INVESTIGATION REPORT
ON
TAIL STRIKE INCIDENT TO
M/S INDIGO A-321 AIRCRAFT VT-ILR
WHILE LANDING AT
NETAJI SUBHASH INTERNATIONAL AIRPORT, KOLKATA
ON
02.01.2023

DISCLAIMER

In accordance with the Rule 3 (1) of Aircraft (Investigation of Accidents and Incidents) Rules, 2017, "The sole objective of investigation of this incident is the prevention of accidents and incidents and not to apportion a blame or liability."

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INVESTIGATION REPORT ON TAIL STRIKE INCIDENT TO M/S INDIGO AIRLINE A-321 AIRCRAFT VT-ILR AT KOLKATA AIRPORT ON 02.01.2023

1.	Aircraft Type	: A-321
	Nationality	: Indian
	Registration	: VT-ILR
2.	Owner	: Accipiter Investments Aircraft 2 Ltd, Ireland
3.	Operator	: M/s Interglobe Aviation Ltd
4.	Pilot in Command	: ATPL Holder
	Extent of Injury	: Nil
5.	Place of Incident	: Netaji Subhash Chandra Bose International Airport, Kolkata
6.	Geographical Location of Site	: 22°39′14.27″N, 88°26′48.2″E
7.	Last point of Departure	: Dhaka Airport, Bangladesh
8.	Intended place of landing	: Netaji Subhash Chandra Bose International Airport, Kolkata
9.	Type of operation	: Scheduled Flight
10.	Date and time of Incident	: 02.01.2023, 11:29 Hrs
11.	Passengers/Crew on Board	: Crew-07
		Passenger- 174 (173+01 infant)
	Extent of Injury	: Nil
12.	Phase of Operation	: Landing
13.	Type of Incident	: Abnormal Runway Contact (Tail Strike)

(All the timing in the report is in GMT)

SYNOPSIS

On 02.01.2023, M/s Indigo A321 Neo aircraft VT-ILR was involved in an incident of tail strike at Kolkata while operating flight from Dhaka to Kolkata. There were 181 persons on board the aircraft including 02 Flight Crew, 05 Cabin Crew and 01 infant.

This was a supervised landing, FO was Pilot Flying (PF) and PIC was Pilot Monitoring (PM). The aircraft touched down with slight bounce followed by high nose pitch attitude that led to tail strike. 'PITCH PITCH' annunciation was also heard.

The PIC reported 'Tail Strike during landing' and made the techlog entry. All the persons on-board the aircraft were safe. No pre/post incident fire was reported.

DGCA instituted the investigation into the cause of incident by appointing the Investigation In-charge under Rule 13(1) of the Aircraft (Investigation of Accidents and Incidents) Rules, 2017.

The investigation revealed that continuous high pitch-up input by the FO while landing causing the increase in pitch attitude of the aircraft after touchdown attributed to the tail strike.

Lack of monitoring the flight parameters and no corrective input by PIC while landing contributed to the incident.

1. FACTUAL INFORMATION

1.1. HISTORY OF THE FLIGHT*:*

On 02.01.2023, the aircraft VT-ILR departed from Hyderabad at 01:00 hrs. to operate the first flight of the day from Hyderabad to Bhubaneshwar with a different set of crew. On arrival at Bhubaneshwar the operating crew reported a snag of 'SMOKE MAINT' after engine shut-down. The aircraft was released by the AME under MEL Category 'C' to operate further flights. The Aircraft operated two more flights from Bhubaneshwar to Hyderabad and Hyderabad to Kolkata. NIL snag was reported by the operating crew except the carry forwarded MEL.

At Kolkata, the same aircraft was handed over to the involved set of crew to operate a flight from Kolkata to Dhaka and return back to Kolkata. It was the first flight of the day for both the crew. The aircraft was released by a certified AME after carrying out the due transit inspection. The aircraft took-off from Kolkata at 08:42 Hrs and landed at Dhaka at 09:13 hrs. After landing the crew reported suspected hard landing at Dhaka. Hard landing inspection was carried out as per the AMM and no damage was reported. The aircraft was released for further flight.

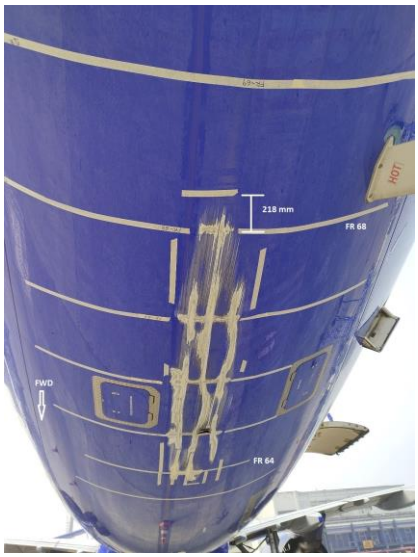
The aircraft departed from Dhaka at 10:22 Hrs and took-off for Kolkata at 10:42 Hrs. During the take-off & cruise from Dhaka to Kolkata, the flying was normal. The aircraft was cleared for ILS approach on runway 01R at Kolkata Airport and the approach was normal. The FO was the pilot flying (PF) to perform the supervisory landing and the PIC was the pilot monitoring (PM). While landing, a bounce was observed and RH main wheel lifted up again after touch down for a fraction of second and touched again. After touch down the pitch was increased to 10.7^{o} that led to the tail strike. No input from the PIC as PM was observed while approaching for landing till touchdown. Crew reported the tail strike and made the tech log entry. CVR and DFDR data was downloaded. No injury to any of the occupant and no fire at any stage was reported. The aircraft was grounded for further inspection.

1.2. INJURIES TO PERSON

INJURIES	**CREW**	**PASSENGERS**	**OTHERS**
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
MINOR	Nil	Nil	Nil
NONE	02 +05	173 +01	

1.3. DAMAGE TO AIRCRAFT

During the walk around inspection, damages observed on aft fuselage. During detailed inspection of the aircraft various internal and external structural damages, cracks, scratches, deformations were observed including the damage to the skin.



1.4. OTHER DAMAGE

NIL

1.5 PERSONNEL INFORMATION:

1.5.1. Pilot-in-Command

He is experienced pilot having vast flying experience on various aircraft. Before joining M/s Indigo Airlines, he had flown B-737, A330, Cessna 152 etc. aircraft as PIC with other operators. He joined M/s Indigo on 16.05.2019. He operated A320 aircraft first time on 13.09.2019 as First Officer. The operator released him as PIC on 06.10.2019 after endorsement of A320 series on his ATPL.

On 16.06.2020, he operated first time A321 aircraft as FO. He was released as PIC on A321 on 25.08.2020. He was involved in an incident of deviation from assigned SID on 23.09.2021 while operating flight 6E-9149 (HKG-CCU) aircraft VT-IUT. He was off-rostered by DGCA and released for flying duties after undergoing recommended corrective trainings**.** On 04.04.2022, he was assessed and cleared to permit the FO for STOL (Supervisory take-off Landing) by the operator**.** Details of his experience at the time of incident are given below:

Date of Birth	:	26.11.1971
Gender	:	Male
License type	:	ATPL

Date of Initial Issue	:	15.03.2007
Valid up to	:	14.03.2027
Class I Medical Valid up to	:	09.06.2023
FRTO validity	:	18.11.2032
Date of last IR Check	:	21.12.2022
PPC check	:	21.12.2022
Aircraft Ratings:		
As PIC	:	A320 Family, A330, B737 (300-900), Cessna 152
Date of Endorsement	:	01.10.2019 for A320

Flying Details:

Total Flying Experience	:	15757:25 Hrs.
Total Flying as PIC	:	9050:18 Hrs.
Total Experience as PIC on type	:	1656:41 Hrs.
A320	:	1420:20 Hrs.
A321	:	236:21 Hrs.
Flying during Last One year	:	634:33 Hrs.
Flying during last 180 days	:	341:31 Hrs.
Flying during Last 30 days	:	25:31 Hrs.
Flying during last 7 days	:	13:28 Hrs.
During last 24 hours	:	01:55 hrs

1.5.2. Co-Pilot

The Co-pilot had sufficient experience to perform supervised landing. He joined M/s Indigo Airline on 28.11.2019. He was assessed on simulator and cleared for STOL (Supervisory take-off Landing). During the FFS (Full Flight Simulator) training on 18.08.2021, additional training was recommended for him based on his performance. On 30.09.2021, he operated his first flight on A320 aircraft as FO with M/s Indigo. On 13.12.2021, he was rostered to operate his first flight on A321 aircraft as FO. The available record does not indicate his involvement in any incident/accident prior to the incident under investigation. Details of his experience at the time of incident are given below:

Date of Birth	:	15.04.1986
Gender	:	Male
Type of Licence	:	CPL
Date of Initial Issue	:	11.03.2014
Valid till	:	14.01.2024
Class I Medical Valid up to	:	03.11.2023
FRTO validity	:	14.01.2024
Date of last IR check	:	02.08.2022
PPC check	:	02.08.2022
Aircraft Ratings:		
As PIC	:	Cessna 152, Cessna 310
As FO	:	A320
Date of Endorsement	:	13.05.2019 for A320

Flying Details:

Total Flying Experience	:	872:36 Hrs
Total Experience as FO on type	:	659:03 Hrs.
A320	:	509:33 Hrs
A321	:	149:30 Hrs
Flying during Last One year	:	542:32 Hrs.
Flying during last 180 days	:	297:50 Hrs
Flying during Last 30 days	:	43:33 Hrs
Flying during last 7 days	:	14:12 Hrs.
During last 24 hours	:	01:55 Hrs.

Both the crew underwent pre-flight breath analyser test at Kolkata as per the provision of CAR Section 5 Series F Part III. No indication of alcohol consumption by any of the involved crew was detected during the pre-flight Breath Analyser test. No exceedance in the Flight Duty Time for both the crew was observed as per the record available.

1.6 AIRCRAFT INFORMATION:

1.6.1 Aircraft:	
Manufacturer	AIRBUS, Germany
Type	A321-251NX
Constructor's S.No.	10551
Year of Manufacturer	2021
Certificate of Airworthiness	7449, Issued on 06.09.2021
Airworthiness Review Certificate	Issued on 06.09.2022 Valid till 05.09.2023
Category	Normal
Sub Division	Passengers/Mail/Goods.
Certificate of Registration no. and validity	No. 5350 Validity: 12.08.2031
Owner	ACCIPITER INVESTMENTS AIRCRAFT 2 LIMITED, IRELAND
Operator	M/s INTERGLOBE AVIATION LIMITED
Minimum Crew Required	02
Maximum All Up Weight	97,000.000 Kg
Empty Weight	47768.020 Kg
Max Usable Fuel	18510.000 Kg
Max Payload with full fuel	29651.089 Kg
Empty Weight C.G	22.885 meters from the datum
Last Major Inspection	750FH / 90D inspection c/o at aircraft TAH 4184 Hrs/ TAC 2559 on 16/11/2022
Date of Aircraft weighment	15-Jul-2021

1.6.2 Engine	
Manufacturer	SAFRAN AIRCRAFT ENGINES
Type	LEAP-1A
Serial No.	ENG#1 – 59A294 ENG#2 – 59A340
Date of Manufacture	ENG#1 – 30-MAR-2021 ENG#2 – 07-MAY-2021
Hours Done Since New	ENG#1 – 4712:30 Hrs ENG#2 – 4712:30 Hrs
Cycle Since New	ENG#1 – 2874 Cycles ENG#2 – 2874 Cycles
Average Fuel Consumption	Satisfactory

The aircraft was maintained as per the approved maintenance schedule and all the mandatory modifications applicable to the aircraft were complied with. The aircraft is fitted with the tailstrike prevention system. This modification introduces the tailstrike pitch limit indicator on the PFD and the PITCH PITCH synthetic voice to avoid tailstrike during landing.

As per the approved weight schedule, MTOW of the aircraft is 97000 Kg, the Maximum Landing Weight is 79200 Kg, and the Maximum Zero Fuel Weight is 75600 Kg.

On 02.01.2023, the aircraft was released to operate first flight of the day from Hyderabad to Bhubaneshwar. At Bhubaneshwar, the crew reported ‘Smoke Maintenance’ message after engine shut down and the aircraft was released under MEL on ‘Smoke Maintenance Msg’ under category ‘C’ valid till 12.01.2023. The aircraft operated 02 more sectors uneventful. In the third sector from Kolkata to Dhaka, the crew reported suspected hard landing. The maximum vertical acceleration was recorded 1.86 that comes under Amber exceedance. As per PFR no related failure or warning message was observed. ALW was 74300 Kg that was 4900 Kg below the MLW. The aircraft was released for further flight.

As per the load and trim sheet for the incident flight from Dhaka to Kolkata, the actual TOW was 69510 Kg, the Actual Landing Weight was 68144 Kg, and the

actual ZFW was 64410 Kg. The ALW was 11056 Kg below the MLW permitted for the aircraft.

C.G. with LIZFW (Loaded Index at Zero Fuel Weight) was 54.3% and with LITOW (Loaded Index at Take-off Weight) was 49% from datum point, which were within the limits. C.G. can vary from 28.10% to 84.88% with LIZFW and from 20.12% to 73.87% with LITOW.

1.7 METEOROLOGICAL INFORMATION:

Weather report for Kolkata Airport as destination and Bhubaneshwar Airport as an alternate is given below:

VECC 021000Z 04004KT 2800 HZ NSC 26/16 Q1017 NOSIG=
VECC 021030Z 06003KT 2800 HZ NSC 25/16 Q1016 NOSIG=
VECC 021100Z 07004KT 2600 HZ NSC 25/16 Q1016 NOSIG=
VECC 021130Z 05004KT 2600 HZ NSC 24/17 Q1016 NOSIG=
VECC 021200Z 04006KT 2600 HZ NSC 24/17 Q1017 NOSIG=
VECC 021230Z 04004KT 2600 HZ NSC 23/17 Q1017 NOSIG=

VEBS 021030Z 04004KT 2500 HZ SCT018 SCT100 27/22 Q1016 NOSIG=
VEBS 021100Z 06006KT 2500 HZ SCT018 SCT100 26/22 Q1016 NOSIG=
VEBS 021130Z 07005KT 2500 HZ SCT018 SCT100 26/22 Q1017 NOSIG=
VEBS 021200Z 10009KT 2500 BR SCT018 BKN100 25/23 Q1017 BECMG 2000 BR=
VEBS 021230Z 12006KT 2000 BR SCT018 BKN100 24/23 Q1018 NOSIG=

At the time of landing at Kolkata, the weather was normal. The visibility was reported 2600m, with expected wind speed of 04kt. No significant cloud and no significant change in the weather was reported.

1.8 AIDS TO NAVIGATION*:*

Kolkata Airport is equipped with navigational aids like ILS, DME, DVOR, PAPI etc. No limitation on serviceability / use of any navigational aid was reported by the ATC at the time of incident. Further, no unserviceability or non-availability of any navigational aid was reported by the flight crew during any phase of flight.

1.9 COMMUNICATIONS:

Two-way communication was available at Mumbai Airport at the time of the incident. No unserviceability of any communication aid was reported by the ATC as well as by the flight crew.

1.10 AERODROME INFORMATION:

Kolkata Airport is known as Netaji Subhas Chandra Bose International Airport, Kolkata. Earlier it was known as Dum Dum Airport. It is largest airport in the eastern india. It is located about 17 Km from Center of the city. The Airport has Latitude 22°39′14.27″N, and Longitude 88°26′48.2″E. It is the licensed airport. The airport has two parallel runways; RWY 01R 19L and RWY 01L 19R. Detail of RWY is given below:

RWY	Dimension (M)	TORA (M)	TODA (M)	ASDA (M)	LDA (M)	RESA	ILS
01R	3633 x 45	3633	3633	3633	3633	240M x 90M	CAT IIIB
19L		3633	3633	3633	3207	240M x 90M	CAT II
01L	3271 x 45	3271	3271	3271	2833	165M x 90M	SALS
19R		3271	3271	3271	3183	240M x 90M	CAT I

The involved aircraft was cleared for ILS approach on runway 01R.

1.11 FLIGHT RECORDERS:

The aircraft was fitted with CVR and DFDR type: CVDR

CVR : Part No. DM58-0048-10 S. No. 002039576

DFDR : Part No. 7100-0200-00 S. No. 002058798

DFDR:

As per DFDR data, the aircraft approach was normal till touch down. All the parameters were within limit. The autopilot was disconnected at 1847ft RA for manual approach. Auto thrust was active till 20ft RA. Wind component may not be considered as significant as the wind speed remained between 1 to 4 kt.

Below 40ft RA, the FO made continuous pitch up input. The input was small and the aircraft remained in the profile. After crossing 20ft, the FO increased pitch-up input significantly and reached to -7.3°. It caused significant decrease in the ROD that was reduced to -224ft/min at 10ft RA. From 10ft RA, pitch up input by FO started again increasing and reached 17.6°. Maximum pitch up input can be -18°. At the time of first touchdown of LH main wheel, the pitch angle of the aircraft was 5.7°. The aircraft landed on main wheel. LH main wheel touched the runway first followed by RH main wheel. After 01 second of the touchdown, the RH main wheel left the runway surface for about 01 second and touched the surface again. However, due to continuous high pitch up input by the FO, the pitch attitude of the aircraft started increasing after touch down and reached 10.7° that caused the tail of the aircraft to touch the runway. The nose wheel came in contact with runway surface after about 06 seconds of the initial contact of main landing gear. Even after tail strike, while the nose wheel was in the process of touching down, the FO continued pitch up input to its maximum possible limit. However, due to decrease in ground speed after touchdown the lift component reduced as per aerodynamic law and the aircraft itself started to reduce its pitch. No input from the PIC observed during the flight even after bounced landing and sudden increase in the pitch attitude of the aircraft while landing. Maximum vertical acceleration at the time of touch down was recorded as 1.523g that was within the limits. Relevant parameters of DFDR data below 100ft are reproduced below for the reference:

Time UTC	Rad. Alt	Vert. SPD	IAS	Pitch	Roll	#1 N1	#2 N1	E#1 TLA	E#2 TLA	Pitch Input PIC	Pitch Input FO	MLG LH	NLG	MLG RH	Vert Acc	Eng1 Revsr Fully Depld	Eng2 Revsr Fully Depld
11:20:31	103	-592	130	2.5	-0.3	52.7	52.8	25	25	0	0	0	0	0	0.988	0	0
11:20:32	93	-592	130	2.2	-0.4	53	53.1	25	25	0	0	0	0	0	0.969	0	0
11:20:33	81	-608	130	2.2	1.1	53.3	53.8	25	25	0	-0.1	0	0	0	0.957	0	0
11:20:34	71	-624	130	2.4	0.4	54.3	54.3	25	25	0	0	0	0	0	0.949	0	0
11:20:35	61	-608	131	2.5	-2.4	54	53.9	25	25	0	0	0	0	0	0.996	0	0
11:20:36.000	38			2.5	-0.7	53.8	53.8			0	0	0	0	0	0.996		
11:20:36.125	37	-544		2.5	-0.6					0	-2.5				0.988		
11:20:36.250	36			2.6	-0.6			25	25	0	-5.5	0	0	0	0.988	0	
11:20:36.375	34	-512	130	2.7	-0.6					0	-6.2				0.988		
11:20:36.500	33			2.9	-0.6					0	-1.3	0	0	0	0.988		
11:20:36.625	32	-480		3	-0.6					0	-0.1				0.977		
11:20:36.750	31			3.1	-0.5			25	25	0	-0.1	0	0	0	0.988		0

Time UTC	Rad. Alt	Vert. SPD	IAS	Pitch	Roll	#1 N1	#2 N1	E#1 TLA	E#2 TLA	Pitch Input PIC	Pitch Input FO	MLG LH	NLG	MLG RH	Vert Acc	Eng1 Revsr Fully Depld	Eng2 Revsr Fully Depld
11:20:36.875	30	-480	130	3.2	-0.5					0	-0.1				1.008		
11:20:37.000	29			3.3	-0.4	53.7	53.8			0	-0.1	0	0	0	1.016		
11:20:37.125	28	-464		3.3	-0.4					0	-0.1				1.035		
11:20:37.250	27			3.4	-0.4			24.6	24.6	0	-0.2	0	0	0	1.016	0	
11:20:37.375	25	-448	130	3.5	-0.4					0	-0.2				1.023		
11:20:37.500	24			3.5	-0.4					0	-0.2	0	0	0	1.023		
11:20:37.625	24	-432		3.6	-0.4					0	0				1.023		
11:20:37.750	23			3.6	-0.4			4.9	14.4	0	0	0	0	0	1.023		0
11:20:37.875	22	-416	130	3.7	-0.4					0	-1				1.016		
11:20:38.000	21			3.7	-0.4	54.3	54.5			0	-2.7	0	0	0	1.035		
11:20:38.125	20	-384		3.7	-0.4					0	-4.7				1.008		
11:20:38.250	19			3.8	-0.5			-0.4	-0.4	0	-6.2	0	0	0	1.016	0	
11:20:38.375	18	-352		3.9	-0.6					0	-7.1				1.016		
11:20:38.500	17			4	-0.6					0	-7	0	0	0	0.996		
11:20:38.625	17	-304		4.1	-0.7					0	-7.3				1.023		
11:20:38.750	16			4.3	-0.8			-0.4	-0.4	0	-6.4	0	0	0	1.016		0
11:20:38.875	15	-272		4.4	-0.8					0	-4.4				1.023		
11:20:39.000	14			4.6	-0.8	53.7	51.9			0	-1.5	0	0	0	1.023		
11:20:39.125	14	-256		4.7	-0.9					0	-0.2				1.035		
11:20:39.250	13			4.7	-0.9			-0.4	-0.4	0	-0.1	0	0	0	1.063	0	
11:20:39.375	12	-240	129	4.7	-0.8					0	-1.6				1.063		
11:20:39.500	12			4.7	-0.8					0	-3.6	0	0	0	1.063		
11:20:39.625	11	-224		4.7	-0.6					0	-3.6				1.055		
11:20:39.750	11			4.7	-0.4			-0.4	-0.4	0	-3.3	0	0	0	1.035		0
11:20:39.875	10	-224	129	4.7	-0.2					0	-1.1				1.023		
11:20:40.000	10			4.5	0	47.5	45.2			0	0	0	0	0	1.023		
11:20:40.125	10	-224		4.4	0.2					0	0.1				1.016		
11:20:40.250	10			4.2	0.3			-0.4	-0.4	0	0	0	0	0	1.016	0	
11:20:40.375	9	-240	128	4	0.4					0	-0.4				1.008		
11:20:40.500	9			3.9	0.4					0	-1.3	0	0	0	0.988		
11:20:40.625	9	-256		3.7	0.5					0	-2.1				0.977		
11:20:40.750	8			3.4	0.7			-0.4	-0.4	0	-3.8	0	0	0	0.969		0
11:20:40.875	8	-272	128	3.3	0.9					0	-4.7				0.938		
11:20:41.000	8			3.2	1	40.3	33.7			0	-6.7	0	0	0	0.93		
11:20:41.125	7	-272		3.1	1.1					0	-8.3				0.91		
11:20:41.250	7			3.1	1.1			-0.4	-0.4	0	-8.3	0	0	0	0.91	0	
11:20:41.375	6	-272	127	3	1.1					0	-8.2				0.91		
11:20:41.500	6			3.1	1.1					0	-9.5	0	0	0	0.91		
11:20:41.625	5	-288		3.1	0.9					0	-9.4				0.902		
11:20:41.750	5			3.2	0.7			-0.4	-0.4	0	-9	0	0	0	0.902		0
11:20:41.875	4	-288	127	3.3	0.4					0	-9.5				0.93		
11:20:42.000	4			3.5	0.2	32.3	31.3			0	-12.5	0	0	0	0.93		
11:20:42.125	3	-272		3.7	-0.1					0	-14.2				0.91		
11:20:42.250	2			4	-0.4			-0.4	-0.4	0	-14	0	0	0	0.938	0	

Time UTC	Rad. Alt	Vert. SPD	IAS	Pitch	Roll	#1 N1	#2 N1	E#1 TLA	E#2 TLA	Pitch Input PIC	Pitch Input FO	MLG LH	NLG	MLG RH	Vert Acc	Eng1 Revsr Fully Depld	Eng2 Revsr Fully Depld
11:20:42.375	1	-272	125	4.2	-0.7					0	-14.2				0.918		
11:20:42.500	0			4.6	-1.1					0	-14.9	0	0	0	0.957		
11:20:42.625	0	-240		4.8	-1.2					0	-15.5				0.957		
11:20:42.750	0			5.2	-1.3			-0.4	-0.4	0	-16.7	0	0	0	0.969		0
11:20:42.875	0	-208	125	5.4	-1.2					0	**-17.9**				0.977		
11:20:43.000	0			5.7	-1	30.3	29.2			0	-17.8	1	0	0	1.273		
11:20:43.125	0	-16		6	-0.8					0	-17.1				1.391		
11:20:43.250	0			6.3	-0.4			-0.4	-0.4	0	-15.6	1	0	1	1.523	0	
11:20:43.375	0	176	124	6.6	-0.4					0	-11.9				1.359		
11:20:43.500	0			6.9	-0.4					0	-10.5	1	0	1	1.227		
11:20:43.625	0	224		7.2	-0.6					0	-9.7				1.023		
11:20:43.750	0			7.7	-1.1			-0.4	-0.4	0	-9	1	0	1	0.969		0
11:20:43.875	0	224	122	8.1	-1.3					0	-8.3				0.957		
11:20:44.000	0			8.5	-1.8	28.5	27.7			0	-7.5	1	0	1	0.871		
11:20:44.125	0	176		8.9	-1.9					0	-7.3				0.883		
11:20:44.250	0			9.5	-2.2			-0.4	-0.4	0	-7.1	1	0	0	0.824	0	
11:20:44.375	0	112	122	9.8	-2.3					0	-7.2				0.863		
11:20:44.500	0			10.2	-2.2					0	-7.1	1	0	0	0.832		
11:20:44.625	0	16		10.5	-2.1					0	-7.1				0.844		
11:20:44.750	0			10.6	-1.8			-0.4	-0.4	0	-6.1	1	0	0	0.871		0
11:20:44.875	0	-80	121	**10.7**	-1.6					0	-3.2				0.883		
11:20:45.000	0			10.4	-1.1	27.3	26.6			0	-0.1	1	0	1	0.988		
11:20:45.125	0	-224		10.1	-0.8					0	-3.6				0.957		
11:20:45.250	0			9.7	-0.3			-0.4	-0.4	0	-8.4	1	0	1	1.254	0	
11:20:45.375	0	-256	120	9.3	-0.1					0	-4				0.883		
11:20:45.500	0			8.9	0.1					0	-7.3	1	0	1	0.988		
11:20:45.625	0	-272		8.5	0.1					0	-9.4				0.969		
11:20:45.750	0			7.9	-0.1			-0.4	-0.4	0	-9.3	1	0	1	1.023		0
11:20:45.875	0	-256	119	7.6	-0.2					0	-11.2				0.969		
11:20:46.000	0			6.9	-0.3	26.3	26.4			0	-12.7	1	0	1	1.055		
11:20:46.125	0	-288		6.6	-0.4					0	-13.4				0.844		
11:20:46.250	0			6	-0.3			-0.4	-0.4	0	-15.3	1	0	1	0.969	0	
11:20:46.375	0	-288	119	5.5	-0.3					0	-17				0.977		
11:20:46.500	0			5	-0.2					0	-18	1	0	1	1.043		
11:20:46.625	0	-256		4.7	-0.2					0	-18				1.094		
11:20:46.750	0			4	-0.2			-0.4	-0.4	0	-18	1	0	1	0.996		0
11:20:46.875	0	-288	117	3.6	-0.3					0	-18				0.902		
11:20:47.000	0			3.1	-0.3	26.2	26.3			0	-18	1	0	1	0.949		
11:20:47.125	0	-288		2.7	-0.3					0	-18				0.91		
11:20:47.250	0			2.1	0			-0.4	-0.4	0	-17.9	1	0	1	1.043	0	
11:20:47.375	0	-272	116	1.7	0					0	-17.9				0.996		
11:20:47.500	0			1.1	0					0	-16.9	1	0	1	0.977		
11:20:47.625	0	-288		0.8	0					0	-15.6				0.988		
11:20:47.750	0			0.4	-0.2			-0.4	-0.4	0	-15.8	1	0	1	0.918		0

Time UTC	Rad. Alt	Vert. SPD	IAS	Pitch	Roll	#1 N1	#2 N1	E#1 TLA	E#2 TLA	Pitch Input PIC	Pitch Input FO	MLG LH	NLG	MLG RH	Vert Acc	Eng1 Revsr Fully Depld	Eng2 Revsr Fully Depld
11:20:47.875	0	-240	115	0.1	-0.2					0	-18				0.977		
11:20:48.000	0			-0.1	-0.2	26.1	26.1			0	-17.9	1	1	1	0.977		
11:20:48.125	0	-112		-0.1	-0.2					0	-17.6				1.082		
11:20:48.250	0			-0.1	-0.1			-0.4	-0.4	0	-13.4	1	1	1	0.969	0	
11:20:48.375	0	-32	113	0	0.1					0	-12.2				1.008		
11:20:48.500	0			0.2	0.2					0	-10	1	1	1	0.977		
11:20:48.625	0	0		0.3	0.2					0	-8.8				0.996		
11:20:48.750	0			0.4	0.3			-20.4	-20	0	-7.6	1	1	1	1.023		0
11:20:48.875	0	-32	110	0.4	0.2					0	-6.7				0.824		
11:20:49.000	0			0.5	0.3	26	25.8			0	-6.4	1	1	1	0.938		
11:20:49.125	0	-32		0.6	0.2					0	-6.5				1.008		
11:20:49.250	0			0.7	0.3			-20.4	-20	0	-6.5	1	1	1	1.035	0	
11:20:49.375	0	-32	108	0.7	0.4					0	-6.6				0.969		
11:20:49.500	0			0.7	0.4					0	-6.3	1	1	1	0.957		
11:20:49.625	0	-16		0.8	0.4					0	-5.5				1.055		
11:20:49.750	0			0.7	0.2			-20.4	-20	0	-3.2	1	1	1	1.082		0
11:20:49.875	0	-48	106	0.7	0.2					0	-1.8				0.949		
11:20:50.000	0			0.5	0.3	25.8	25.9			0	-0.2	1	0	1	0.93		
11:20:50.125	0	-112		0.4	0.4					0	-0.1				0.883		
11:20:50.250	0			0.3	0.5			-20.4	-20	0	-0.1	1	1	1	0.883	0	
11:20:50.375	0	-128	104	0.2	0.5					0	-0.1				0.93		
11:20:50.500	0			0	0.4					0	-0.1	1	1	1	1.055		
11:20:50.625	0	-112		-0.2	0.4					0	-0.1				1.055		
11:20:50.750	0			-0.2	0.4			-20.4	-20	0	0	1	1	1	0.988		0
11:20:50.875	0	-80	102	-0.3	0.4					0	0				0.969		
11:20:51	0	-112	101	0.4	0.4	25.8	25.7	-20.4	-20	0	-0.1	1	1	1	0.883	0	0
11:20:52	0	0	100	-0.2	0.4	25.8	26.4	-20.4	-20	0	0	1	1	1	1.043	1	1
11:20:53	0	-32	96	-0.2	0.4	28	36.7	-20.4	-20	0	0	1	1	1	0.977	1	1
11:20:54	0	-32	92	-0.2	0.1	41.5	50.3	-20.4	-20	0	0	1	1	1	0.977	1	1
11:20:55	0	-32	87	-0.3	-0.1	56.8	64.9	-20.4	-20	0	0	1	1	1	1.008	1	1
11:20:56	0	-32	83	-0.3	-0.1	65.5	65	-20.4	-20	0	0	1	1	1	1.023	1	1
11:20:57	0	-64	79	-0.3	-0.2	65.4	66.9	-20.4	-20	0	0	1	1	1	0.918	1	1

CVR:

As per CVR recording, in the previous sector, while landing at Dhaka airport, crew suspected hard landing and made the techlog entry. The PIC briefed the FO after landing advised him to keep the side stick slightly pulled up during landing to arrest the ROD at the time of touch down.

For the incident flight, the approach was normal and PIC advised the FO to continue for landing. While approaching, the landing checklist was performed. PIC advised the FO to pull-up the side stick slightly. He repeated the same

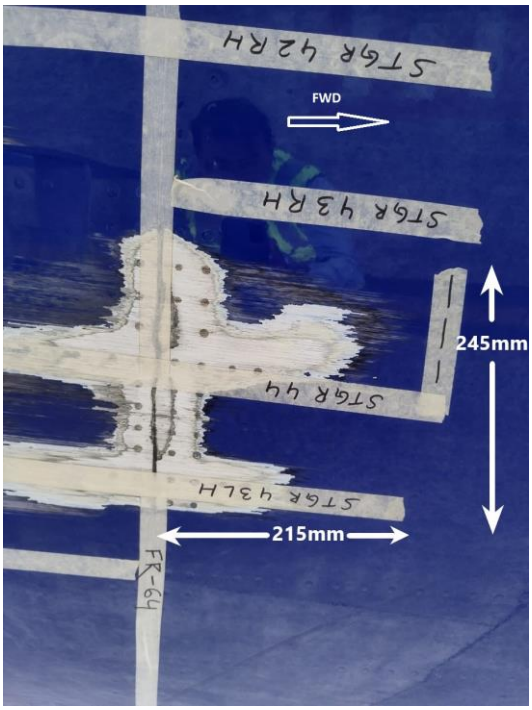
statement severally before touchdown. After touchdown, the PIC said that pitch input by FO was high. Both the flight crew discussed the possibility of tail strike after landing. During taxi, the cabin crew reported bad landing experienced in the cabin and a loud sound heard at the time of landing. Then PIC admitted the possibility of tail strike. The PIC was also aware of the Tail strike Prevention System fitted on the aircraft and he discussed the same with the FO after landing.

1.12 WRECKAGE AND IMPACT INFORMATION:

In view of bounced landing, hard landing inspection was carried out and no relative failure/damage was observed. During walk around inspection, extensive tail strike damages observed on aft fuselage. Detailed inspection was carried out by engineering team for internal and external damages and following observations were made

External Damages

- Aft fuselage skin damage in between Frame 63 to 69 and between Stringer 42LH and Stringer 42RH.



- Frame # 64, 65, 66, & 67, bottom chord at 6 O' clock location, have deep rubbing/ gouge marks.

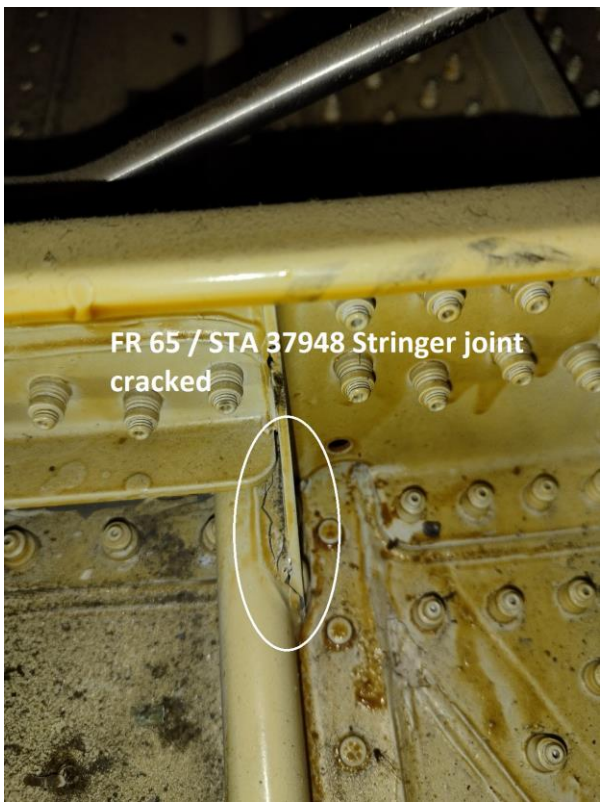
- Frame # 65 depressed, torn and bottom attachment lug found missing in an area of 4 inches length between stringer 44 to stringer 43RH.
- Overall lower skin damage was observed of dimensions: max length 2540 mm and max width 390mm.
- Damage started from 350mm aft of Frame 63 upto 165mm forward of Frame 69.
- Skin teared at 06 locations below Frame 65, 66 & 67 with maximum dimension: length 95mm and width 85mm at frame 65.
- -Drain mast damaged (bent and cracked). No further damage observed on drain mast support structure.

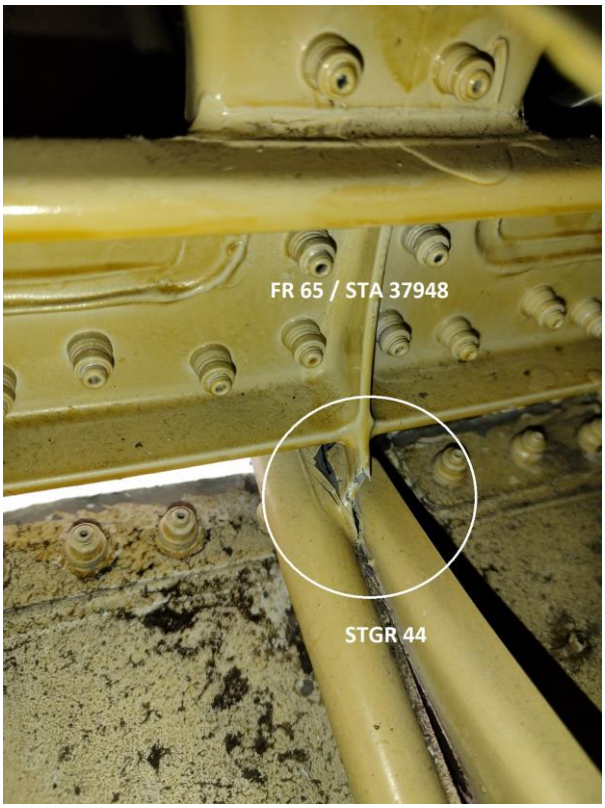
Internal Damage

- Frame 65 damage and distorted between stringer 43RH to stringer 42LH.
- Rivets pulled off on frame 65 to stringer 43LH, stringer 44 and stringer 43 RH attachment clip.
- Rivets loose on frame 66 and frame 67 attachment between stringer 43LH and stringer 43RH.

- Sharp bend observed on water tank filling line (p/n: D3817021101600). No further damage observed on water and waste tank mounting/attachment structure.

- Slight depression observed in skin panel between stringer 44 and stringer 43LH from frame 65 to 67.





For further examination and rectification action, the aircraft was declared on ground and all the findings were forwarded to Airbus for Technical support.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION*:*

Both the crew underwent pre-flight breath analyser check as per the provision of CAR Section 5 Series F Part III. No indication of alcohol consumption by any of the involved crew was observed during the check.

1.14 FIRE:

There was no pre/post incident fire.

1.15 SURVIVAL ASPECTS:

All the persons on-board the aircraft including 07 crew members were safe.

1.16 TESTS AND RESEARCH:

M/s Airbus was contacted by the operator for further examination of the damage and necessary maintenance action. M/s Airbus examined the whole aircraft for possible damage, deformation, cracks or paintwork. All the tail section fittings, jack points, drain fittings, waste water fittings, waste mast, toilet systems, Landing gear doors and their attachments, APU door fittings and its attachments to the fuselage, belly fairings etc. were examined. Sealants with cracks were removed to examine any further damage to the structure. All the floor panels, side wall panels and overhead panels of the aft cargo compartment and service panels were removed for necessary structural repair/maintenance work.

All the damaged structural fittings, systems components, waste lines, hoses, drain mast, toilet system etc, were replaced/repaired as per Airbus approved procedures. Sections S17 and S18 lower shells and internal structure suffered several damages due to Tail Strike.

- S18 Lower equipped shell replacement done as per repair references
- S17 between FR63-64 flush skin repairs done as per repair references
- Embodiment deviations repaired as per repair references

On completion of required maintenance and repair work, all the service panels and internal panels of aft cargo compartment were installed.

All the damages/cracks/deformations observed during the inspection were caused by the impact of aircraft due tail strike. No abnormality in the movement or unbalancing of flight controls was reported before the incident that can cause

deviation in pitch or roll attitude of the aircraft. The MEL on 'Smoke Maintenance Msg' was revoked on 03.01.2023.

1.17 ORGANIZATIONAL AND MANAGEMENT INFORMATION:

M/s InterGlobe Aviation Ltd (Operating as IndiGo Airline) is a subsidiary of InterGlobe Enterprises. It is a scheduled airline operator with its main base at IGI Airport, New Delhi. The airline is engaged in international and domestic operation as passenger carrier as well as a cargo operator.

It started its operation in 2006 with Airbus A-320 aircraft as a domestic passenger carrier. Later on A321 and ATR 72 aircraft were also introduced into its fleet. The airline extended its operation to international destinations in the year 2011. At the time of incident, the airline had a fleet of 294 aircraft engaged in Domestic and International operation. The company is headed by a Chief Executive Officer. It has various departments like Engineering, Operations, Flight Safety, Security etc. headed by the competent professionals. The company has own training set-up to conduct technical, operational, safety and other in-house trainings for its employees and other services providers.

1.18 ADDITIONAL INFORMATION:

As per the PIC statement, the FO was the PF. The runway in use in Kolkata was 01R and the type of approach was ILS. The approach was conducted with Flaps Full and Autobrake Low. The aircraft was fully stabilised by 1500 ft. The aircraft was flown manually from approximately 1500 ft. The touchdown was in the touchdown zone. After the touchdown there was a slight bounce and during that the FO pulled the side stick back which resulted in nose high pitch attitude and PITCH PITCH annunciation came. He further submitted that before he could give his input the tail had already hit the runway. After parking, the tail strike was confirmed with the AME.

The first officer submitted that the aircraft was fully configured with autobrake low and was stabilized at around 1800 Feet. At 1500 ft the autopilot was disconnected and aircraft was flown manually. The aircraft stayed stabilized and crossed runway threshold around 50 feet RA and a very light backward side stick input was given to arrest the ROD slightly. On reaching 30 feet flare started and retarded thrust levers. After retarding thrust levers he felt the aircraft was sinking. To arrest ROD, he further pulled the side stick and nose went up ‘High’ caused the auto "PITCH PITCH" annunciation. After finishing parking checklist and other paperwork when he went for external walk around, the tail strike was noticed.

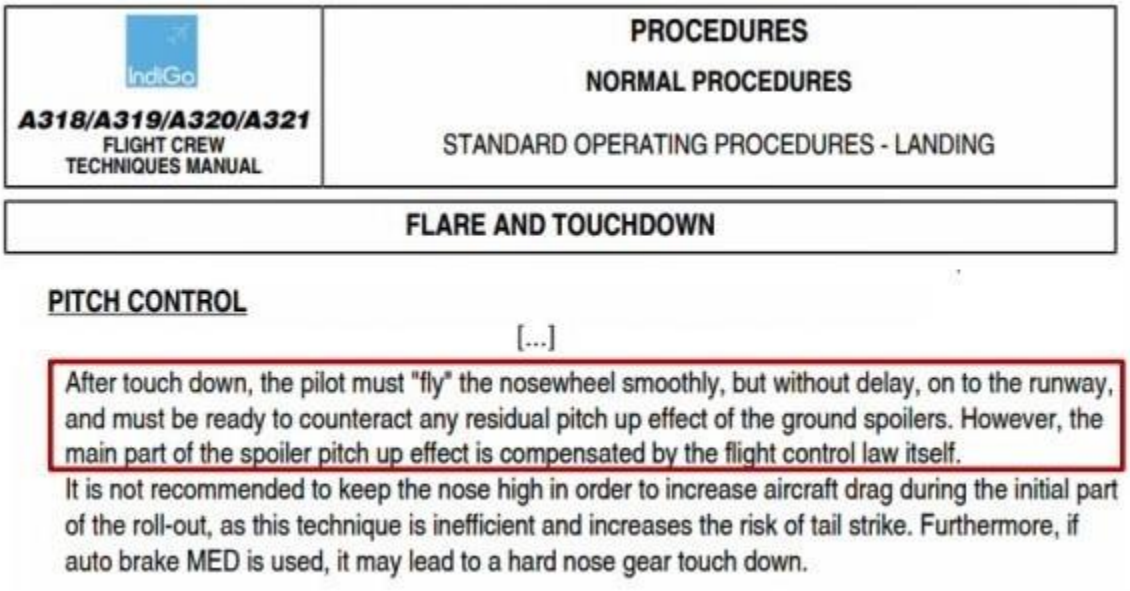
As per the Airbus report, the aircraft involved in the incident is fitted with the tail strike prevention system. This modification introduces the tailstrike pitch limit indicator on the PFD and the ‘PITCH PITCH’ annunciation to avoid tailstrike during landing.

M/s Indigo has also reflected in its FCTM, the SOP for Pitch control while flaring and touchdown the aircraft.

As per the FCTM, after touchdown, the flight crew should “fly” the nose wheel without delay onto the runway and must be ready to counteract any **residual pitch up effect of the ground spoiler.**

It is **not recommended** to keep the nose high in order to increase aircraft drag during the initial part of the roll-out, as this technique is inefficient and increases

the risk of tail strike. Furthermore, if auto brake MED is used, it may lead to a hard nose gear touch down.



A318/A319/A320/A321 FLIGHT CREW TECHNIQUES MANUAL	PROCEDURES NORMAL PROCEDURES STANDARD OPERATING PROCEDURES - LANDING

FLARE AND TOUCHDOWN

PITCH CONTROL

[...]

After touch down, the pilot must "fly" the nosewheel smoothly, but without delay, on to the runway, and must be ready to counteract any residual pitch up effect of the ground spoilers. However, the main part of the spoiler pitch up effect is compensated by the flight control law itself.

It is not recommended to keep the nose high in order to increase aircraft drag during the initial part of the roll-out, as this technique is inefficient and increases the risk of tail strike. Furthermore, if auto brake MED is used, it may lead to a hard nose gear touch down.

From the above discussion, application of ground spoiler also causes the pitch up effect in addition to the side stick input.

1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES.

Nil.

2. ANALYSIS:

2.1. Technical Aspects: Aircraft had valid Certificate of Airworthiness. All the mandatory modifications were complied with and the aircraft was maintained as per the approved maintenance programme. The tailstrike prevention system fitted on the aircraft introduced the tailstrike pitch limit indicator on the PFD and the PITCH PITCH synthetic voice to avoid tailstrike during landing.

The ARC was last renewed on 06.09.2022 which was valid till 05.09.2023. On the day of incident after operating first flight of the day, the aircraft was released under MEL. The invoked MEL has no contribution to the incident of tail strike. On 03.01.2023, the MEL was revoked.

The Suspected hard landing reported in the sector previous to the incident flight had no effect on the aircraft performance. The vertical acceleration recorded for suspected hard landing was well below the maximum vertical acceleration defined by the manufacturer that requires maintenance action. As per the PFR generated, no failure/damage was observed. As per load report, the landing weight was within the limit. The aircraft released for further flight.

From the above deliberations, it is evident that the technical aspect was not the contributory factor to the incident.

2.2. Operational Aspects: PIC had sufficient flying experience to fly the aircraft. He had flown various aircraft as PIC before joining M/s Indigo. He had successfully completed the required trainings for endorsement of A320 series aircraft on his ATPL as PIC. He was also cleared by the operator to permit the FO for supervisory take-off landing (STOL) after due assessment. He was involved in an incident of deviation from assigned SID while operating an international flight with M/s Indigo although the incident was not of similar type.

The FO officer had sufficient experience to operate A320 family aircraft as First Officer and to perform the STOL. He underwent the required training and the operator assessed him properly and imparted him additional trainings based on his performance before releasing him as FO.

While operating the previous sector (from Kolkata to Dhaka), suspected hard landing was reported. The PIC advised the FO to pull the side stick slightly to arrest the ROD and to avoid the possibility of hard landing. For the incident flight the PIC repeatedly advised the FO to pull the side stick slightly while approaching for landing. Initially the FO gave very small pitch up input. Later he started to increase the pitch-up input that resulted reduction in ROD to 224ft/min at 10ft RA. After crossing 10ft of RA, he suddenly increased the input to maximum at the time of touch down. Application of ground spoiler while landing also caused the pitch up effect. High pitch-up input alongwith application of ground spoiler caused the pitch attitude of the aircraft increased to 10.7^{o} after touchdown. This high

pitch attitude caused tail strike of the aircraft. PITCH PITCH annunciation came however, no input from the PIC has been observed throughout the flight. The FO continued pitch-up input to its maximum limit even after touchdown of Main Landing Gear. However, after the touchdown, lift component reduced as per aerodynamic law due to decrease in ground speed and the aircraft itself started to reduce its pitch. After landing, the FO and PIC discussed the possibility of tail strike. Meanwhile, Cabin crew informed the cockpit about the abnormal landing and **loud sound** heard in the cabin.

The landing profile during flaring and touch down was not as per the FCTM of the operator. The FCTM clearly mentions that, after touchdown, **the flight crew should "fly" the nose wheel without delay onto the runway** and must be ready to counteract any residual pitch up effect of the ground spoiler.

It is **not recommended** to keep the **nose high** in order to increase aircraft drag **during the initial part of the roll-out**, as this technique is inefficient and increases the risk of tail strike.

The weather was normal throughout the approach and has no contribution to the incident.

2.3. Factors Leading to Incident: From the above analysis, it is observed that continued high pitch-up input by the FO along with pitch-up effect of the ground spoiler, lack of monitoring by the PIC of high input by the FO with low ROD and absence of any input by the PIC after PITCH PITCH annunciation caused the sudden increase in pitch attitude of the aircraft after the touchdown that resulted in the tail strike incident.

3. CONCLUSIONS:

3.1. FINDINGS:

1. Aircraft had valid Certificate of Airworthiness. All the applicable checks for maintenance as per the approved schedule and mandatory modifications were performed on the aircraft.

2. The aircraft actual landing weight was well within the maximum landing weight permitted for the aircraft.
3. Weather was normal at the time of incident.
4. Both the crew had sufficient flying experience on the type of aircraft.
5. Both the crew had undergone Pre-Flight Breath Analyser test and they were not observed under the influence of alcohol.
6. Flight Duty Time of both the crew was found to be within the limits.
7. Earlier the PIC had been involved in an incident of deviation from assigned SID on 23.09.2021 while operating an international flight with M/s Indigo.
8. The aircraft was cleared for ILS approach on RWY 01R.
9. Both crew were assessed and cleared by the operator for supervisory take-off landing (STOL).
10. For the incident flight, the FO was the pilot flying (PF) to perform the supervisory landing and the PIC was the pilot monitoring (PM).
11. In the previous sector, the FO was also the PF and he performed a suspected hard landing. After landing, the PIC had advised the FO to keep side stick pulled up slightly to arrest the ROD.
12. For the incident flight, the aircraft approach was normal till the touchdown.
13. The PIC asked the FO to pull the side stick slightly to keep the aircraft nose slightly up.
14. Suddenly, the FO increased the pitch up input that caused reduction in ROD to 224ft/min at 10ft of RA.
15. The PIC could not monitor the increase in pitch up input and decrease in ROD. Even, he advised the FO to pull-up the side stick during landing.
16. The FO continued to increase the pitch-up input that reached to its maximum limit at the time of touchdown.
17. High pitch up input caused the increase in pitch attitude of the aircraft after landing.
18. Pitch angle after touchdown increased to 10.7^{o} which led to the tail strike.
19. No input from the PIC side has been observed throughout the flight neither in the previous sector nor in the incident flight even after PITCH PITCH annunciation.
20. The FO continued high pitch-up input after touch down causing the delay in nose wheel touching the runway.

21. Later the PIC pointed out that pitch input by FO was very high.

3.2 PROBABLE CAUSES:

Continuous high pitch-up input by the FO while landing causing the increase in pitch attitude of the aircraft after touchdown attributed to the tail strike.

Lack of monitoring the flight parameters and no corrective input by PIC while landing contributed to the incident.

4. SAFETY RECOMMENDATIONS:

The action in view of findings on the part of crew as deemed fit may be taken.

(Rupinder Singh)
Investigator In-charge

Place: New Delhi
Dated : 23.10.2023

ABBREVIATIONS USED IN THE REPORT

AD	:	Airworthiness Directive
AFC	:	Airframe Cycles
AME	:	Aircraft Maintenance Engineer
AMM	:	Aircraft Maintenance Manual
ALW	:	All-up Landing Weight
ASDA	:	Accelerate-Stop Distance Available
ATC	:	Air Traffic Control
ATIS	:	Automatic Terminal Information Service
ATPL	:	Airline Transport Pilot License
AUW	:	All-up Weight
CAR	:	Civil Aviation Requirements
C.G.	:	Center of Gravity
CPL	:	Commercial Pilot License
CVR	:	Cockpit Voice Recorder
DGCA	:	Directorate General of Civil Aviation
DFDR	:	Digital Flight Data Recorder
DI	:	Daily Inspection
DVOR	:	Doppler VHF Omnidirectional Range
FCTM	:	Flight Crew Training Manual
FDTL	:	Flight Duty Time Limitations
FFS	:	Full Flight Simulator
FEW	:	Few clouds
FO	:	First Officer
HZ	:	Haze
IAS	:	Indicated Air Speed
ICAO	:	International Civil Aviation Organisation
ILS	:	Instrument Landing System
IMD	:	Indian Meteorological Department
IST	:	Indian Standard Time
LDA	:	Landing Distance Available

MLG	:	Main Landing Gear
NDB	:	Non Directional Beacon
NOSIG	:	No Significant Change
OVC	:	Overcast Cloud
PDR	:	Pilot Defect Report
PIC	:	Pilot-in-Command
POH	:	Pilot's Operating Handbook
PAPI	:	Precision Approach Path Indicators
QNH	:	Pressure Setting to Indicate Elevation
RA	:	Radio Altitude
RESA	:	Runway End Safety Area
ROD	:	Rate of Descent
RWY	:	Runway
SALS	:	Simple Approach Lighting System
SB	:	Service Bulletin
STOL	:	Supervisory Take-off Landing
TAH	:	Total Airframe Hours
TAC	:	Total Aircraft Cycles
TODA	:	Take-off Distance Available
TORA	:	Take-off Run Available
TOW	:	Take-off Weight
UTC	:	Universal Time Coordinated
VHF	:	Very High Frequency
VOR	:	VHF Omni Range
ZFW	:	Zero Fuel Weight