (WESTERN REGION)
INTEGRATED OFFICE, NEW AIRPORT COLONY, MUMBAI-400099**

FOREWORD

In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 13(1) of Aircraft (Investigation of Accidents and Incidents), Rules 2012, the sole objective of the investigation of an incident shall be the prevention of accidents and incidents and not apportion blame or liability.

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts, etc., the opportunity was accorded to all the parties to participate during the course of investigation. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.

Content

Description		Page No.	
Aircraft details		1	
Synopsis		2	
1	Factual information	2	
	1.1	History of the Flight	2
	1.2	Injuries to Persons	3
	1.3	Damage to Aircraft	3
	1.4	Other Damage	3
	1.5	Personnel Information	5
	1.6	Aircraft Information	5
	1.7	Meteorological Information	6
	1.8	Aids to Navigation	7
	1.9	Communication	7
	1.10	Aerodrome Information	10
	1.11	Flight Recorders	10
	1.12	Wreckage and Impact Information	13
	1.13	Medical and Pathological Information	15
	1.14	Fire	15
	1.15	Survival Aspects	15
	1.16	Tests and Research	15
	1.17	Organizational & Management Information	15
	1.18	Additional Information	16
	1.19	Useful or Effective Investigation Techniques	19
2	Analysis	19	
3	Conclusions	23	
	3.1	Findings	23
	3.2	Causes	25
4	Safety recommendations	25	

FINAL INVESTIGATION REPORT ON LATERAL RWY EXCURSION TO M/s. INTERGLOBE AVIATION LIMITED, AIRBUS-320 AICRAFT VT-IFN AT SARDAR VALLABHAI PATEL INTERNATIONAL AIRPORT, AHMEDABAD ON 12.09.2022

1.	Aircraft	Type	Airbus 320-232
		Nationality	Indian
		Registration	VT-IFN
2.	Owner	Unicorn Leasing Limited	
3.	Operator	M/s Interglobe Aviation Limited	
4.	Pilot- in- command	ATPL holder	
	Extent of Injuries	NIL	
5.	Co-Pilot	ATPL holder	
	Extent of Injuries	NIL	
6.	Date and Time of Incident	12/09/2022 & 19:14 UTC	
7.	Place of incident	RWY 23, Sardar Vallabhai Patel International Airport, Ahmedabad	
8.	Last point of Departure	Dabolim Airport, Goa	
9.	Point of intended landing	Sardar Vallabhai Patel International Airport, Ahmedabad	
10.	No. of Persons on board	175 (passengers) + 6 (crew)	
	Extent of Injuries	NIL	
11.	Type of operation	Scheduled passenger flight	
12.	Phase of operation	Landing	
13.	Type of incident	Runway Excursion	
14.	Geographical location of site	23°04'38"N 072°38'05"E	

(All times in the report are in UTC unless specified)

SYNOPSIS:

M/s Interglobe Aviation Limited aircraft Airbus 320, VT-IFN, while operating sector Dabolim (VOGO) - Sardar Vallabhai Patel International Airport, Ahmedabad (VAAH), was involved in a Runway excursion, after landing at Sardar Vallabhai Patel International Airport, Ahmedabad on 12.09.2022. The flight was operated by ATPL holder on type as PIC and a ATPL holder on type as Co-Pilot. There were total 181 persons on board including 06 crew.

The aircraft took off from Goa at 17:44 UTC and the flight was uneventful till descent to land at Ahmedabad; during final approach at Ahmedabad, the aircraft was stabilized & Auto Pilot was 'ON' till 620 ft Radio altitude (RA). However the aircraft landed to the right of the center line with right main wheels touching down 22 m right of the center line and skidded further to the right. The No. 04 wheel of right main wheels subsequently departed the RWY surface and entered the soft ground to the right and rolled about 129 m before entering back to the runway. In the process, 04 RWY edge lights got damaged. Further, the crew controlled the aircraft to bring back to the center line and was taxied to parking bay safely.

The DGCA instituted investigation by appointing Investigator-In-Charge under Rule 13(1) of Aircraft (Investigation of Accident and Incidents) Rules, 2017.

Failure to manage the aircraft lateral and longitudinal path due to improper flare technique when encountered with sudden rains/down pour along with gusty cross winds was the probable cause of the incident.

1. FACTUAL INFORMATION

1.1. History of the Flight

M/s Indigo, A-320 aircraft registration VT-IFN was operating flight 6E-6023 of 12.09.2022 in sector Goa–Ahmedabad and was involved in a Runway excursion incident on landing at Sardar Vallabhai Patel International Airport, Ahmedabad on 12.09.2022 (19:14 UTC). The flight was operated by ATPL holder on type as PIC and ATPL holder on type as Co-Pilot. There were total 181 persons on board including 06 crews.

The aircraft took-off from Goa at 17:44 UTC. The flight was uneventful during cruise from Goa to Ahmedabad. After arriving over Ahmedabad, the aircraft made an approach for landing at Ahmedabad runway 23 and it was cleared to land at 19:11 UTC by ATC. As informed by Ahmedabad ATC, the wind direction was 220⁰ and wind speed was 04 kt. The wind speed was within permissible limit of 'crosswind' for landing.

As informed by ATC, Initially it was heavy raining from approach path till turn pad only and over the surface of airfield was dry. However at 19:09 UTC, the ATC had informed aircraft that it was raining over the airfield. Also as per special METAR issued on 19:10 UTC, the visibility had reduced to 3500 m as against visibility of 4000 m METAR issued at 19:00 UTC.

The aircraft touched down at 19:13:44 UTC at a ground speed of 131 kt. After touchdown (at 538 m from runway threshold), the aircraft rolled towards right edge of the runway 23 and continued its roll along shoulder of the runway and damaged 04 runway edge lights. Immediately on touchdown, while rolling along the shoulder of the runway spoilers were out followed by 'reverse thrust' being deployed. The pilot realized that the aircraft had reached near the right edge of the runway and he maneuvered the aircraft back on runway center line. In the process, the aircraft had crossed the runway center line and went to left in attempt to correct using rudder application. Further the aircraft was brought to the centerline using appropriate rudder application. After completing the landing roll, the aircraft vacated runway via taxiway B. Further the pilot informed ATC that some runway edge lights were suspected to be damaged and the same be inspected. The occurrence was informed to regulatory authority by the operator and the ATC,

Ahmedabad. The aircraft taxied to its allocated bay no. 13 L and got parked. All passengers, flight crew and cabin crew disembarked from the aircraft safely.

1.2. Injuries to persons

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
NONE	2+ 4	175	Nil

1.3. Damage to aircraft

- 02 dents observed on RH inboard flap trailing edge, same within AMM limit (figure 1).
- Observed multiple cuts on #2 nose wheel assembly, however damage within AMM limit (figure 2).
- 02 dents observed in belly area, same within AMM limit (figure 3).



Figure 1



Figure 2



Figure 3

1.4. Other damage

After touch down at Ahmedabad Runway (RWY) 23, the aircraft veered off to right side of the runway. The aircraft starboard wheels touched down at 538 m from threshold, rolled through the area between the runway edge line and the paved surface for approximately 140 meters along the runway shoulder. After 678 m from runway threshold the right main wheel No.04 had exited the runway shoulder to the unpaved surface (kutchra) and rolled for 129 meters before entering back to the paved surface of runway. It is at this

time simultaneously the Nose wheel went over the runway edge lights and damaged 04 runway edge lights(refer figure 4) B44,A 44, B43 and A43. (Refer figure 5, 6, 7 & 8).

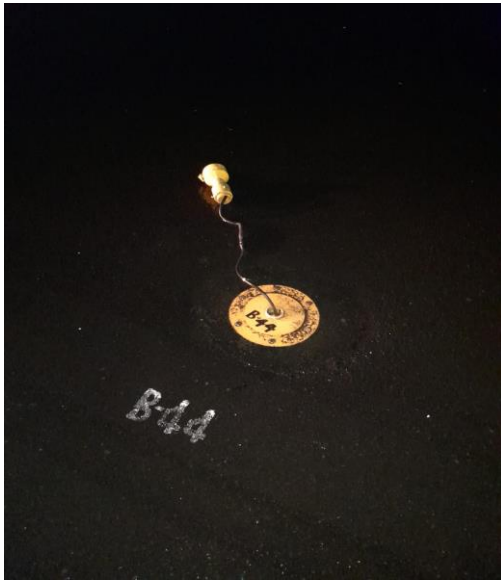
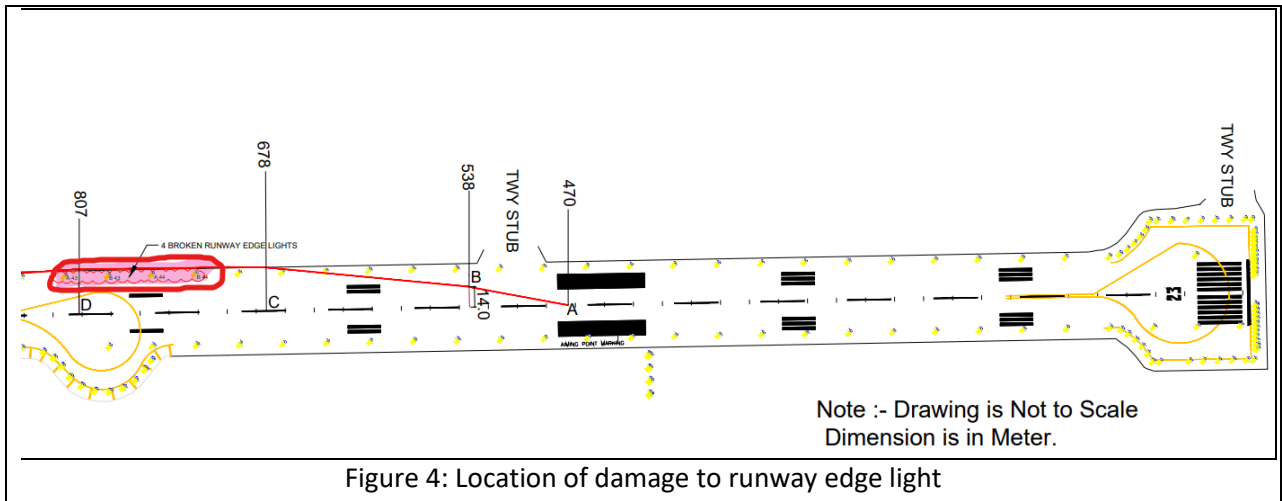


Figure 5



Figure 6



Figure 7



Figure 8

1.5. Personnel information

Crew information		
Details	PIC	FO
Age(as on date of incident)	34	37
Licence	ATPL	ATPL
Validity	24/02/2027	21/12/2026
Category	Aeroplane	Aeroplane
Date of Medical Examination	14/08/2022	19/07/2022
Validity of Medical	13/08/2023	23/07/2023
Endorsement as PIC	17/09/2018	NA
Experience as PIC on type	A320-1782:12, A321-265:52	NA
Experience on type	A320-3390:41, A321-265:52	A320-2264:15, A321-109:15
Total flying experience	5515:58	2688:38
Flying experience in last 24 hrs	06:57	02:33
Flying experience in last 7 days	30:04	14:05
Flying experience in last 30 days	65:07	84:18
Flying experience in last 365 days	579:30	529:43
Rest period before incident flight	22:31	25:04

As on the date of incident both crew has the following current ratings/validity.

CAPT

- a. IR/LR valid till – (IR- 21/05/2023), (LR- 15/08/2023)
- b. Refresher valid till – (Includes CRM) (21/02/2023)
- c. DGR- valid till ----- (17/11/2023)
- d. AVSEC – valid till ----- (19/10/2022)
- e. Monsoon rating- -----cleared
- f. SEP – valid till ----- (29/11/2024)
- g. Valid Supervised take-off/Landing approval – YES
- h. RTR- valid till – -----(30/05/2068)
- i. FRTO- valid till – ----- (06/03/2024)

FO-

- a. IR/LR valid till ----- (IR-20/05/2023), (LR-12/07/2023)
- b. Refresher valid till – ----- (Includes CRM)(17/10/2022)
- c. DGR- valid till ----- (21/12/2023)
- d. AVSEC – valid till ----- (03/12/2023)
- e. Monsoon rating- ----- cleared
- f. SEP – valid till ----- (06/01/2024)
- g. Valid Supervised take-off/Landing approval – YES
- h. RTR- valid till – ----- (11/02/2065)
- i. FRTO- valid till – ----- (22/05/2027)

1.6. Aircraft information

Aircraft manufacturer	Airbus
MSN serial number	5577
Aircraft Type	A-320
Aircraft registration	VT-IFN
Year of manufacturer:	2013
Certificate of registration	6530/2
Category C of A	Normal
Last certificate of Airworthiness date	09.02.2018

The highest inspection schedule on this aircraft with its completion date	5C check on 29/03/2022
When the Highest inspection schedule was carried out and at what FH/FC	28076:35 FH/ 17479 FC
MEL history	Nil at time of incident
Aircraft empty weight	41118.700 Kg
Maximum Take-off weight	77000 Kg
Maximum Landing weight	66000 Kg
Total fuel capacity	19052 Kg
Maximum All up weight	73000 Kg
Date of Aircraft weighment	06.04.2022
Next weighing due	17.03.2027
Maximum operating altitude	41000 Ft
Aircraft length	123 Ft 3 Inch
Wing span	117 Ft 5 Inch
Height of the aircraft	38 Ft 7 Inch
Engine ground clearance distance	2 Ft 2 Inch
The distance between main wheel center	24 Ft 11 Inch
Aircraft hours (since new) till date of incident	28436:26 FH
Engine hours (since new) till date of incident	(LH Engine: 26560 Hrs. RH Engine: 26940 Hrs)
Engines Two	(LH Engine PN: 4W5198, RH Engine PN: 4W5198)
Passenger capacity	180

There had not been snag/defect persisted prior or during the flight. No fault codes were obtained from the CMC. No MEL was active for this flight. The AME had carried out the pre-flight inspection at Goa and had released the aircraft for further service.

Post-occurrence at Ahmedabad, crew had made an entry w.r.t drifting to left and suspected runway edge light being damaged. The PFR did not show any warning or failure messages. Also the test reports and ground scanning reports on BSCU, LRU wiring showed satisfactory the detailed visual inspection of NLG and MLG area was carried out followed by the inspection and check of adjacent areas for damage. Thereafter, the condition of wheel, brakes and tires were checked. General visual inspection of all control surfaces were carried. There were no major structural damages and the damages were within the allowable limits. As precautionary measures, the No.2 NLG wheel was changed. The aircraft was released for further flight.

1.7. Meteorological information

The following were the METAR reports issued:

Time	Wind Direction and Speed	Visibility	Weather	Trend	Temp and Dew Point	Cloud	QNH (hPa)
1900 (METAR)	090 deg at 05KT	4000	BR TS	TEMPO 3000 TSRA	28/27	FEW015 SCT020 FEW030CB BKN080	1002
1910 (SPECI)	230 deg at 05KT	3500	RA	TEMPO 3000 TSRA	28/26	SCT012 SCT018 FEW030CB OVC080	1001
1930 (METAR)	230 deg at 05KT	3000	RA	TEMPO 2000 TSRA=	27/26	SCT012 SCT018 FEW030CB OVC080	1001

As per METAR Report of Ahmedabad ATC prepared at 19:00 UTC on 12th September 2022, the weather forecast was that the Wind was 05 kt in the direction of 90 deg. Cloud coverage was few at 1500ft and 3000ft (cumulonimbus), scattered at 2000ft and broken at 8000ft. Visibility was 4000 m with temporary visibility 3000m in TSRA(thunderstorm with moderate rain) with weather mentioning Mist and thunderstorm.

However at 1910 UTC, there was a special METAR, predicting wind as 05 kt in direction 230 deg. Cloud coverage was scattered at 1200 ft to 1800 ft and 3000ft (cumulonimbus), and overcast at 8000ft. Visibility 3500 m, temporary visibility of 3000 m in TSRA, weather moderate rain. This was informed at 1912 UTC with intensity of rain mentioned as heavy raining to another Indigo aircraft (training aircraft) which was in preparation for take-off. The Approach controller had informed the training aircraft as the respective crew had requested the latest visibility and current weather status.

However the aforesaid was not informed to the incident aircraft in specific as there were no significant changes in weather other than the intensity of raining as moderate over the field which was informed to the incident aircraft at 1909 UTC and the actual wind conditions informed to incident aircraft at 1912 UTC as 220 deg and 4 kts and actual intensity of rains were visually identified as heavy rains over airfield by ATC controller & were informed in the approach frequency.

As per METAR Report of Ahmedabad ATC prepared at 19:30 UTC on 12th September 2022, weather forecast was predicted that the Wind was 05 kt in the direction of 230 deg. Visibility was 3000 m with temporary visibility 2000 m in TSRA with weather mentioning moderate rain.

At short final(from AP disengaged at 620 ft till 50 ft, the wind parameters obtained from the FDR indicates gradual directional change ranging from 250 deg to 220 deg and average strength of 5-7 knots. Just prior to touch down from 36 ft till touch down, the winds were abruptly changing direction from 220 deg to 149 deg with the strength ranging from 5 kts to 19 kts.

1.8. Aids to Navigation

The Ahmedabad airport is equipped with Cat-I ILS (for RWY 23), DVOR, DME and NDB. All the nav-aids were found to be serviceable at the time of occurrence.

1.9. Communication

Relevant ATC transcript, Intercom transcript from 1900 UTC till 1924 UTC

Unit: - TWR Frequency: - 119.6 Readability: - 4 Date: - 12.09.2022

Time	Transmission
19:00:00	IGO8005 TOWER, ROGER
	*READY TO COPY
	IGO8005 TOWER CONFIRM ROUTING VIA RKT THEN BVR THEN BACK TO AAE
	*AFFIRM SIR WE REQUEST 15 TOUCH AND GO
	15 TOUCH AND GO CONFIRM AFTER COMING BACK FROM BVR
	*NEGATIVE SIR ITS ONLY TOUCH AND GO
	IGO8005 ROGER, CLEARANCE AT TIME OF TAXING
	*ROGER.
19:01:35	OP JEEP 1 VACATE VIA FIRE APPROACH ROAD, EXPEDITE
19:01:39	*EXPEDITING, WE WILL VACATE VIA FIRE APPROACH ROAD OP JEEP 1
19:02:23	*TWR IGO7079 ESTABLISHED LOCALIZER RWY 23
16:02:27	IGO7079 TWR CONTINUE APP RWY 23 WIND CALM
19:02:30	*CONTINUE APP RWY 23 WINDS CALM IGO7079
19:02:50	*CONFIRM RAINING OVER THE FIELD IGO7079
19:02:55	IGO7079 NEGATIVE
19:02:56	*COPIED

19:03:12	*TWR OP JEEP 1, RWY VACATED VIA FIRE APP ROAD, WE ARE HOLDING AT FIRE APPROACH , RWY FOUND FIT FOR OPERATION
19:03:21	OP JEEP 1 TWR ROGER
19:03:23	IGO7079 TWR QNH 1002, RWY 23 CLEAR TO LAND WIND CALM
19:03:28	*QNH 1002 RWY 23 CLEAR TO LAND WINDS CALM IGO7079
19:04:32	OP JEEP 1 TWR CONFIRM RWY SURFACE CONDITION DRY
19:04:36	*AFFIRM RWY SURFACE DRY
19:05:10	WIND 180 DEGREES 08 KNOTS
19:05:15	*COPIED
19:07:20	*TWR IGO7079 CONFIRM VACATION
19:07:26	IGO7079 VACATE VIA ALPHA, TAXI VIA L3 L9 STAND 21
19:07:32	*VACATE VIA ALPHA FURTHER TAXI VIA L3 L9 STAND 21 AND SIR ON THE APPROACH PATH TILL TURN PAD ITS HEAVY RAIN AND THEN ITS DRY
19:07:47	IGO7079 ROGER, THANK YOU
19:11	*TOWER IGO8005
	IGO8005 TOWER STANDBY
	IGO6023 TOWER
	*TOWER NAMASKAR IGO6023
	IGO6023 TOWER RUNWAY23 CLEARED TO LAND WIND 220 DEGREE 4KNOTS
	*CLEAR TO LAND IGO6023
	*SIR IN CASE OF GO AROUND WILL TAKE HEADING 250 IGO6023
	IGO6023 TOWER ROGER
19:12	IGO8005 TOWER
	*REQUEST LATEST VISIBILITY
	IGO8005 TOWER HEAVY RAINING OVER THE FIELD CURRENT VISIBILITY 3500M TEMPO VISIBILITY 3000M IN THUNDERSTORM WITH RAIN
	*COPIED IGO8005
19:14	*TOWER IGO6023
	IGO6023 TOWER
	*SIR WE HAVE LANDED BUT WE MIGHT HAVE DAMAGED RIGHT EDGE LIGHTS RUNWAY23 SIR DUE TO HEAVY RAIN AND VISIBILITY DROPPING CONSIDERABLY
	IGO6023 TOWER ROGER
	IGO6023 TOWER CONFIRM ABLE TO VACATE RUNWAY
	*AFFIRM SIR IGO6023
	OPERATION JEEP1 TOWER
	*TOWER OPERATION JEEP1
	OPERATION JEEP1 TOWER REPORT AT FIRE APPROACH ROAD
	*REPORT AT FIRE APPROACH ROAD OPERATION JEEP1
	IGO6023 VACATE RUNWAY VIA TAXIWAY A
	*VACATE VIA A IGO6023
19:16	OPERATION JEEP1 TOWER REPORT POSITION
	*APPROACHING FIRE APPROACH ROAD IN 02 MIN.
	ROGER
19:17	*TOWER OPS JEEP1 REQUEST TO ENTER RUNWAY VIA FIRE APPROACH

	ROAD
	CONFIRM OPS JEEP1
	*AFFIRM
	OPERATION JEEP1 TOWER ENTER RUNWAY23 VIA FIRE APPROACH ROAD TOWARDS 23 BEGINNING AND CHECK FOR ANY DAMAGED EDGE LIGHTS AT THE RIGHT SIDE OF RUNWAY NEAR TOUCHDOWN.
	*ROGER CLEAR TO ENTER VIA FIRE APPROACH ROAD AND PROCEED TOWARDS 23 BEGINNING.
	*BREAK BREAK CONFIRM VACATION RIGHT ON "B" IGO6023
	IGO6023 ROGER VACATE VIA B
	*BAY NUMBER FOR IGO6023
	IGO6023 TOWER STAND 13L
	*TURNING RIGHT ON B FOR VACATION IGO6023
	IGO6023 TOWER TAXI VIA B L4 L9 STAND 13L
	*STANDBY FOR FURTHER TAXI IGO6023, CONFIRM TAXI VIA L4 L9 BAY 13L IGO6023
	IGO6023 TOWER AFFIRM AND CONFIRM ALL OPS NORMAL
	* AFFIRM IGO6023 VTIFN
	ROGER
19:21	*CONFIRM OUR BAY IS 13L IGO6023
	IGO6023 TOWER AFFIRM 13L.
	*TOWER OPERATION JEEP1
	OPERATION JEEP1 TOWER
	*4 LIGHTS BROKEN AND AIRCRAFT LANDED ON COUNTERSIDE ON THE RUNWAY
	OPERATION JEEP TOWER ROGER AND HOW MANY LIGHTS ARE BROKEN
	*TOWER OPERATION JEEP1 TOTAL 04

INTERCOM	
19:08:00	RAIN IN APP PATH TILL ... (TWR TO APP)
19:08:02	IGO6023 TURN RIGHT HEADING 120 (APP)
19:08:04	TILL? (APP TO TWR)
19:08:06	TILL TURN PAD ITS RAINING SIR (TWR TO APP)
19:08:07	OK (APP TO TWR)
APP FREQUENCY 119.8	
19:08:21	IGO6023 TURN RIGHT HEADING 130
19:08:24	*RIGHT HEADING 130 IGO6023
19:08:29	IGO6023 FOR INFORMATION IN APP PATH, ITS RAINING, APPROACH PATH TILL TOUCH DOWN HOWEVER RWY SURFACE IS DRY
19:08:39	*ROGER SIR THANK YOU SO MUCH IGO6023
INTERCOM	
19:08:48	NOW..NOW RAINING OVER THE FIELD (TWR TO APP)
19:08:50	OK (APP TO TWR)
APP FREQUENCY 119.8	
19:09:02	IGO6023 NOW ITS RAINING OVER THE FIELD
19:09:05	*ROGER IGO6023

19:09:15	IGO6023 TURN RIGHT HEADING 195 CLEARED FOR ILS APP RWY 23
19:09:20	*195, CLEARED FOR ILS APP RWY 23 IGO6023
19:10:42	*ON LOCALIZER IGO6023
19:10:45	IGO6023 ROGER, POSITION SEVEN MILES FROM TOUCH DOWN, CONTACT TWR 119.6 HAPPY LANDING SIR
19:10:51	*119.6 THANK YOU SIR, AMAZING HAVE A GREAT NIGHT IGO6023
19:10:56	THNAK YOU SIR
19:10:57	*IN CASE OF GO AROUND, WE WILL BE TURNING RIGHT HEADING 250, WILL ADVISE TWR AS WELL IGO6023
19:11:03	ROGER SIR MONITORED

*Transmission by pilot or ops jeep

Transmission in **bold** are by controller

Two-way communication existed between the aircraft and ATC. No read back or hear back errors were observed. Latest ATIS information was also available with the crew. On the day of occurrence, all ATC communication systems, including the hotline and intercom, were found to be serviceable.

1.10. Aerodrome information

Ahmedabad airport is maintained and operated by the Airports Authority of India. It has one runway, orientation 05/23. At the time of incident, RWY 23 was in use.

The runway has a dimension of 3505 m x 150 m. The runway magnetic orientation (QFU) of RWY 23 is 246 deg.

As per Runway inspection report, inspection carried out on 12.09.2022 at (entry time 18:58 UTC and exit time 19:04 UTC), all approach, end, edge lights were in serviceable condition and runway was dry. Post-occurrence, the surface condition was marked as 'Wet'.

The previous Runway friction test was carried out on 07.09.2022 which was within limits.

1.11. Flight recorders

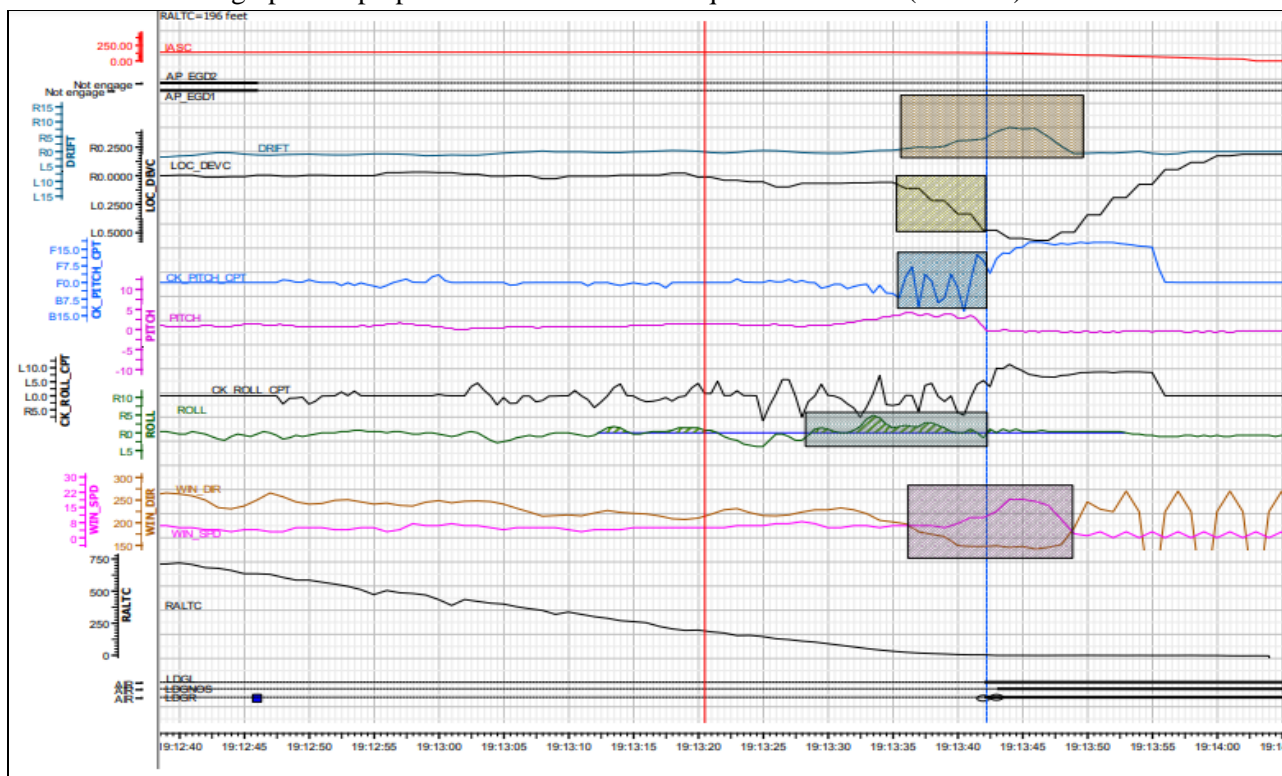
1.11.1 DFDR

- The aircraft lifted off from Mumbai at 17:44:07UTC
- Aircraft was carrying out ILS approach for RWY 23 at AMD. At approx. 1500ft RA, aircraft was fully configured with gear down and winds were approx. 270/8 kts
- The PIC (LHS was flying) was in controls and First officer(RHS was pilot monitoring) during landing.
- The aircraft was stabilized by 1000 ft.
- The longitudinal and lateral wind evolutions highlighted: Between 1000ft RA (19:12:19 UTC) and 200ft RA (19:13:21 UTC), the average wind recorded by the FDR came from 247° at 5kt:
 - Headwind component varied between ~0kt and ~5kt.
 - Mean crosswind component reversed from around -5kt (right) to around +2kt (left).
- The autopilot was disengaged at Rad Alt 620 ft at 19:12:48 UTC.
- The winds were observed to be gusty from 620 ft till 50 ft with average strength ranging 05-07 kts and direction changing from 250 deg to 220 deg Further from 50 ft to touch down, the wind direction and strength is seen abruptly changing from 174 deg and reduces to 149 deg on touch down when the winds have increased to 13 kts. So it is evident that, in the last ~50 ft, a left crosswind increase was encountered by the aircraft.
- Selected and calculated approach speed was 140 knots. The aircraft was flown on Managed speed mode from time 19:09:56 UTC to 19:18:06 UTC (short finals on approach) as observed from Auto speed control parameter depicted as "Auto" .

- At ~90 ft RA, pitch inputs are observed as Nose up orders. Passing ~36 Ft at 19:13:35 UTC, initiation of slight right roll is observed followed by right roll input of approx. 5.32 units on the side stick at 19:13:36 UTC, which led to aircraft banking with right wing down of approximately 4.9 deg as observed from the very next second. A left rudder pedal input is also observed. The aircraft had been aligned to runway orientation center line until 19:13:37 UTC (32 ft RA)(Localizer indication -0.0098 DDM). Simultaneously, the pitch inputs seem to be varying/vibrant from Nose up and Nose down several times, thereby showing signs of floating very close to the ground (ranging from 1.08 to 0.89 G for 06 seconds) even when RA shows -ve value. Even the wheel speeds are showing value “0”.
- It is observed that the Pitch angle increased from +1° to +4° then stabilized around +3.5° (nose-up) and Rate of descent decreased from ~750ft/min to ~300ft/min before stabilizing around 200ft/min and the flight path angle decreased from -3° to -1°.
- The flare mode is observed to be activated from about 20 ft at 19:13:38 UTC .Also thrust levers were retarded to the IDLE detent leading to A/THR disconnection. CAS decreased from 142kt (speed target+2kt) to 133kt (VLS+3kt). Localizer indication becomes -0.0152 DDM from -0.0098DDM depicting that the aircraft had started moving towards the right of the centerline (Localizer indication showing “-ve” value means localizer indication is to the left or Aircraft is to the right of the localizer).
- The aircraft is seen continuously drifting towards right from the time right roll input is given till touchdown (time 19:13:38 UTC to 19:13:45 UTC). This action led the drift angle to increase from +4° to +14° (aircraft nose toward the left of the track).The aircraft initially did floating with heading 224.6 deg and after 06 seconds did the firm landing with heading of 217 deg as there was abrupt and sudden application of rudder to the left prior to touch down.
- The aircraft touched down with Main Landing gears registered compressed and wheel speeds also registered at 19:13:45 UTC with ground speed 131 kts, 1.34 G and subsequently in next second the Nose landing gear also registering compressed. The pitch input is also seen to be firm Nose down value reaching to 18 deg of control stick for about 14 seconds. Localizer value is recorded as -0.0457 DDM which has been 22 m laterally right to centerline.(also verified to be correct during the site visit as measured from right MLG wheel). During touch down, the crosswind was maximum 13 knots with wind direction 149.1 deg. The strength of the winds started increasing from 05 kts to 19 kts and back to 07 kts from 19:13:40 UTC till 19:13:49 UTC due to artificial increasing crosswind trend which is observed due to the sudden commanded yaw dynamics of the aircraft. Therefore the crosswind trend is thus not valid anymore when left rudder pedal orders started to be applied, from ~14 ft RA. Hence an actual crosswind from left to right with strength ranging from only 5-7 kt was prevalent.
- Nose down input along with left roll input on the side stick was observed after touchdown.
- Effective Left rudder application is observed from 19:13:40 UTC till 19:13:48 UTC, almost reaching highest value of left rudder pedal deflection of 15.2 units (Max deflection=21 units) which changed the heading from 225 Deg. To 215 Deg. From 19:13:49 to 19:13:57 UTC, there is no effective rudder application observed and the heading becomes 222 Deg from 215 Deg. Further right rudder application is observed from 19:13:57 UTC to 19:14:05 UTC to about rudder pedal deflection about 13 units wherein heading is maintained at 223 Deg.
- Localizer indication reaches a maximum of -0.492 DDM which means it has gone a little further right after touch down (right MLG wheel measured to be 26 m from center line)
- The wheel speed and aircraft ground speed data did not indicate any presence of aqua planning.
- Anti-skid protector was ON mode during landing.
- The spoilers were immediately out after the touchdown. Simultaneously the brakes application is also observed. After 02 seconds of touchdown, the maximum reverse thrust is observed for ~18 seconds and left roll order up to full deflection for ~14s.
- The medium auto braking and rudder pedal were used to control the aircraft and bring back to center line.
- Then aircraft is seen moving towards the left of runway centerline and then after rolling for some time towards the left(reached a maximum of 14 m as measured from right MLG wheel during site visit), seen moving towards the right and thereby aligning with the centerline.
- Further after some time the aircraft has taxied back to bay which is on right side of the RWY 23. DFDR raw data of the flight was replayed using software. Replay of DFDR data shows that

during approach the aircraft was aligned with the runway centerline till it was 20 feet approx. Below 20 feet, it began to drift towards right from the runway centerline and touched down near the ‘Aiming Point’ marking on the right side of centerline. After touchdown the aircraft rolled obliquely towards runway edge on the right side and rolled on the shoulder of the runway. Thereafter, the aircraft rolled towards centerline, crossed centerline and rolled on left side of centerline for some time. Further the aircraft has aligned back to the centerline.

Also a graph was prepared to understand the sequence of events (5 events):



As observed from the highlighted areas, there is a significant right roll (event 1) observed prior to the flare at 19:13:35 UTC .Further during the initiation of flare at 19:13:38 UTC, 4 events are observed simultaneously, i.e, the winds start to abruptly change directions with increasing strength(event 2),Nose up and nose down pitch is seen applied 3 times(event 3), Localizer indication shows aircraft moving to right of runway centerline(event 4) and aircraft drifting towards right of runway centerline(event 5) . From the above it is evident that there was a right roll input given which has resulted in the aircraft drifting towards the right after 3 seconds, also confirmed by the localizer indication inputs. It is simultaneously that the gusty cross winds from left starts changing direction with increasing strength and the nose up and down pitch inputs are observed. This continues till touchdown and subsequent 4 seconds after touch down.

1.11.2 CVR

During this flight, the PIC was the Pilot Flying and FO was the Pilot Monitoring. Salient observations from CVR readout is tabulated below:

Relative Time	Observation
01:14:00	Arrival ATIS is heard. Visibility of 4000m and QNH 1001. During descend, crew was heard informing the ATC about weather to the right and requested for vectors from the north for ILS RWY 23
01:28:00	Heading was requested passing AH410 and ATC was requested to confirm if raining over the airfield.
01:29:00	Cabin crew is called and advised to secure the cabin. 01:31:00 onwards, Crew is heard requesting heading of 320 due weather on the right and confirms if raining over the airfield. ATC replies “Lightning Only”

01:37:00	Crew is discussing regarding weather on approach, a call of “I have controls, due rain” was heard.
01:40:00	ATC issues heading, but crew is unable to accept and requests to maintain heading for another 20 NM.
01:42:00	Wind shear actions were heard to be reviewed before transition level.
01:46:00	Radio altitude of 2500 is heard, flaps 1 call was heard followed by ATC “IFLY 6023, for info raining on approach till touchdown. However, RWY surface is dry.
01:47:00	ATC “Now, it’s raining over the field” followed by vectors to intercept the approach. Localizer was intercepted, flaps 2 call was heard followed by a discussion on changing the landing configuration to flaps full and selecting Medium auto brakes. V Pilot speed was heard to be increased by 4-5 Kts.
01:48:30	Crew informed radar controller just before changing over to tower frequency that if in case of go around, they will be turning right heading 250 due to weather. Same was also informed on tower frequency.
01:50:05	ATC reported to another aircraft, heavy rain with visibility of 3500m and TEMPO 3000 is thundershower rain.
01:50:15- 01:50:30	A call of 1000ft stabilized was heard. "Be ready for Go-around, review wind shear actions in your mind" was heard thereafter.
01:50:45	A/P was disconnected.
01:51:16	Minimum call and "continue" was heard
01:51:31- 01:51:34	50 ft, 40 ft,30 ft, 20 ft call out heard
01:51:35- 01:51:42	Retard was heard which was followed by multiple "Go left" calls
01:51:43	Touchdown with drag sound heard.
01:52:17- 01:52:32	The following was heard, We have landed but might have damaged right edge lights RWY 23 due heavy rain and visibility dropping considerably.
01:56:40	ATC confirmed all ops normal which was replied is positive and A/C parked thereafter

It is understood that from above that the crew were being updated on the current significant weather conditions including that it is raining over the field, about 4 minutes prior to touch down. The PIC was also heard briefing the First officer of a possible Go around situation and preparations. The same had been informed to ATC. After retard callout(just after 20 ft auto callout, continuous First officer “Go Left” callouts were heard for 7 seconds for correction depicting that the aircraft had started to drift towards the right side of Runway centerline. After sometime of touchdown, the crew informed the ATC that some runway edge lights have been damaged.

CVR –DFDR correlations were used keeping Auto pilot disengagement as reference point to determine the initiation of flare at about 36 ft along with right roll inputs resulting the aircraft floating for about 7 seconds prior to touch down. The radio altitudes has also been corrected by correlating the A-SMGCS data with the altitude auto callouts and time (Refer fig 12 under useful and effective investigation techniques)

1.12. Wreckage and impact information

During site visit on 12th September 2022, the following were observed:

- On 12.09.2022, the aircraft touchdown at RWY 23 of Ahmedabad Airport and tyre Markings and 04 runway light damages were observed and their measurements are with the reference to RWY 23 threshold. Total landing distance available at RWY 23 was 3505m.



Fig 9



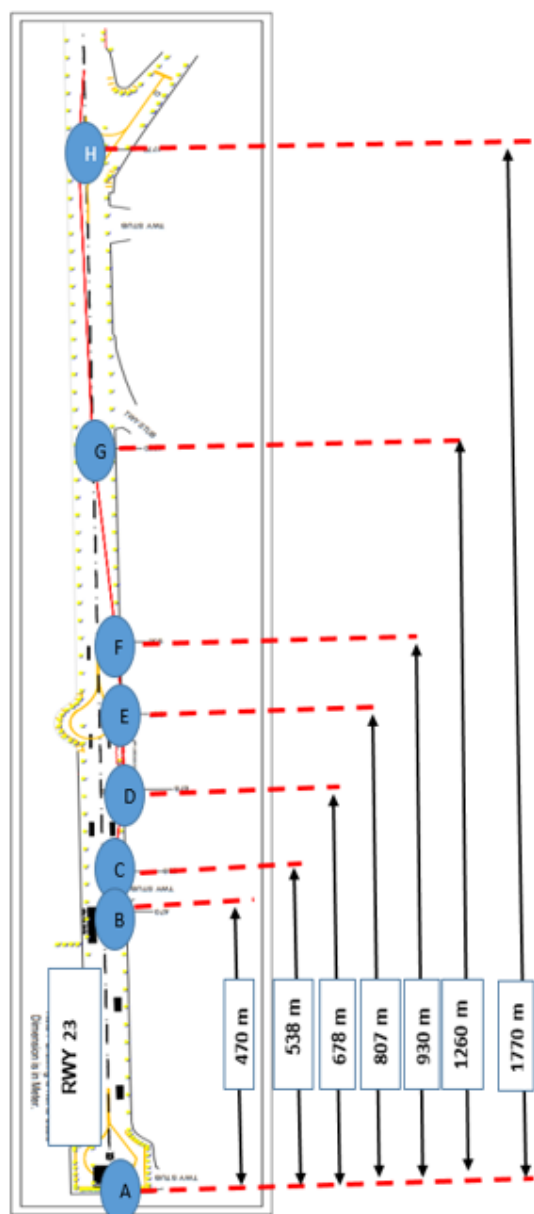
fig 10



Fig 11

- The aircraft touched down at the right side of the RWY 23 beyond Aiming point (400m) and just before touch down zone 2 (600m) as its Starboard wheel tyre first marking started seeing approximately 538 m from RWY 23 threshold and 22 m laterally away from runway centerline, where the tyre is first crossing the runway edge line and rolled exactly over the runway edge light A 47 without damaging the light. (refer fig 9)
- Further, VT-IFN Starboard Wheel right tyre marking veering towards the unpaved surface and at 678 m from Runway threshold, the right wheel No.04 of starboard Main landing gear enters the unpaved surface (kutcha) (refer fig 11) and rolls till 807 m from threshold before entering back to paved surface of runway.
- Simultaneously, the adjacent 4 edge RWY lights (B44, A44, B43, A43) had been damaged by the Nose landing gear wheels going over.
- VT-IFN right main wheel after entering into the paved surface rolls over the B 40 edge light towards the center line of the runway (refer fig 10).
- Further, VT-IFN starboard wheel tyre crossed center line at 1260 m from threshold and rolls to left side wherein right main wheel tyre marks are observed to 10 m from centerline and then rolling back towards centerline. Further the aircraft rolled forward & vacated runway via taxiway B.

Illustration of the entire track followed by the aircraft on runway



H- 1770 m from threshold is the point where the right main wheel are observed reaching to a maximum of 10 m left side of the runway centre line. Further the aircraft has come back to the centre line.
G- 1260 m from threshold is the point where the Right main wheel are observed crossing over the runway centre line.
F- 930 m from the threshold is the point where and Right Main wheel tyre marks observed rolling over the RWY edge light B40 without damaging and moving towards centre line.
E- 807 m from threshold is the point where the aircraft right main wheel no.4 enters back to the paved surface. Meanwhile, when the aircraft right Main wheel rolled between Point D and Point E, the Nose wheel has broken the Runway edge lights B 44, A 44, B 43, A 43.
D- 678 m from threshold is the point where the aircraft right main wheel no. 4 has exited the paved surface
C- 538 m from threshold is the point where the aircraft touch down is registered(Landing gear compressed) and Right Main wheel tyre marks observed(22 m lateral distance from centre line) which subsequently rolls over the RWY edge light A 47 without damaging.
B- 470 m from threshold is the point wherein the aircraft has started floating very close to runway surface and RA is shown as "-ve" value in DFDR.
A- Runway 23 threshold of Ahmedabad Airport (Reference for all measurements)

1.13. Medical and pathological information

Both the crew had had given the declaration w.r.t. non-consumption of alcohol as per the DGCA order in force.

1.14. Fire

Not Applicable

1.15. Survival aspects

Not Applicable

1.16. Tests and Research

Not Applicable

1.17. Organizational & Management Information

Inter Globe Aviation Ltd (Indigo) is an Indian schedule airline headquartered in Gurgaon, Haryana, India. As on April 2022, it has a fleet of 282 aircraft including 140 new generation

A320 NEOs, 56 A320 CEOs, 35 ATRs and 51 A321 NEO. IndiGo has a total destination count of 95 with 71 domestic destinations and 24 International.

1.18. Additional information

1.18.1 Excerpts from statements of both the Crew:

As per the crew, Pilot-in-Command (PIC) was the Pilot Flying (PF) and First Officer was Pilot monitoring while doing Ahmedabad-Goa-Ahmedabad sector. During first sector they noticed weather build up around AMD and so they had catered for extra fuel due weather enroute, around Ahmedabad and planned for Indore as alternate. During descent and final approach into Ahmedabad, runway was very much in sight. However, bad weather was observed around airfield especially with intensity of rains picking up when approaching close to the ground. Approach Radar also had reported runway surface dry but Rain over Approach of Runway 23. So, for the wet runway requirement, the crew planned for Full Flaps, Auto Brake Medium and Max reverser to be used after landing for deceleration. The App Radar as well as Tower were informed that in case of go around, they would take heading 250 degree which is right of runway heading due weather. The aircraft was stabilized at around 1500'. As it was raining on approach path, wipers were selected to maximum. Runway was spotted around 5 NM and so the approach was continued. Tower gave landing clearance with winds 220⁰/4-7kts. At 1000 ft, ONE THOUSAND STABILISED call was given after monitoring all parameters required according to stabilization criteria. The PIC disconnected the autopilot around 800' and started flying manually. At minimum 430ft for ILS RWY 23, the aircraft was on Profile with flight parameters Normal and Runway insight, CONTINUE call was given. Approaching Threshold, Visibility started reducing but the crew had still Runway in visual.

When the aircraft crossed the Threshold at approximately 50ft, they were on profile and Runway visual. When around starting flare, the crew encountered heavy and quick downpour from cross, they were blinded for fraction of time. As per the copilot visual, Runway Edge lights were approaching from right, and he made several calls "Go Left Go left" to the Captain for drift correction. But at such low height, less reaction time available and everything happened so fast, aircraft landed towards right edge of Runway. Immediately correction to left was given and first the aircraft went little left of center line and then followed Centre line. Reverser Max was selected and Decelerated with Medium auto brake. The crew advised ATC about occurrence and vacated via Taxiway B following L4 L9 to Bay 13L. After inspection, Jeep reported 4 REDL were broken. Because of Heavy and quick flash or rain, it was hard to identify Runway Centre Line and Taxiway centre line. Even Marshaller stopped the aircraft well ahead of Stop markings as he was also not able to identify markings. Tow tractor was called for pulling Aircraft Forward. After chocks on the crew informed engineer on first contact who reported back main gear condition normal. Then they informed OCC and FRB entry was made. The PIC apologized for the lapse on his part, and mentions that they should have ideally done a go around, however lost the runway in fraction of time, had already initiated the flare & before they could realize, they had already hit the lights.

The PIC had given additional clarifications on the following:

- The PIC was not aware that he had given right roll below 50 ft AGL. He has reasoned that this must have happened as there was no visual reference being blinded by rains and he probably did not have anything to rely to make sure wings were level.
- The PIC has agreed that there was lack of confidence during application of pitch during flare as there was lack of visual reference & assurance during landing maneuver. The aircraft was flared just by feel. Due to continuous changing environmental factors, he probably kept getting different feel which may have resulted in initial flare followed by release of back pressure on side stick followed by further flare.

- The PIC had lost visual references at initiation of flare & gradually regained back the references on FO continuous callouts to Go left and when the aircraft slowed down after touchdown due to braking actions.
- Left rudder applications were given based on the FO callouts of Go left.
- The Go-Around decision was not executed as the heavy downpours/rains suddenly occurred very close to the ground about 50 ft during flare which startled him. Prior to this he was confident about his profile to be right. However all preparations were made for a Go Around from approach phase and had discussed with the Copilot. As per PIC lack of reaction time and occurrence at low height was the reason for not responding to the situation & never considering a Go-around.

In addition, the First officer had given additional clarifications on following:

- Visual references reduced approximately around flare and improved a few seconds later.
- A right roll was felt approximately around flare or just before, subsequently realized that Right runway edge lights coming close and aircraft is veering towards right.

1.18.2 Excerpts from the Statement of Air traffic controller of Ahmedabad ATC:

“IGO6023, VOGO-VAAH, A320, VT-IFN, after landing at time 1914 UTC reported that perhaps it had broken Runway edge lights of rights side of Runway 23. Aircraft reported all operation normal and vacated Runway via taxiway B. After runway inspection operational jeep initially reported that five edge lights had been broken. Later on operational jeep informed four lights were broken. Operational jeep reported it would take at least 30 minutes to repair edge lights. Normal operations were resumed once Runway edge lights were reported serviceable. Informed all concerned as per SOP.

In addition the following clarifications were also given:

- The Special METAR was received when the arrival aircraft (incident aircraft) was at about 4 miles from touchdown.
- The Special METAR was informed to another aircraft which was about to depart and not to the arrival aircraft as there was no significant change in visibility and other significant changes in weather like raining over air field, wind conditions were already informed.

1.18.3 Excerpts from the Statement of Air side operations control center (AOCC), Ahmedabad

The DM, Airside Operations was on night Duty dated 12.09.2022 and statement pertaining to aircraft related incident for 6E 6023 (VOGA-VAAH) Reg- VT- IFN) is as follows:

00:22-00:34 IST; he carried out runway inspection along with electrical team and Runway found fit for operations and Runway surface condition was dry.

00:44 IST; Message received from ATC that 6E 6023 after landing reported might have broken runway edge lights and aircraft reported all ops normal.

00:46 – 01:30 IST; On Runway inspection it was found that total no. of 04 runway edge lights were found broken (A-43/44 & B-43/44) and found tyre marks on edge of runway shoulder and same has been informed to ATC that it will take 30 minutes approximately to rectify it. Immediately informed to electrical department to rectify the lights and same has been informed to Head Ops/Head Airside and CAO. Runway Lights were rectified, replaced and cleared FOD at 01:30 IST.

01:30-01:34 IST; Runway inspection carried out with all men & material and found fit for operations. RCR Assessed and reported as “5/5/5 100/100/100 NR/NR/NR WET/WET/WET”.

01:35 IST; Proceeded to bay 13L and have physically checked that on aircraft starboard side wheel drum were having some grasses stick to it. It is confirmed with AME that there was no structural damage to Aircraft.

1.18.5 CONSIDERATION ABOUT GO-AROUND (A320 FCTM PR-NP-SOP-260)

DECISION MAKING

The flight crew must consider to perform a go-around if:

- *There is a loss or a doubt about situation awareness, or*
 - *There is a multifunction which jeopardizes the safe completion of the approach e.g major navigation problem, or*
 - *ATC changes the final approach clearance resulting in rushed action from the crew or potentially unstable approach, or*
 - *The approach is unstable in speed, altitude, or flight path in such a way that stability is not obtained by 1000 ft AAL in IMC or (500ft AAL in VMC), or is not maintained until landing, or*
 - *Any of the following alerts occur:*
 - *GPWS, or*
 - *TCAS, or*
 - *Wind shear, or*
 - *ROW alerts for the relevant runway condition. Refer to AS-ROROP Operating techniques.*
- Adequate visual reference are not obtained at minima or lost below minima.*

GO AROUND NEAR THE GROUND

- *The PF must not initiate a go –around after the selection of the thrust reversers. If the PF initiates a go-around, the flight crew must complete the go-around maneuver.*
- *If the flight crew performs a go-around near the ground, they should take into account the following*
- *The PF should avoid excessive rotation rate, in order to prevent a tailstrike. For more information refer to PR-NP-SOP-250 tail strike avoidance*
- *A temporary landing gear contact with the runway is acceptable.*
- *Only when the aircraft is safely established in the go-around, the flight crew retracts flaps one stem and the landing gear.*

Note: If the aircraft is on the runway when the PF applies TOGA thrust CONFIG ECAM red warning(s) may transiently trigger. The flight crew should disregard these alerts.

1.18.6 FLARE TECHNIQUE

- *As recommended in the following FCTM extract #1 (cf. next page), the flight crew should:*
 - Start the flare at ~30ft RA (from stabilized conditions) with a positive (or "prompt")*
 - Back pressure on the sidestick and holding as necessary.*
- *Avoid forward stick movement in the last 30ft (once flare initiated).*

1.18.7 ROLLOUT(CROSSWIND CONDITIONS)

- *The above-mentioned technique applies. Additionally, the flight crew will avoid setting side stick into the wind as it increase the weathercock effect. Indeed, it creates a differential down force on the wheels into the wind side.*
- *There reversers have a destabilizing effect on the airflow around the rudder and thus decrease the efficiency of the rudder. Furthermore they create a side force, in case of a remaining crab angle, which increases the lateral skidding tendency of the aircraft. This adverse effect is quite noticeable on contaminated runways with crosswind. In case a lateral control problem occurs in high crosswind landing, the pilot will consider to set reverses back to REV IDLE.*

1.19. Useful or Effective Investigation techniques

Advanced Surface Movement Guidance & Control System (ASMGCS) replay and approach radar replay was analyzed. It was observed that the aircraft touched down near aiming point at the right side (at 19:13:45 UTC) and after touchdown it continued to roll towards right edge of runway. Its heading was becoming parallel to the runway center line and the aircraft rolled on the right outermost edge (shoulder) of the runway for some distance (from 19:13:47 UTC to 19:13:50 UTC). Further it enters back to the runway (at 19:13:51 UTC) and crosses the runway centerline and then rolls to left side of center line for some time (from 19:13:55 UTC to 19:14:15 UTC). Further it rolls back to the center line of the runway (at 19:13:21 UTC)

Aircraft in flight/ground from A-SMGCS	CVR relative time	Aircraft ground speed(knots)	DFDR Radio Altitude(feet)	Correct Radio Altitude from Approach radar	CVR auto altitude call out(feet)
Flight(19:13:35 UTC)	(01:51:31)	139	36	53	50
Flight(19:13:36 UTC)	(01:51:32)	139	24	42	40
Flight(19:13:37 UTC)	(01:51:33)	139	14	32	30
Flight(19:13:38 UTC)	(01:51:34)	138	6	24	20
Flight(19:13:39 UTC)	(01:51:35)	138	-1	18	Retard
Flight(19:13:40 UTC)	(01:51:36) to (01:51:42)	138	-5	14	Aircraft floats as continuous "Go left" calls from First officer
Flight(19:13:41 UTC)		137	-9	11	
Flight(19:13:42 UTC)		136	-13	6	
Flight(19:13:43 UTC)		135	-16	4	
Flight(19:13:44UTC)		134	4074	4	
Flight(19:13:45 UTC)	(01:51:43)	131	4075(touch down)	Touchdown	Touch down sound heard

Fig. 12

The aircraft was aligned with the RWY centerline till 20 ft and ground speed was observed to be 138 kts. By correlating the Approach radar replay and A-SMGCS replay the aircraft touched down with ground speed 131 kts after floating for 07 seconds.

The following table shows the corrected altitude from 50 ft till touch down since the DFDR readout showed some unrealistic values when correlated with CVR.

2. ANALYSIS

2.1 Serviceability of the Aircraft

No snag/defect persisted prior or during the flight. No fault codes were obtained from the CMC. No MEL was active for this flight. The AME had carried out the pre-flight inspection at Goa and had released the aircraft for further service. As such maintenance task post incident as per the Aircraft Maintenance Manual and as per OEM recommendations were carried out. As precautionary measures, post incident, the No.02 Nose wheel had been replaced.

From the above it is evident that serviceability of the aircraft and maintenance aspect is not a contributory factor to the incident.

2.2 Weather

It started raining over the airfield from about 4 minutes prior to touchdown. ATC informed the pilots that the wind was 220°/04 kt. Wind speed at the time of landing varied. As per DFDR, The winds were observed to be gusty from 620 ft till 50 ft with average strength ranging 05-07 kts and direction changing from 250 deg to 220 deg Further from 50 ft to touch down, the wind direction and strength is seen abruptly changing from 174 deg and reduces to 149 deg on touch down when the winds have increased from 5 kt to 13-19 kts. A major part of the wind evolution (from ~14ft RA) observed during the rudder pedal action was artificial due to the sudden commanded yaw dynamics of the aircraft. The crosswind trend is thus not valid anymore when rudder pedal orders started to be applied, from ~14 ft RA (19:13:40 UTC to 19:13:49 UTC). So it is evident that the actual cross winds were blowing from left to right of the aircraft with strength of 5-7 kt.

The longitudinal and lateral wind evolutions highlighted: Between 1000ft RA (19:12:19 UTC) and 200ft RA (19:13:21 UTC), the average wind recorded by the FDR came from 247° at 5kt: Headwind component varied between ~0kt and ~5kt, Mean crosswind component reversed from around -5kt (right) to around +2kt (left).

The winds were blowing from left to right of the aircraft. This continuous drift towards right was attributable to crosswind which was blowing from left to right of the aircraft. The wind speed was within limits for landing. The crew mentioned in his statement that there was a drastic reduced visibility to zero (black out) for a short while during flare due to heavy rain. The aircraft had landed at 19:13:45 UTC. However, information obtained from observatory of India Meteorological Department indicated that at 19:00 UTC, the predicted Winds were 05 kt in the direction of 90 deg. Visibility was 4000 m with temporary visibility 3000m in TSRA with weather mentioning Mist, thunderstorm. However at 1910 UTC, there was a special METAR, predicting wind as 05 kt in direction 230 with visibility 3500 m, temporary visibility of 3000 m in TSRA, weather moderate rain. The ATC controller had only informed about the rains over the airfield and wind current wind conditions as 220°/04 kts and not informed the special METAR to the arrival aircraft (incident aircraft) as there were no significant changes in visibility. From this it is evident that the intensity of rain between was moderate & not so high to cause zero visibility. Also the forecast visibility was 3500 meters during the period of touchdown of the aircraft. Even though there was a reduced visibility forecast at 1910 UTC as against the visibility forecast at 1900 UTC, the claim of the pilot that there was zero visibility during flare due to heavy rain is not correct on the basis of available evidences. However from the corroboration of ATC controller's communication from ATC transcript, Special METAR and crew statements, it is evident that there was a transition in intensity of rains from moderate rain to heavy rain over the airfield when the aircraft had just passed over the threshold and was about to flare. This sudden transition may have caused momentarily loss of visual cues/references having detrimental impact on general visibility of the crew. In other words, in addition to any true meteorological reduction of visibility, raindrops impacting the windscreen/canopy would have additionally reduce visibility. Windscreen wipers at maximum may also not be able to fully cope with the rainfall rate. Also, the gusty cross winds increasing in strength were blowing from left to right that was adding on to the rightward drift to the aircraft.

Also as understood from the ATC transcript that the previous aircraft IGO 7079 had confirmed that it is not landing over the field at 1902 UTC. The previous aircraft landed on dry Runway surface and wind conditions 1800/08 kts at 1905 UTC. Further, the aircraft IGO 7079 had informed the ATC controller that it is heavily raining from Approach path till turn pad and then it is dry. Based on this information at 1908 UTC, the ATC controller had confirmed to the incident aircraft that it's raining, approach path till touch down, however RWY surface is dry. Afterwards, at 1909 UTC the approach controller had informed the incident aircraft that it has

started raining over the airfield which was acknowledged by the incident aircraft. Subsequently at 1911 UTC, approach controller had given clearance to incident aircraft to land on RWY 23 with wind conditions informed as 220 degree 4 knots. The aircraft acknowledged and informed their Go Around preparations that they would take Heading 250⁰ in case of Go Around.

AT 1912 UTC, the Approach controller on requested by another training aircraft (about to departure) about the latest visibility had informed current conditions as heavy raining over the field current visibility 3500 m tempo visibility 3000m in thunderstorm with rain(as obtained from the special METAR at 1910 UTC). However the aforesaid was not informed to the incident aircraft as there was no significant changes in weather other than raining over the field and actual wind conditions (220⁰/04 kts) which was already informed.

All available weather information sources highlight no adverse wind conditions during final approach and landing, but a thunderstorm with moderate rain and a visibility of 3000 m. Also there was a transition in intensity of rains from moderate to heavy over the airfield when the aircraft had just passed over the threshold and was about to flare.

In the last ~50ft, a left crosswind increase was also encountered by the aircraft.

Weather was a contributory factor to the incident.

2.3 Operational Aspect

2.3.1 Handling of aircraft by the crew

a. Prior to touchdown

About 7 minutes prior to the incident aircraft touchdown, the Runway inspection was carried out and mentioned the runway surface to be “Dry”. Also, all nav-aids, lighting systems and communication systems were working normal. Runway friction was found to be adequate during the last friction test. The runway in use was RWY 23 and the runway surface was ‘Wet’ at the time of occurrence. No report w.r.t. standing water was made by the aerodrome officials. The runway was fit for operations.

Aircraft was carrying out ILS approach for RWY 23 at AMD. The PIC(LHS was flying) was in controls and First officer(RHS was pilot monitoring) during landing). At approx. 1500ft RA, aircraft was fully configured with gear down and winds were approx. 270/8 kts. The aircraft was stabilized by 1000 ft with the flaps and main landing gears extended. The calculated approach speed was 140 knots and was also fed in FMS. The aircraft was making approach in crosswind conditions and in rains. The wind creen wipers were put to maximum and continued throughout the landing phase. Also the approach was made in managed speed mode and continued throughout the landing. From CVR and ATC transcript, it is evident that the crew was prepared to do a Go-Around if necessary. The flight crew voluntarily disengaged both the APs at 620 ft(19:12:45 UTC) via the side stick instinctive push button, then final approach was manually handled by PIC.

During approach, the winds were observed to be gusty from 620 ft till 50 ft with average strength ranging 05-07 kts and direction changing from 250 deg to 220 deg.

At approx.. 90 ft RA, pitch inputs are observed as Nose up orders. Passing approx. 36 Ft RA at 19:13:35 UTC, initiation of slight right roll is observed followed by right roll input which has resulted in the aircraft drifting towards the right of the runway centerline subsequently at 20 ft. A left rudder pedal input is also observed. Also, from 50 ft to touch down, the wind direction and strength is seen abruptly changing from 174 deg and reduces to 149 deg on touch down when the winds have increased to 13 -19 kts from 5 kt. The increasing strength of the winds from 14 ft(19:13:40 UTC) till 4 seconds after touch down(19:13:49 UTC) is an artificial increasing crosswind trend which is observed due to the sudden commanded yaw dynamics of the aircraft. Therefore the crosswind trend is thus not valid anymore when rudder pedal orders started to be applied, from ~14ft RA. The actual strength of the crosswind blowing from left to right is 5-7 kt. Hence, this continuous drift towards right was also attributable to crosswind which was blowing from left to right of the aircraft. Simultaneously, the PIC has initiated the flare, and the inputs seem to be varying/vibrant from Nose up and Nose down several times, thereby showing signs of

floating very close to the ground for about 6 seconds with a left crosswind. However at about 20 ft, the aircraft had started moving towards the right of the centerline.

The Lateral dynamics induced by the right roll commanded by the crew in the last 40 ft RA due to loss of visual cues by the sudden & simultaneous gusty crosswinds and environmental changes, predominantly led the aircraft to swerve/veer towards the right of the RWY.

Further it is evident that the crew had executed an improper flare wherein after initiating the flare at 36 ft, the crew has applied forward stick movement resulting in the aircraft floating over the ground. This extended flare has decreased the aircraft energy making it more sensitive to crosswind.

Also during flare, as a visibility drop due to heavy rain was experienced by the PIC, then he should have considered to perform a go-around if adequate visual references were lost below minima. Even the FO who had experienced reduction of visual cues due to deteriorating weather during flare, should have given a Go-around call out.

The CVR/DFDR analysis shows that the flight crew followed company procedures till the point of incident and the final approach can be considered as stabilized in the gusty wind conditions. Just from about 20 ft RA, the FO was aware of the aircraft heading towards the right edge and the PIC, though acknowledging his calls, was not able to manage with appropriate inputs. The FO could have played a more pro-active role by making standard PM Callouts i.e Go-Around to preclude the impending lateral runway excursion. However he had called the "Go Left" callouts to which the PIC had instantly acted avoiding the aircraft from going completely into the kutchra and causing further damages.

From CVR-DFDR correlation, as a response to FO's callout at 20 ft, to rectify to left, the PIC applied leftward rudder pedal order up to almost full deflection, most probably to try to return on the centerline of the RWY, but this input did not change the aircraft trajectory to avoid the lateral deviation. This action led the drift angle to increase from +1° to +7° (aircraft nose toward the left of the track) till touch down and the heading to decrease from 225° to 215° (QFU 224°).

b. On touchdown

As per DFDR readout, aircraft touched down on main wheels followed by nose wheel after 1 second (Heading 217/215 Deg.). The aircraft touched down with 131 kts, 1.34 G and cross wind of 13 kts(understood to be artificial increasing cross wind trend). The actual cross winds of strength 5-7 kts were blowing from left to right of the aircraft.

Localizer value is recorded as -0.0457 DDM which depicted that the aircraft touched down 23.5 m laterally right to centerline. This has been established with physical inspection and tire markings during site visit post incident. The wheel speed and aircraft ground speed data doesn't indicate any presence of aqua planning. Anti-skid protector was ON mode during landing.

c. Rollout and deceleration

After touchdown, the pitch input is also seen to be firm Nose down value reaching to 18 deg of control stick for about 14 seconds. Localizer indication reaches a maximum of -0.492 DDM which means it has gone a little further right after touch down (right MLG wheel measured to be 26 m from center line). 4 RWY edge lights had been damaged by the Nose Landing gears when the right Main landing travelled (30 m laterally away from centerline and parallel to the runway) for 129 m before entering back to the runway shoulders.

The spoilers were immediately out after the touchdown. Simultaneously the brakes application is also observed. Between touchdown (19:13:45 UTC) and 19:13:48 UTC, a differential manual braking (with a higher braking order on the left pedal) and a leftward rudder pedal order (up to almost full deflection) were applied to correct the trajectory and return on the RWY. After 02 seconds of touchdown, the maximum reverse thrust was observed for about 18 seconds and left roll order up to full deflection was observed for about 14 seconds.

The medium auto braking and rudder pedal were used to control the aircraft and bring back to center line for about 13 seconds after touch down. Manual braking was applied 20 seconds after touch down resulting in de-activation of the auto brake function. A differential manual braking

(with a higher braking order on the left pedal) and a leftward rudder pedal order (up to almost full deflection) were applied to correct the trajectory and return on the RWY.

Once the aircraft reached centerline, Then aircraft moved towards the left of runway centerline and then after rolling for some time towards the left (reached a maximum of 14 m as measured from right MLG wheel during site visit), seen moving towards the right and thereby aligning with the centerline due to rightward rudder pedal order applied to realign the aircraft heading with the RWY.

It is evident that, in case of lateral control problem, the flight crew had not considered to set the reverse thrust to REV IDLE instead of MAX REV, resulting in the reversers having a destabilizing effect on the airflow around the rudder and thus decreasing the efficiency of the rudder. Furthermore they created a side force, in case of a remaining crab angle, which increased the lateral skidding tendency of the aircraft.

Further, the flight crew should have not avoided setting side stick into the wind thereby increasing the weathercock effect.

Circumstances leading to the incident

A. Disorientation due to deteriorating weather

In the night hours, due to sudden heavy rain over the airfield and other environmental factors (crosswinds of increasing trend 5-7 Knots gusty in nature from left direction) during flare, impaired the crew visual cues resulting in sudden right roll input. This resulted in the aircraft initiating a bank at 14 ft towards the right of the Runway centerline & swerving to the right side of the Runway.

B. Improper flare technique

During the aircraft drifting towards right due to right roll input in deteriorating weather conditions, the PIC was not confident and applied varying/vibrant Nose up and Nose down pitch inputs several times, thereby resulting in the aircraft floating with left crosswinds very close to the ground during aircraft low energy state (as Power cut off) predominantly aggravating the aircraft swerving to the right of the RWY.

C. Mismanagement of Lateral control problem.

Just after touch down, when there was a lateral control problem, the flight crew had not considered to set the reverse thrust to REV IDLE instead of MAX REV. Further, the flight crew had not avoided setting side stick into the wind thereby increasing the weathercock effect and worsening the situation.

D. Go Around decision-not executed by the Flight crew

Also during flare, as a visibility drop due to heavy rain was experienced by the PIC, then he should have considered to perform a go-around if adequate visual references are lost below minima. In addition, the First officer should have played a more pro-active role by making Go-around callout/decision to preclude the impending Lateral Runway excursion.

3. CONCLUSIONS

3.1 Findings

- 3.1.1 The aircraft was airworthy with all valid certifications. All maintenance schedules, mandatory modifications and checks were carried out as per the requirements. The maintenance aspect was not a contributory factor to the incident.
- 3.1.2 All nav-aids, lighting systems and communication systems at aerodrome and ATC were working normal. The runway surface conditions were adequate for operations.
- 3.1.3 Two-way communication existed between the aircraft and ATC. No read back or hear back errors were observed. Latest ATIS information was also available with the crew.
- 3.1.4 Both the flight crew were fit to fly with valid license/ratings.
- 3.1.5 Thunderstorm with moderate rain and a visibility of 4000m persisted at Ahmedabad

Airport. There was a transition in intensity of rains from moderate to heavy over the airfield when the aircraft had just passed over the threshold and was about to flare.

- 3.1.6 The aircraft was stabilized by 1000 ft with the flaps and main landing gears extended. The aircraft was making approach in crosswind conditions and rains over the approach path.
- 3.1.7 Visibility was 3500 m over the air field along with heavy rains when aircraft was approaching. From this, it is evident that the visibility had not reduced to 'zero' as claimed by the PIC. However, the sudden transition when the aircraft entered over airfield just after passing over threshold may have caused momentarily loss of visual cues/references below minima having detrimental impact on general visibility of the crew.
- 3.1.8 Also during flare, as the visibility dropped due to heavy rain, the PIC must have considered to perform a go-around if adequate visual references are lost below minima.
- 3.1.9 The First officer who had also felt the visibility reducing during flare failed to play a more pro-active role by making standard Go-around callout to preclude the impending lateral runway excursion.
- 3.1.10 In the last ~50 ft, a left crosswind increase was encountered by the aircraft. Passing ~50 ft, right roll input was made by the crew due to loss of visual cues because of the deteriorating weather conditions. This resulted in the aircraft drifting to the right side away from the centerline at ~20 ft along with the impact from the cross winds striking from left.
- 3.1.11 Although immediate effective left rudder application has been given by PIC in an attempt to align the aircraft back to the runway centerline, the aircraft trajectory did not change and the drifting continued.
- 3.1.12 During flare at 20 ft, when the power was made to idle and aircraft was in a low energy state, the PIC continued landing by applying varying/vibrant Nose up and Nose down pitch inputs several times that caused the aircraft to float over the runway. This situation had made the aircraft more sensitive to the left crosswind and had predominantly aggravated the aircraft swerving to the right of the RWY.
- 3.1.13 The aircraft touched down right hand side 23.5 m laterally from center line, closer to the right edge of the runway and it drifted further and reached on the right shoulder of the runway. The spoilers were immediately out after the touchdown followed by the brakes application and selection of maximum reverse thrust is observed.
- 3.1.14 Just after touchdown, despite having difficulty to control the aircraft laterally, the flight crew had not considered to set the reverse thrust to REV IDLE instead of MAX REV. Further, the flight crew had not avoided setting side stick into the wind thereby increasing the weathercock effect and worsening the situation.
- 3.1.15 The medium auto-braking and rudder pedal were used to control the aircraft and bring back to center line after touch down. Further, the auto brake function was de-activated once the manual braking was applied. A differential manual braking (with a higher braking order on the left pedal) and a leftward rudder pedal order (up to almost full deflection) were applied to correct the trajectory and return on the RWY.
- 3.1.16 Four (04) runway edge lights were damaged by Nose wheel during landing roll of the aircraft along right shoulder of runway 23.
- 3.1.17 The ATC controller had only informed the incident aircraft about the rains over the airfield and current wind conditions as 220⁰/04 kts during final approach and not informed the special METAR conditions as there were no significant changes in visibility.

3.1 Probable Cause

Failure to manage the aircraft lateral and longitudinal path due to improper flare technique when encountered with sudden rains/down pour along with gusty cross winds was the probable cause of the incident.

4. SAFETY RECOMMENDATIONS

4.1 Necessary corrective training for the crew as deemed fit by DGCA HQrs.

22.04.2024
Mumbai

(Vipin Venu Varakoth)
Investigator-In-Charge, VT-IFN

----End of report----