Final Investigation Report on Abnormal Runway Contact Incident to M/s. Srilankan Airlines A330-343 aircraft Regn. 4R-ALR at Cochin on 27/05/2018

1. Aircraft

Manufacturer	: Airbus
Model	: A330-343
Nationality	: Sri Lanka
Registration	: 4R-ALR

2. Name of the Owner : HKAC leasing 1689 (Ireland) Limited.

3. Name of the Operator or Hirer : Sri Lankan Airlines Ltd.

4. Pilot-In-Command:

License No.	: Valid ATPL Holder
Extent of Injuries	: Nil

5. Co-Pilot:-

License No.	: Valid CPL Holder
Extent of Injuries	: Nil

6. No. of passengers on-board : 258

Extent of injuries : Nil

7. Place of incident : Cochin International Airport

Coordinates : 10°09'14"N & 76° 24' 25"E

8. Date & Time of incident : 27-05-2018 & 0955 UTC

9. Last point of Departure : VCBI, Colombo, Sri Lanka

10. Point of intended landing : VOCI, Cochin, India

11. Type of operation : Scheduled, Passenger

12. Phase of Operation : Landing

13. Type of incident : Off Centre Landing – (ARC)

Synopsis:

M/s. Srilankan Airlines A330-343 aircraft, while in the Operation of a scheduled passenger flight from Colombo to Cochin involved in an Abnormal Runway Contact incident at Cochin International Airport on 27th May 2018 at 0955 UTC. While landing on runway 27, aircraft's Main Landing Gear (MLG) Right Hand Side touched down on the unpaved surface and longitudinally ran over a distance of approx. 420 metres in the same direction and then RH MLG entered the runway. This was witnessed by the Air Traffic Controller (ATC) and Surface Movement Controller (SMC).

On enquiry with the aircraft by ATC and by SMC (on change over) for any assistance, the aircraft replied aircraft was on control and no assistance required. The aircraft taxied on its own power to the designated parking stand number 22 safely. The aircraft damaged two runway edge lights while re-entering the runway.

The incident has been investigated by an Investigator In-Charge appointed by DGCA, India vide letter No. DGCA-15018(21)/2/2018-DAS dated 29/05/2018 in exercise of power under Rule 13(1) of the aircraft (Investigation of accidents and incidents) Rules 2017.

Srilankan Civil Aviation Authority has nominated accredited representative as state of Registry.

Lapses in the Decision Making by the Pilot Monitoring to land under deteriorated weather condition & inadequate landing maneuvers carried out by the Pilot Flying to correct the deviation of the aircraft in the last 50ft to touchdown was the probable cause of the incident and weather was a contributory factor.

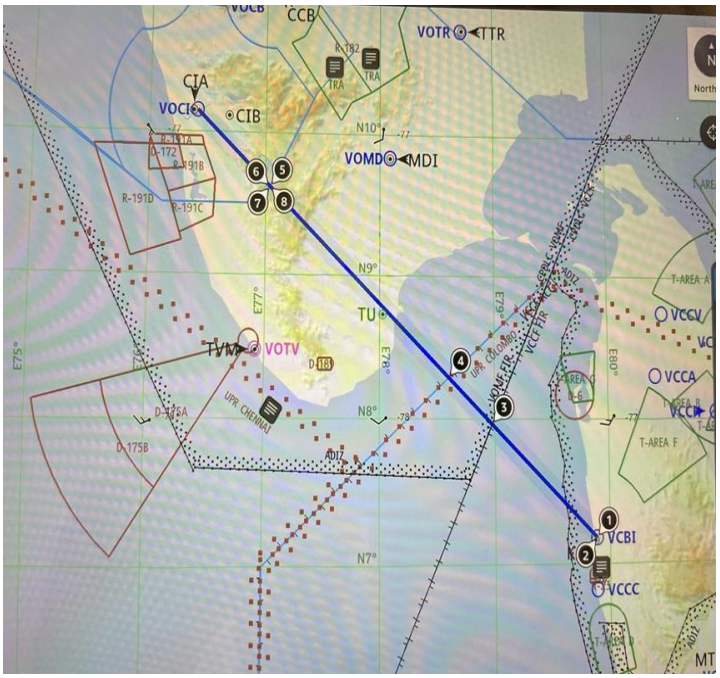
1. FACTUAL INFORMATION

1.1 *History of the flight.*

M/s. Srilankan Airline's Airbus 330-343 aircraft Registration 4R-ALR on 27/05/2018 was scheduled for UL167, Colombo (VCBI) to Cochin (VOCI) with 270 Persons (258 passengers and 12 operating crew) and total fuel of 6800 Kg on board. Aircraft got airborne from Colombo International Airport at 0851 UTC.

After the release of Colombo control, the aircraft came in contact with Trivandrum radar control at FL 272 and climbed to FL 300 in coordination with Trivandrum control. On completion of approach checklist, the aircraft was cleared to descent FL 260 and then FL 190. The aircraft was asked to contact Cochin control at FL 190.

With Cochin control, UL 167 requested for weather deviation and requested for direct routing 'C' 'I' 'B'. But, Controller informed that the runway in use is 09 and hence routed via 'C' 'I' 'A' with wind condition as 190 / 07 kts. Cochin control also informed the aircraft, to be ready for radar vectored VOR approach for runway 09.



When UL 167 (landing sequence #2) was at FL 110, the aircraft requested traffic information of the number one aircraft in the landing sequence. Controller informed that the traffic was at 47 miles from touchdown and updated the visibility of Cochin aerodrome as 1500 meter. UL167 requested for ILS runway 27. Controller informed that as number one carrying out landing on runway 09, UL167 could expect delay on runway 27. Aircraft enquired with the controller that if, the aircraft (UL167) could expedite, whether they could use runway 27 right away. Accordingly, UL167 was asked to proceed direct 'C' 'I' 'B' for ILS X-ray runway 27 and at that time they were 23 miles from touchdown.

Aircraft came in contact with Cochin tower at 11 miles and tower informed the runway condition as wet and wind was 210° / 04 kts & rain almost stopped. When the aircraft was at 04 miles to touch down, current surface wind condition was informed to the aircraft as 180° / 08 kts.

At 0955 UTC, the aircraft carried out landing at Cochin International Airport. However, while landing, Tower controller and SMC controller noticed that the aircraft not landed on the centre of the runway 27 and subsequently the aircraft re-entered the runway. Immediately, fire station was alerted by the Air traffic controller and also the aircraft was contacted for any assistance. Crew reported that the aircraft was under control and no assistance required.

When the aircraft came under the control of SMC control, SMC controller also enquired with the aircraft for any assistance and the aircraft informed no assistance required. The aircraft vacated runway 27 and taxied via 'C 3', 'F' to stand 22 on its own power. As per the airport surveillance camera recorded data at the time of landing it was drizzling and runway was wet.

Fig.1A: Aircraft position during touchdown on runway 27 (NLG still in the air)

Fig.1B: Aircraft position during touchdown on runway 27. (Another view)

1.2 ***Injuries to persons.***

Injuries	*Crew*	*Passengers*	*Others*
Fatal	*Nil*	*Nil*	*Nil*
Serious	*Nil*	*Nil*	*Nil*
Minor/ None	*Nil/12*	*Nil/258*	

1.3 ***Damage to aircraft.***

Aircraft sustained minor damages. On visual inspection, RH side MLG tyres received the following damages;

a. Multiple cuts on # 3, # 4 and # 8 main wheels side wall.
b. Thread got separated and found hanging on #7 main wheel.

Fig 2A: Damaged tyre

Fig 2B: Damaged tyre

Fig 2C: Damaged tyre

Fig 2D: Damaged tyre

Fig 2E: RH MLG wheel areas with debris

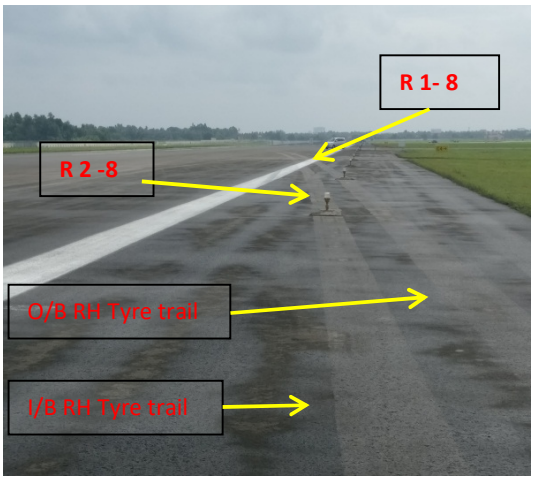
Fig 2F: RH MLG wheel areas with debris

1.4 ***Other damage.***

During runway inspection, two runway edge lights R 1-8 & R 2-8 were found broken at the re-entry point of the RH MLG.

Fig 03: R 1-8 & R 2-8 Runway edge lights (broken)

Fig 04: Tyre marks (Photo's taken after replacement of the lights)



1.5 ***Personnel information:***

1.5.1 ***Pilot – in - Command:-***

Age, Gender	: 41Years, Male
Licence	: Holder of ATPL
Date of Issue	: 19/02/2018
Valid up to	: 24/08/2018
Category	: Aeroplane
Date of Class I Med. Exam	: 25/08/2017
Class I medical Valid up to	: 24/08/2018
IR rating and instructor rating	: IR 19/02/2018 & Nil
Flying Experience	
During the last One Year	: 512:10 Hrs.
During the last Six Months	: 454:38 Hrs.
During the last 90 Days	: 196:18 Hrs.
During the last 30 Days	: 58:33 Hrs.
During the last 07 Days	: 32:59 Hrs.
During the last 24 Hours	: 00:54 Hrs.
Rest Before the flight	: 18:34 Hrs.

1.5.2 **Co-Pilot:-**

Age, Gender	: 38Years, Male
Licence	: Holder of CPL
Date of Issue	: 16/02/2018
Valid up to	: 28/02/2019
Category	: Aeroplane
Date of Class I Med. Exam	: 16/02/2018
Class I medical Valid up to	: 28/02/2019
IR rating and instructor rating	: IR 19/02/2018 & Nil
Flying Experience	
During the last One Year	: 900:27 Hrs.
During the last Six Months	: 493:57 Hrs.
During the last 90 Days	: 215:13 Hrs.
During the last 30 Days	: 88:23 Hrs.
During the last 07 Days	: 28:51 Hrs.
During the last 24 Hours	: 00:54 Hrs.
Rest Before the flight	: 68:10 Hrs.

1.6 ***Aircraft information:***

Aircraft Make & Model	: Airbus & A 330- 343
Aircraft Serial No	: 01689
Registration	: 4R-ALR
Certificate of Airworthiness	: valid till 28/12/2018
Authorised Operations	: a. Commercial Passenger Operation b. Commercial Cargo Operation c. Crew Familiarisation
Certificate of Registration issued on	: 06/11/2017 & valid till 28/12/2018
Airframe FH	: 12065Hours.
Flight Cycle	: 2356
Insurance period	: 11th July 2017 to 11th July 2018 for World wide
Last major inspection carried out	: A1 Check - 15/05/2018 A4 Check on - 21/03/2018 1C+A3 check on - 05/02/2018

Details of Last inspection carried out prior to the release for the occurrence sector operation

Transit Check on	: 27/05/2018 at 0814 UTC
Daily Check on	: 26/05/2018 at 0720 UTC
Weekly Check on	: 21/05/2018 at 0030 UTC

On the date of incident, the aircraft was fully serviceable.

1.7 ***Meteorological Information***

As per Cochin METAR report, from 0930 UTC to 1000 UTC, wind direction varied between 180° to 150°, wind speed varied between 04 kts to 10 kts and visibility varied between 5000 meters to 1500 meters. Clouds and Thunderstorm with moderate rain was also forecasted.

At (Time)	0930Z	0935Z (SPECI)	0950Z(SPECI)	1000Z
Winds	18009KTS	16010KTS	15004KTS	15008KTS
Visibility	5000M	1500M	3000M	1500M
Weather	HZ	MOD TSRA	MOD TSRA	MOD TSRA

During the course flight, the Cochin controller updated the aircraft about the weather condition as mentioned below:

- At 11 miles for runway 27, wind was 210°/ 04 kts, the runway condition was wet and the rain almost stopped.
- At the time of landing clearance, current surface wind was 180° / 08 kts.

1.8 ***Aids to Navigation***

Cochin international airport is equipped with ILS. At the time of incident, ILS was serviceable. Other standard aids like Approach Lighting System, Runway Lighting System, PAPI, WDIs, Landing Direction Indicators were found available and in serviceable condition.

1.9 ***Communications***

Throughout the operations, two way communications were established between aircraft and control tower.

1.10***Aerodrome Information***

The airport is operated by Cochin International Airport Limited (CIAL). The airport is licensed under DGCA for both IFR and VFR Operations.

Cochin International Airport has one Runway 27/09 (True Heading 268°/88°) of 3400 meters long and 45 meter width which can handle Code E planes. It has a full-length parallel taxiway. CAT-I landing aid is available for runway 27. Elevation of the Airport is 9.14 meter. Runway has got proper markings for Designation, THR, TDZ, RWY Centre line and Edge. Cochin airport has got Category 9 Fire fighting facility.

Latest Runway friction test was carried out on 15th May 2018 and the average lowest friction level was 0.66.

As per the airport surveillance camera, at the time of landing it was drizzling. No standing water on the runway during the time of landing.

Air Traffic Services are provided by M/s. Airports Authority of India.

1.11***Flight Recorders***

1.11.1:- Cockpit Voice Recorder (CVR)

From the CVR recorded data, the following are observed;

Initially crew requested for 'C' 'I' 'B' to clear of weather and straight into Cochin. However, Trivandrum Radar controller replied, the active runway is 09 and UL 167 will also be vectored for VOR approach runway 09.

After the release of Trivandrum Radar, the aircraft came into contact with Cochin approach control and informed that descending to FL130 and proceeding direct 'C' 'I' 'A'. UL 167 requested full procedure over the VOR due weather. Controller informed that they are in number 02 and expect holding over 'C' 'I' 'A' and the position of the aircraft ahead of them is 47 miles from touchdown.

When Cochin Tower cleared the aircraft for FL 110, visibility at Cochin was updated as 1500 meter. Due visibility reduced below UL 167's minima, the aircraft requested for ILS 27. However, the visibility constrain on runway 09 was not informed to the

Controller. Cochin Tower informed that as number one is carrying out landing on runway09, they may expect delay on runway 27.

The aircraft enquired whether they could expedite for landing, as they are ready for ILS x-ray operation on runway 27 right away. The controller approved their request and gave clearance for 'C' 'I' 'B' ILS X-ray runway 27 when UL 167 was at 23 miles from touchdown.

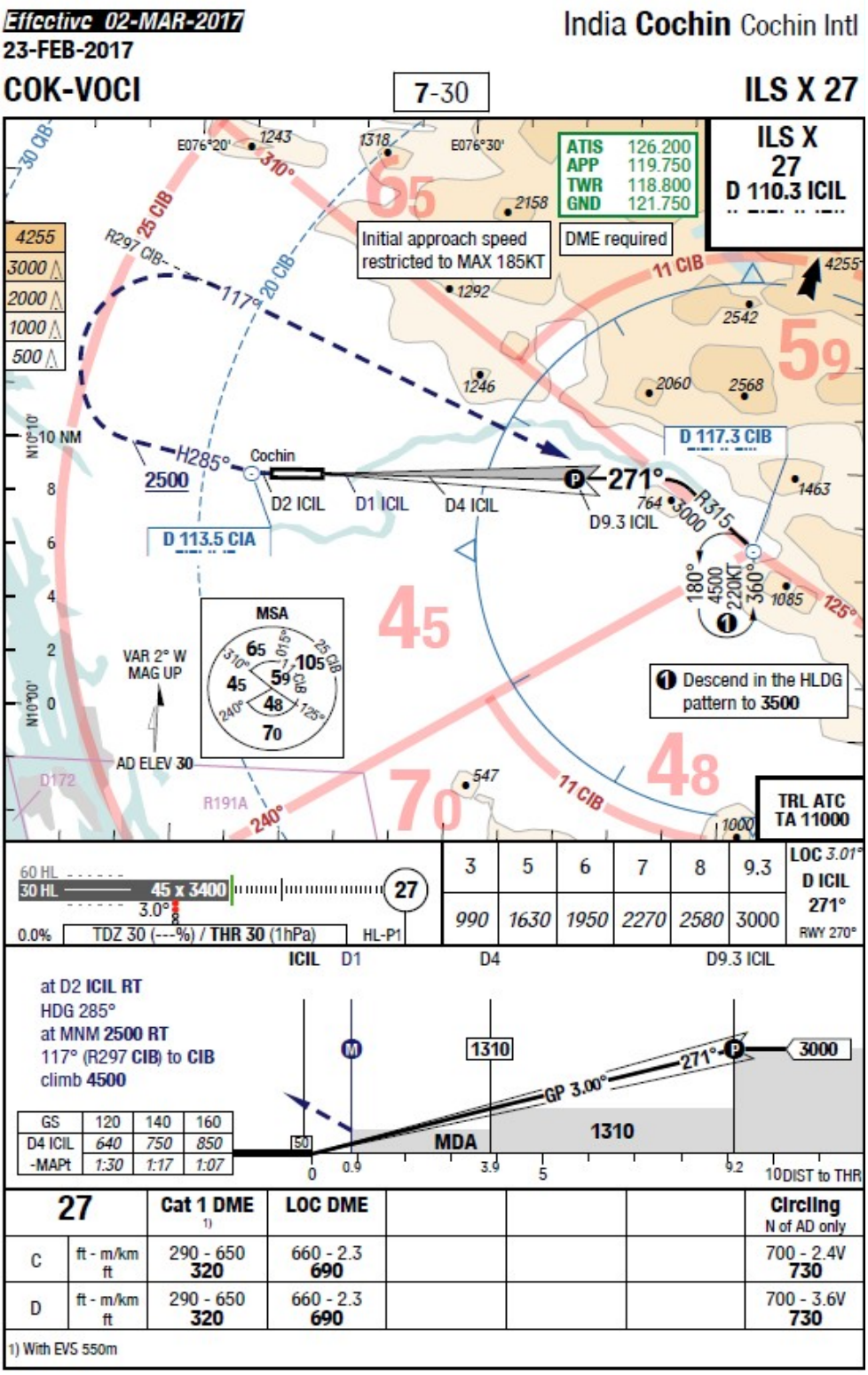
From the CVR, it has been observed that the Pilot In Command (PM) informed to the co-pilot (PF) that he does not want to ask the runway visibility details to the controller because, if it drops, they would messed up.

At 11 miles for runway 27, on enquiry by UL-167, Cochin Tower controller replied that the runway condition is wet, wind is 210°/ 04 kts and the rain almost stopped. The aircraft was configured to auto brakes low.

Crew completed the landing check list and at 04 miles for runway 27, landing clearance was confirmed by the controller. Runway in sight call was made by FO and acknowledged by PIC.

At around 1000 ft, left cross wind of 18 kts witnessed by the crew. Just prior to 400 ft auto call, Wiper was asked by the PF and was made available by PM. Subsequently, upon the aircraft touch down, PM asked for "centreline" twice at 6th second and at 15th second. As the aircraft did not align with the centre line, PM took over the control immediately.

Controller enquired UL 167 to confirm, whether the aircraft is under control and the aircraft replied affirm. The aircraft vacated via Taxiway C3 on its own power.



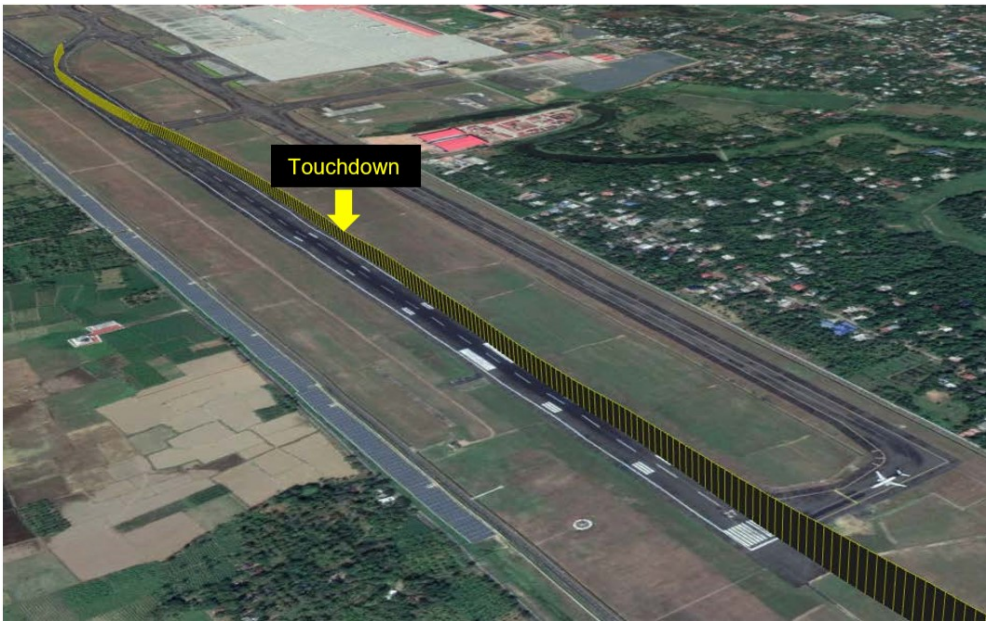
27		Cat 1 DME 1)	LOC DME				Circling N of AD only
C	ft - m/km ft	290 - 650 **320**	660 - 2.3 **690**				700 - 2.4V **730**
D	ft - m/km ft	290 - 650 **320**	660 - 2.3 **690**				700 - 3.6V **730**

1) With EVS 550m

Approach chart - extract

1.11.2:- Digital Flight Data Recorder (DFDR)

The following are the salient points from the numerical data and M/s. Airbus DFDR analysis report provided by the airline.



TRAJECTORY

At 1000ft of RA, the aircraft Gross weight was 163.8 T (MLW 187.0T). Aircraft CG was at 30.6%. Aircraft was in CONF 3 (Slats/Flaps 23°/22°). Landing gear was selected down. Ground spoilers were armed. Auto brake "LOW" mode was armed. Rate of descent was approximately 750ft/min. Pitch was +2.5° (nose up). Heading was 262° (Magnetic Heading of the Runway 270°). Drift angle was +7.5° (aircraft nose toward the left of the track). VLS was estimated at 130kt. Speed target was managed at 138kt (VAPP=VLS+8kt). CAS was 148kt (=VAPP+10kt) decreasing toward the speed target (reached at 09:54:36 UTC). The aircraft was on the correct lateral and vertical flight path and it was on the glide slope and the localizer.

CAS briefly exceeded several times of its callout values (-5 kts and +10 kts). At 900 ft RA CAS reached speed target +12kt and at 500 ft RA, CAS reached speed target -9 kts. But there was no call out made by PM. However, the A/THR countered the CAS exceedances by thrust adjustments to maintain the speed target.

At 880ft RA, crew disengaged the auto pilot and flown manually by the First Officer (PF). Flight Directors (FDs) were engaged in "G/S" (vertical) and "LOC" (lateral) mod. Auto thrust (A/THR) was engaged and active in "SPEED" mode.

Between 450ft RA and 50ft RA:

- Rate of descent varied between 900 ft/min & 600 ft/min, Pitch angle varied between +2° & +5° (nose up) and Roll angle varied between +3.5° (right wing down) & -2.0° (left wing down).
- Heading varied between 259° & 266° and Drift angle varied between +9° & +4° (aircraft nose toward the left of the track).
- Speed target was 138 kts & CAS was varied between 144 kts to 133 kts.
- Auto brake changed from "LOW" to "MED" mode at 320ft RA.
- Between 1000 ft RA (09:54:18 UTC) and 200 ft RA (09:55:18 UTC), the average wind recorded by the FDR comes from 178° at 21 kts (mean headwind component around 2kt and mean left crosswind component around 20 kts).
- Below 200ft, the longitudinal wind component changed from headwind to tailwind prior to touchdown. The left crosswind component significantly increased (approx. 20 kts) in the last 100ft.
- Aircraft was on the localizer and glide path.
- At 100ft RA the wind direction was 171.5° with wind speed of 22 kts. From 100ft to 50ft, the wind direction started changing and reached to 140.6° and speed reduced to 14 kts.

Between 50ft RA to touchdown:

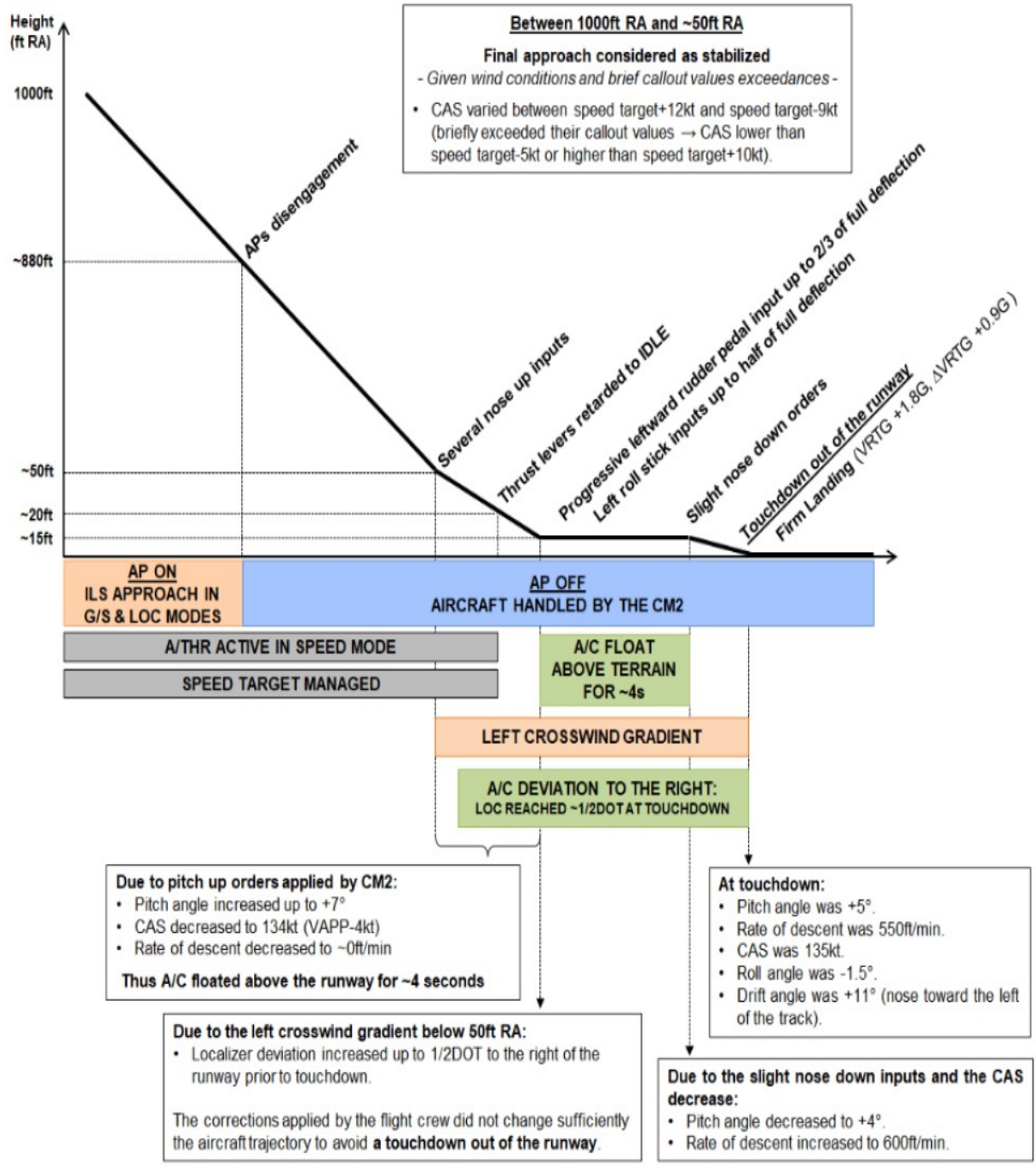
- At 40ft RA the wind direction was 165.9° and speed was 12 kts. From 40 ft RA to 16 ft RA, wind direction changed to 152° with an increased speed of 26 kts and from 40ft to 16ft of RA tail wind component increased from 3 kts to 12 kts and cross wind component from 11.6 kts to 23 kts. From 16 ft RA till touchdown, wind direction increased to 161° and wind speed increased to 31 kts (Tail wind of 10.09 kts and Cross wind of 29.31 kts).
- At approx. 40ft, Flare was initiated by the PF and Rate of Descent (ROD) was decreased from 650ft/min & reached 0 ft/min at 15ft.
- From 15 ft RA ROD started to increase again and reached maximum of 592 ft/min at 8 ft RA.
- At the time of touch down the ROD was 560 ft/min.
- From 50 ft RA to 14 ft RA Pitch angle increased from +4° to +7°. After that it decreased to +4° and at the time of touch down it was +5°.
- From 50 ft RA to 15 ft RA, there was no significant Roll angle variation (1.93° to 1.75°). However from 12ft onwards, it started to increase and reached a maximum of -2.98 (Left Wing down) at approx. 6 ft RA. At the time of touch down, roll angle was approx. 2.3°. At around 19ft, leftward rudder pedal input was applied up to 2/3 of full deflection.
- From 40 ft RA to 15 ft RA, aircraft heading remained at around 265° (QFU 270°). But below 15ft, it started to reduce and reached 258° at the time of touch down.

- From 40 ft RA to 15 ft RA Drift angle varied between +4.3° to +5.53 and below 15 ft RA, it started to increase and reached +12.39 (aircraft nose towards the left of the track) at the time of touch down.
- At 19ft RA, thrust levers were retarded to the "IDLE" detent leading to A/THR disengagement.
- CAS was maintained at around 138 kts till 25 ft RA. Below 25ft RA CAS started to increase and reached maximum of 147.2 kts at around 21 ft RA. After that it started to reduce and reached 134.6 kts at Touch down.
- The Localizer deviation was approximately ½ DOT to the right of the localizer at touchdown.

Touchdown, Rollout & Deceleration:

- At touchdown, the roll angle recorded was -1.5° (left wing down) and heading was 259°, the Left Main Landing Gear touched down first followed by the Right Main Landing Gear. The vertical acceleration recorded was +1.81G. The wind was 161°/31 kts.
- Ground spoilers were fully extended. Nose landing gear compressed after 6 seconds of Main landing gear touchdown.
- Leftward rudder pedal inputs up to full deflection followed by rightward rudder pedal inputs up to full deflection were applied. The localizer deviation was approximately 2/3 DOT just after touchdown before decreasing.
- 07 seconds after touchdown, right nose wheel steering (NWS) tiller order was applied (Ground speed around 126 kts).
- "MAX REV" thrust then "IDLE REV" thrust was selected.
- The manual braking was applied 21 seconds after touchdown, leading to autobrake deactivation.
- Wheel speed of MLG wheel numbers 4 and 8 did not increase as much as on the other wheels. After 5 seconds delay, reached the reference speed.
- Brake pressure of MLG wheel numbers 3, 4, 7 and 8 did not increase as much as on the other wheels. After 4 seconds delay, brake pressure was recorded.
- The aircraft decelerated and exited the runway via taxiway C3. The taxi was performed uneventfully.

M/s. Airbus is of the opinion that the Aircraft lateral deviation to the right increased significantly in the last 50 ft has made the aircraft to finally touchdown out of the runway. The flight crew must consider to perform a go-around if the stability is not maintained until landing.



DFDR Data KEY POINTS

GMT	CAS	GS	R ALT	VRTG	NWSM STR	HDG	RUDP	PTCH	ROLL	DA	WD	WS	NOS QUAT	LH SQUAT	RH SQUAT	WHLSP								
																D1	D2	D3	D4	D5	D6	D7	D8	VSPD
09:55:41-125	132.625	144	16	0.832031	-0.125	261.339	14.8535	4.92188	0.70313	10.3711	154.688	28	0	0	0	0	0	0	0	0	0	0	0	-208
09:55:41-250	132.625	144	16	0.816406	-0.125	261.339	13.0078	4.74609	0.52734	10.3711	154.688	28	0	0	0	0	0	0	0	0	0	0	0	-208
09:55:41-375	132.625	144	15	0.796875	0	261.163	10.2832	4.57031	0.35156	10.3711	154.688	28	0	0	0	0	0	0	0	0	0	0	0	-208
09:55:41-500	128.375	144	15	0.839844	0	260.987	9.66797	4.39453	0	10.3711	154.688	28	0	0	0	0	0	0	0	0	0	0	0	-448
09:55:41-625	128.375	144	14	0.78125	-0.125	260.987	10.3711	4.39453	-0.35156	10.3711	154.688	28	0	0	0	0	0	0	0	0	0	0	0	-448
09:55:41-750	128.375	144	14	0.777344	-0.125	260.635	10.3711	4.21875	-0.87891	10.3711	154.688	28	0	0	0	0	0	0	0	0	0	0	0	-448
09:55:42-000	131.875	144	12	0.839844	-0.125	260.283	9.31641	4.04297	-1.75781	10.3711	154.688	28	0	0	0	0	0	0	0	0	0	0	0	-544
09:55:42-125	131.875	143	10	0.839844	0	260.107	6.76758	4.04297	-1.93359	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-544
09:55:42-250	131.875	143	10	0.878906	0	259.932	6.76758	4.04297	-2.46094	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-544
09:55:42-375	131.875	143	8	0.878906	0	259.756	6.41602	4.04297	-2.63672	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-544
09:55:42-500	135.125	143	8	0.878906	0	259.404	3.95508	4.04297	-2.8125	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-592
09:55:42-625	135.125	143	6	0.945313	0	259.228	3.42773	4.21875	-2.8125	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-592
09:55:42-750	135.125	143	6	0.890625	0	258.876	2.19727	4.39453	-2.98828	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-592
09:55:42-875	135.125	143	3	0.929688	0	258.701	5.09766	4.57031	-2.8125	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-592
09:55:43-000	134.625	143	3	0.890625	0	258.525	5.00977	4.74609	-2.63672	11.3379	154.688	29	0	0	0	0	0	0	0	0	0	0	0	-560
09:55:43-125	134.625	142	0	0.910156	-0.125	258.349	4.21875	4.74609	-2.28516	12.3926	161.016	31	0	0	0	0	0	0	0	79	33	0	0	-560
09:55:43-250	134.625	142	0	1.003906	-0.125	258.173	2.63672	4.92188	-1.40625	12.3926	161.016	31	0	0	0	0	0	0	0	79	33	0	0	-560
09:55:43-375	134.625	142	-2	1.199219	0	258.173	1.05469	4.92188	-0.87891	12.3926	161.016	31	0	1	0	0	0	0	0	79	33	0	0	-560
09:55:43-500	133.25	142	-2	1.507813	0	257.997	1.05469	4.74609	0.17578	12.3926	161.016	31	0	1	0	0	0	0	0	79	33	0	0	-464
09:55:43-625	133.25	142	-4	1.6875	0	257.997	0.9668	4.74609	0.87891	12.3926	161.016	31	0	1	1	0	0	113	28	79	33	126	21	-464
09:55:43-750	133.25	142	-4	1.808594	0	257.997	1.05469	4.74609	1.75781	12.3926	161.016	31	0	1	1	0	0	113	28	79	33	126	21	-464
09:55:43-875	133.25	142	-3	1.628906	0	257.997	0.9668	4.57031	1.75781	12.3926	161.016	31	0	1	1	0	0	113	28	79	33	126	21	-464
09:55:44-000	134.5	142	-3	1.226563	0	258.173	0.87891	4.39453	1.75781	12.3926	161.016	31	0	1	1	0	0	113	28	79	33	126	21	16
09:55:44-125	134.5	140	-2	1.03125	0	258.349	0.87891	4.39453	1.58203	12.3047	163.828	31	0	1	1	112	129	113	28	128	131	126	21	16
09:55:44-250	134.5	140	-2	0.867188	0	258.525	0.61523	4.04297	0.87891	12.3047	163.828	31	0	1	1	112	129	113	28	128	131	126	21	16
09:55:44-375	134.5	140	-1	0.894531	0	258.701	0.79102	3.86719	0.35156	12.3047	163.828	31	0	1	1	112	129	113	28	128	131	126	21	16
09:55:44-500	134.875	140	-1	0.792969	0	258.876	0.9668	3.51563	-0.52734	12.3047	163.828	31	0	1	1	112	129	113	28	128	131	126	21	-48
09:55:44-625	134.875	140	-1	0.832031	0	259.052	5.18555	3.33984	-1.05469	12.3047	163.828	31	0	1	1	112	129	123	28	128	131	118	33	-48
09:55:45-375	131.125	139	-1	1.046875	0	260.107	21.4453	2.28516	-1.23047	10.1074	160.313	26	0	1	1	133	131	123	28	121	128	118	33	-192
09:55:49-375	116.25	126	-1	1.015625	-2.75	258.525	6.94336	-0.5273	1.58203	9.05273	151.172	22	0	1	1	112	116	111	105	111	112	111	120	-96
09:55:49-500	110.875	126	-1	1.011719	-2.75	258.701	6.94336	-0.7031	1.58203	9.05273	151.172	22	0	1	1	112	116	111	105	111	112	111	120	-128
09:55:49-625	110.875	126	-1	0.953125	-6.375	258.525	7.11914	-0.7031	1.75781	9.05273	151.172	22	1	1	1	112	116	112	114	111	112	111	112	-128
09:55:49-750	110.875	126	-1	1.117188	-6.375	258.701	6.5918	-0.7031	1.93359	9.05273	151.172	22	1	1	1	112	116	112	114	111	112	111	112	-128
09:55:49-875	110.875	126	0	0.941406	-8.5	258.701	4.74609	-0.7031	1.93359	9.05273	151.172	22	1	1	1	112	116	112	114	111	112	111	112	-128
09:55:50-000	102.625	126	0	1.066406	-8.5	258.701	1.58203	-0.7031	1.93359	9.05273	151.172	22	1	1	1	112	116	112	114	111	112	111	112	0
09:55:53-750	98.75	107	0	0.929688	-0.25	263.097	-20.2148	-1.05469	1.23047	2.46094	168.047	6	1	1	1	79	93	96	88	79	83	93	87	-32

1.12 ***Wreckage and Impact Information.***

Impact markings indicate that the aircraft's RH MLG made a touch down on the unpaved muddy surface (RH side of the runway 27) and longitudinally around 810 meters from the threshold of runway 27. After rolled out for a distance of approx. 420 metres in the same path, RH MLG entered the runway shoulder pavement area and damaged two runway edge lights (R 1-8 & R 2-8) at the entry point on its track.

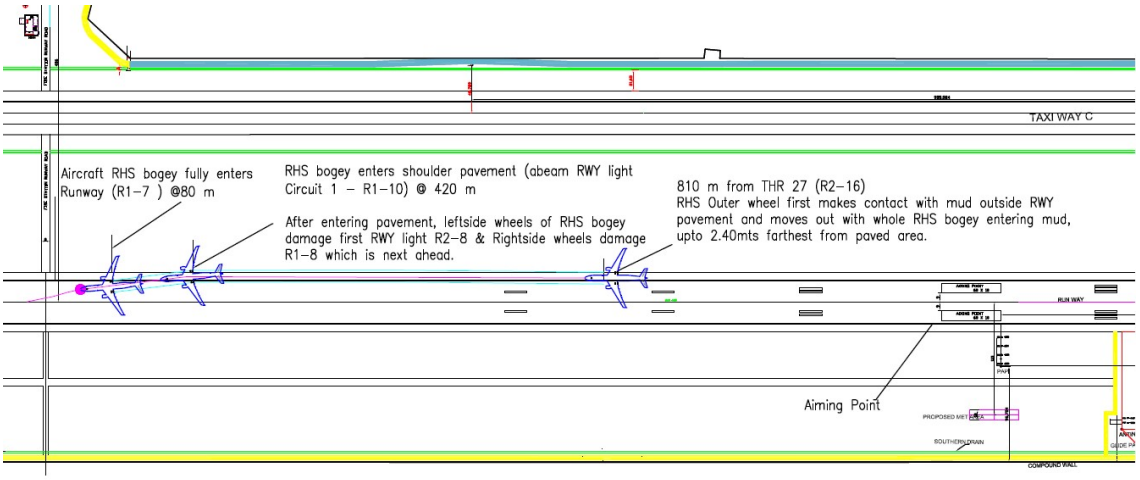


Fig.05A: Ground Markings left over by the aircraft on unpaved surface of Runway 27

Fig 05B: Ground Markings left over by the aircraft on unpaved surface of Runway 27 (in clear light)

1.13 ***Medical and Pathological Information.***

Nil

1.14 ***Fire***

There was no fire.

1.15 ***Survival Aspect.***

The incident was survivable.

1.16 ***Organisational and Management Information.***

a. Airline:-

M/s. Srilankan Airline is the National Carrier of Srilanka, launched in 1979. The airline's hub is at Bandaranaike International Airport in Colombo. It connects to its global route network of 105 destinations in 47 countries. M/s. Srilankan Airline currently has an all-Airbus fleet of 27 aircraft which includes Thirteen A330 &Fourteen A320/A321 aircraft.

b. Aerodrome:-

Cochin airport is built in a public–private partnership and is owned by a public limited company called Cochin International Airport Limited (CIAL) floated by the government of Kerala in 1994.

1.17 ***Tests and Research.***

Nil

1.18 ***Additional Information.***

1.18.1 **Crew Statements:-**

PIC stated that he was the Pilot Monitoring. As the visibility of runway 09 was 1500 metres which was below their minima of 1700 meter, runway 27 was requested. There was some CB activity north and south of airport but the airport was clear of weather. During intermediate approach, reported wind was 210°/04 kts. Upon asking tower about the runway condition, Cochin ATC informed that the rain was almost over. There was heavy rain on approach and wipers were turned ON. Runway was in sight. On Navigation Display wind was 170°/20 kts. At about 540 feet, "stable" call out was made. At Minimum "continue" call out was made and aircraft was on the correct approach path. On landing, the aircraft drifted to the right. Controls were taken over from the First Officer and steered the aircraft back on centreline.

As per the First Officer he was the Pilot Flying. Before the approach the tower changed the runway several times. Finally they were assigned runway 27 for landing. They commenced the approach and were fully configured before 1500 ft and stable before 1000 ft and below 1000 ft, PM asked wind and runway conditions. ATC replied with wind was 210°/04 kts and rain almost over. Approach was continued and at 500ft, stabilized call was made by PM. At that time experienced some rain on the approach path. At the minimums, continue call was made by PM. Below 50ft, it was heavy rain and at about 30 ft, tried to de-crab and align with the runway centre line and the aircraft was drifted off to the right side and touched down. Upon landing, saw some pool of water with some debris. While trying to manoeuvre towards centre line, PM took over the controls.

1.18.2. Standard Operating Procedure:-

a. STANDARD Callouts:-

Ident.: PRO-NOR-SOP-90-B-00011835.0001001 / 18 MAR 15

GEAR CALLOUTS

	CALLOUT	REMARK
PF	"GEAR UP (DOWN)"	
PM	"GEAR UP (DOWN)"	The PM selects the L/G lever position and replies after checking the red lights on the LDG GEAR indicator to confirm gear operation.

FLIGHT PARAMETERS

Applicable to: ALL

Ident.: PRO-NOR-SOP-90-C-00011836.0001001 / 22 MAR 17

APPROACH

During approach, the PM announces:

- "SPEED" if the speed decreases below the speed target -5 kt, or increases above the speed target +10 kt.
- "SINK RATE" when the descent rate exceeds 1 200 ft/min
- "BANK" when bank angle becomes greater than 7 °
- "PITCH" when pitch attitude becomes lower than 0 ° or higher than +10 °
- "LOC" or "GLIDE" when either localizer or glide slope deviation is:
  - ½ dot LOC
  - ½ dot GS
- "CROSS TRACK" when the XTK is greater than 0.1 NM
- "VDEV" when the vertical deviation is greater than ½ dot
- "COURSE" when greater than ½ dot or 2.5 °(VOR) or 5 ° (ADF)
- "__FT HIGH (LOW)" at altitude checks points.

Note: The PM announces the attitude deviations until landing.

Ident.: PRO-NOR-SOP-90-C-00021402.0001001 / 22 MAR 17

LANDING

During landing, the PM announces:

- "PITCH PITCH", if the pitch attitude approaches the tail strike pitch limit indicator ◅ , or reaches 7.5 °.
- "BANK BANK", if the bank angle reaches 7 °.

b. SOP for Go Around:-

GENERAL

Ident.: PR-NP-SOP-260-00019602.0001001 / 20 MAR 17
Applicable to: ALL

Failure to recognize the need for and to execute a go-around, when required, is a major cause of approach and landing accidents. Because a go-around is an infrequent occurrence, it is important to be "go-around minded". The decision to go-around should not be delayed, as an early go-around is safer than a last minute one at lower altitude.

CONSIDERATION ABOUT GO-AROUND

Applicable to: ALL

Ident.: PR-NP-SOP-260-A-00019603.0001001 / 14 MAY 18

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 malfunction 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 1 000 ft AAL in IMC or (500 ft AAL in VMC), or is not maintained until landing, or
- Any of the following alerts occur:
  - GPWS, or
  - TCAS, or
  - Windshear, or
  - ROW ◁ alerts for the relevant runway condition. Refer to AS-ROWROP Operating Techniques.
- Adequate visual references are not obtained at minima or lost below minima.

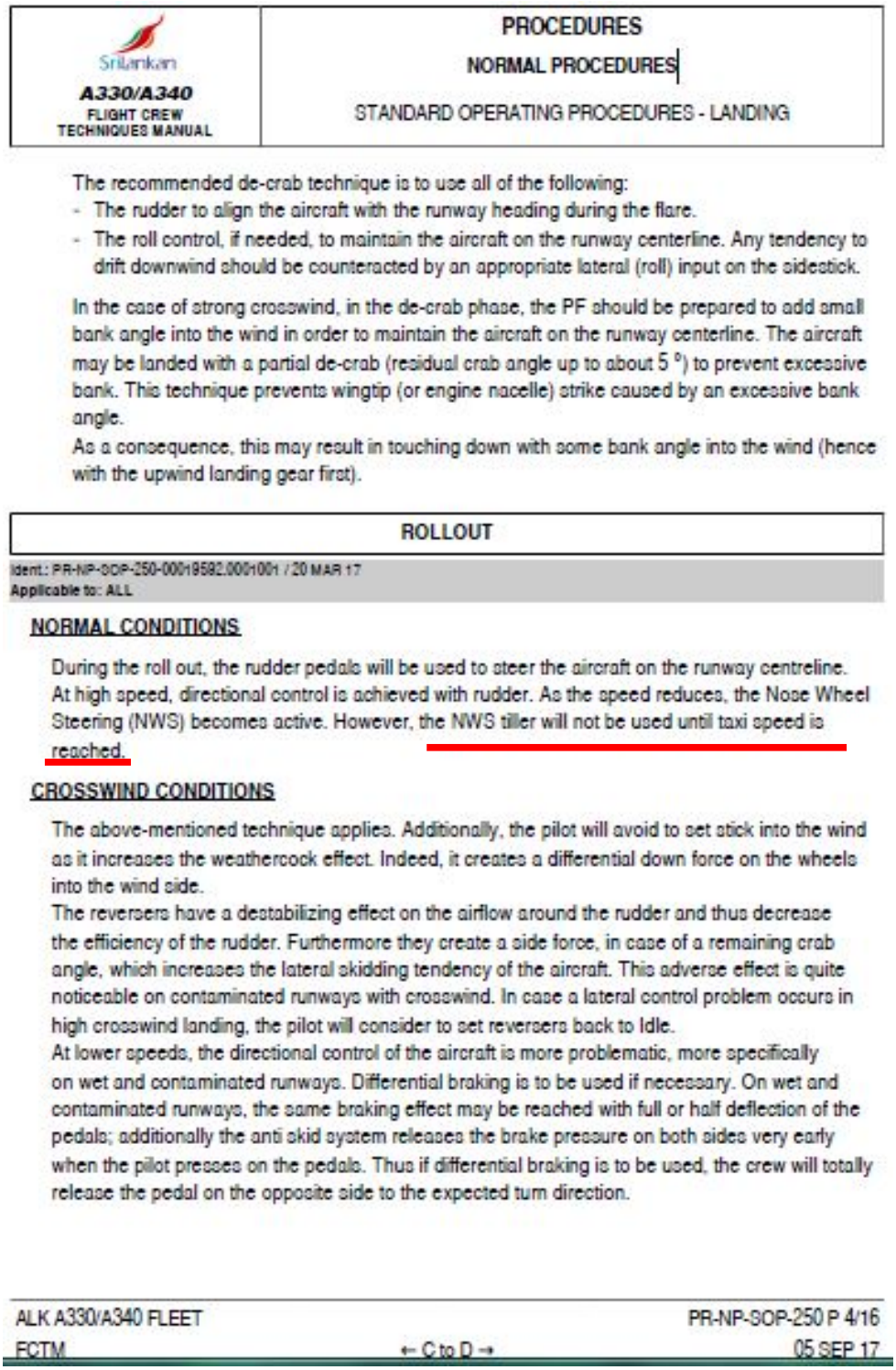
A Go- Around shall be initiated if Stable Approach Criteria is not achieved as per FOM 10.3.17

Ident.: PR-NP-SOP-260-A-00019604.0001001 / 20 MAR 17

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.

1.18.3. FCTM Procedure:-



Srilankan A330/A340 FLIGHT CREW TECHNIQUES MANUAL	PROCEDURES NORMAL PROCEDURES STANDARD OPERATING PROCEDURES - LANDING

The recommended de-crab technique is to use all of the following:

- The rudder to align the aircraft with the runway heading during the flare.
- The roll control, if needed, to maintain the aircraft on the runway centerline. Any tendency to drift downwind should be counteracted by an appropriate lateral (roll) input on the sidestick.

In the case of strong crosswind, in the de-crab phase, the PF should be prepared to add small bank angle into the wind in order to maintain the aircraft on the runway centerline. The aircraft may be landed with a partial de-crab (residual crab angle up to about 5 °) to prevent excessive bank. This technique prevents wingtip (or engine nacelle) strike caused by an excessive bank angle.

As a consequence, this may result in touching down with some bank angle into the wind (hence with the upwind landing gear first).

ROLLOUT

Ident.: PR-NP-SOP-250-000/19592.000/1001 / 20 MAR 17
Applicable to: ALL

NORMAL CONDITIONS

During the roll out, the rudder pedals will be used to steer the aircraft on the runway centreline. At high speed, directional control is achieved with rudder. As the speed reduces, the Nose Wheel Steering (NWS) becomes active. However, the NWS tiller will not be used until taxi speed is reached.

CROSSWIND CONDITIONS

The above-mentioned technique applies. Additionally, the pilot will avoid to set stick into the wind as it increases the weathercock effect. Indeed, it creates a differential down force on the wheels into the wind side.

The 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 reversers back to Idle.

At lower speeds, the directional control of the aircraft is more problematic, more specifically on wet and contaminated runways. Differential braking is to be used if necessary. On wet and contaminated runways, the same braking effect may be reached with full or half deflection of the pedals; additionally the anti skid system releases the brake pressure on both sides very early when the pilot presses on the pedals. Thus if differential braking is to be used, the crew will totally release the pedal on the opposite side to the expected turn direction.

ALK A330/A340 FLEET — PR-NP-SOP-250 P 4/16
FCTM — ← C to D → — 05 SEP 17

As per DFDR Data, it has been observed that 07 seconds after touchdown, a right nose wheel steering (NWS) tiller order was applied (at Ground speed around 126kt). *At high ground speeds, the commanded NWS angle is limited. Above 80kt of ground speed, a NWS tiller order is inhibited. The NWS tiller will not be used until taxi speed is reached.*

1.18.4. FCOM extract on Cross wind Limitations:-

As per the FCOM , Maximum cross wind on wet and contaminated runways with gust condition is 40Kt.

Ident.: LIM-AG-OPS-ARPT_WIND-00020759.0005001 / 22 MAR 17
Applicable to: ALL

MAXIMUM RECOMMENDED CROSSWIND ON WET AND CONTAMINATED RUNWAYS

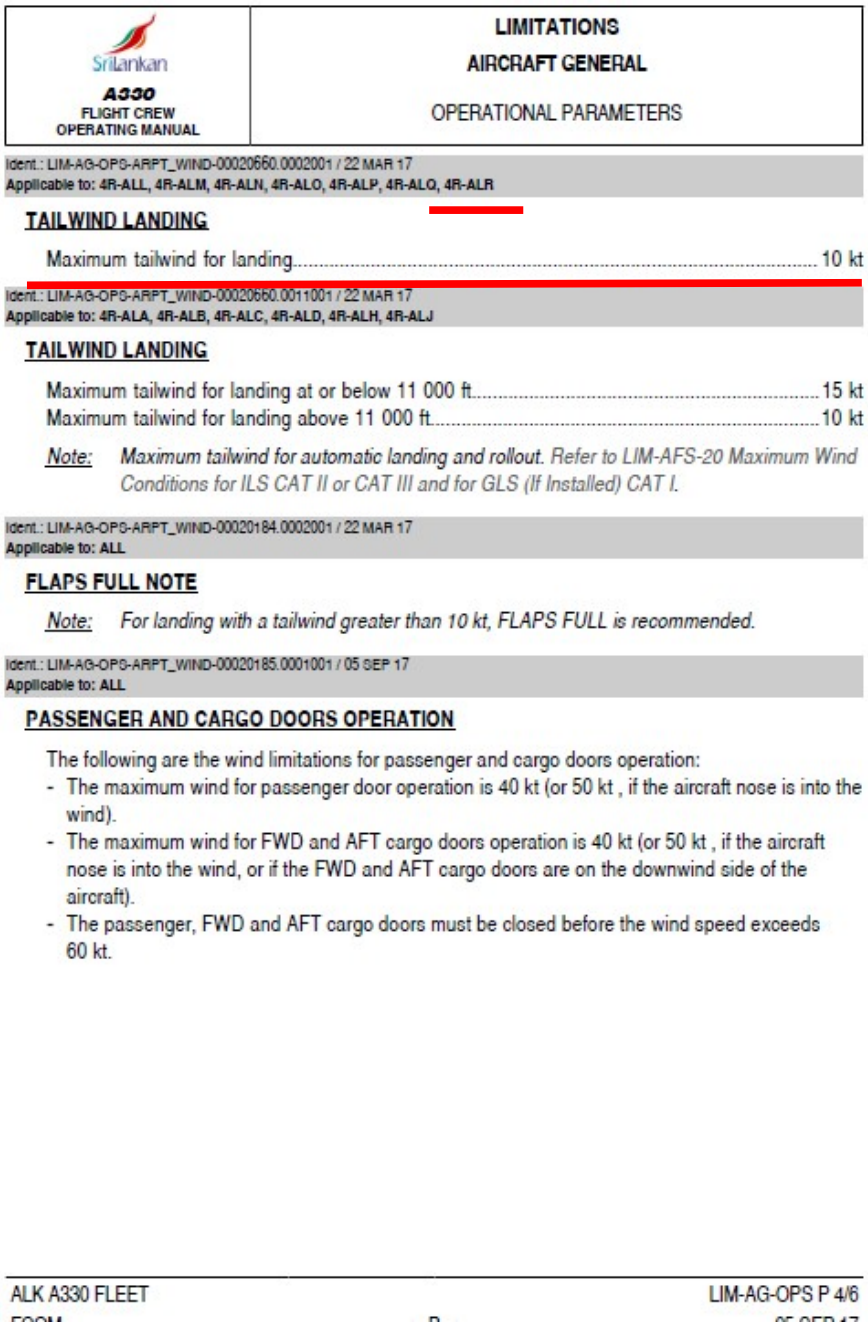
Runway Surface Conditions		Maximum Crosswind for Takeoff (Gust Included)	Maximum Crosswind for Landing (Gust Included)
Runway State or / and Runway Contaminant	ESF[1] or PIREP[2]		
Damp Wet Up to 3 mm (1/8") of water Slush Up to 3 mm (1/8") Dry snow Up to 3 mm (1/8") Wet snow Up to 3 mm (1/8") Frost	Good	32 kt	40 kt
Compacted snow OAT at or below -15 °C	Good to Medium	27 kt	27 kt
Dry snow More than 3 mm (1/8"), up to 100 mm (4") Wet snow More than 3 mm (1/8"), up to 30 mm (6/5") Compacted snow OAT above -15 °C Dry snow over compacted snow Wet snow over compacted snow Slippery when wet	Medium	20 kt	20 kt
Water More than 3 mm (1/8"), up to 12.7 mm (1/2") Slush More than 3 mm (1/8"), up to 12.7 mm (1/2")	Medium to Poor	20 kt	20 kt
Ice (cold & dry)	Poor	15 kt	15 kt

(1) *ESF: Estimated Surface Friction*

(2) *PIREP: Pilot Report of Braking Action*

Note: The maximum crosswind values given in the above table are recommended values based on computations.

1.18.5. FCOM extract on Tail wind Limitations:-



SriLankan
A330
FLIGHT CREW
OPERATING MANUAL

LIMITATIONS
AIRCRAFT GENERAL
OPERATIONAL PARAMETERS

Ident.: LIM-AG-OPS-ARPT_WIND-00020660.0002001 / 22 MAR 17
Applicable to: 4R-ALL, 4R-ALM, 4R-ALN, 4R-ALO, 4R-ALP, 4R-ALQ, 4R-ALR

TAILWIND LANDING

Maximum tailwind for landing..... 10 kt

Ident.: LIM-AG-OPS-ARPT_WIND-00020660.0011001 / 22 MAR 17
Applicable to: 4R-ALA, 4R-ALB, 4R-ALC, 4R-ALD, 4R-ALH, 4R-ALJ

TAILWIND LANDING

Maximum tailwind for landing at or below 11 000 ft..... 15 kt
Maximum tailwind for landing above 11 000 ft..... 10 kt

Note: *Maximum tailwind for automatic landing and rollout. Refer to LIM-AFS-20 Maximum Wind Conditions for ILS CAT II or CAT III and for GLS (If Installed) CAT I.*

Ident.: LIM-AG-OPS-ARPT_WIND-00020184.0002001 / 22 MAR 17
Applicable to: ALL

FLAPS FULL NOTE

Note: *For landing with a tailwind greater than 10 kt, FLAPS FULL is recommended.*

Ident.: LIM-AG-OPS-ARPT_WIND-00020185.0001001 / 05 SEP 17
Applicable to: ALL

PASSENGER AND CARGO DOORS OPERATION

The following are the wind limitations for passenger and cargo doors operation:
- The maximum wind for passenger door operation is 40 kt (or 50 kt , if the aircraft nose is into the wind).
- The maximum wind for FWD and AFT cargo doors operation is 40 kt (or 50 kt , if the aircraft nose is into the wind, or if the FWD and AFT cargo doors are on the downwind side of the aircraft).
- The passenger, FWD and AFT cargo doors must be closed before the wind speed exceeds 60 kt.

ALK A330 FLEET LIM-AG-OPS P 4/6

1.19. Useful or Effective investigation Techniques used

Nil

2. ANALYSIS

2.1 Aircraft handling techniques Operational Aspects:-

First Officer was carrying out the Pilot Flying duties and Pilot in Command was carrying out Pilot Monitoring activities. Crew initially planned for runway 27 on direct into Cochin. However, ATC has cleared UL 167 for runway 09 through 'C' 'I' 'A', since the runway in use was 09 at that time.

While descending to FL110, visibility on runway 09 dropped to 1500meter which is lesser than the UL 167's minima (i.e. 1700 meter). Hence crew requested ATC to clear for runway 27 through 'C' 'I' 'B' and the same was approved by the controller with landing sequence of #2 position. However crew has not informed the ATC about the reason for the change of runway (i.e. reduced minima on the runway 09). UL 167 was at 23 miles to runway 27. The sequence #1 aircraft was at 47 miles to runway 09. Meanwhile UL167 requested for ILS X-ray 27 to carry out landing immediately prior to the sequence #1 aircraft and the same was approved by the controller. During this time PM has not enquired about visibility on runway 27 to the controller, presuming that if the visibility on runway 27 is less than the required minima then landing at Cochin would be a problem. At 11miles, UL 167 was updated that runway condition as wet and wind 210°/04 kts. On enquiry by the crew about rain, controller informed rain almost stopped. Hence, the aircraft was configured for auto brakes LOW level and Landing Gear was selected down. After the completion of landing checklist, when the aircraft was at 04 miles to runway 27, clear to land on runway 27 was confirmed by the controller. Runway in sight call was made by PM and acknowledged by PF.

The final approach was manually handled by PF with the A/THR engaged and active in "SPEED" mode. CAS briefly exceeded several times from its callout values of -5 kts and +10 kts and CAS reached speed target +12 kts at 900 ft. The A/THR system countered the CAS exceedances by thrust adjustments to maintain the speed target. However no call out was made by PM. Just prior to 400 ft (auto call), Wipers were selected ON, which confirms the existence of rain on final phase of landing.

At 320 ft RA Auto brake changed from "LOW" to "MED" mode. Below 200ft, the longitudinal wind component changed from headwind to tailwind prior to touchdown. The left crosswind component significantly increased (approx. 20 kts) in the last 100ft. Aircraft was on the localizer and glide path.

From 50ft RA, the left crosswind component started to increase from 12 kts and reached 31 kts at the time of touchdown. The aircraft, initially aligned with the centreline of the runway, it started to deviate to the right for approximately 10 seconds. At approx., 40ft RA, flare was initiated correctly by the PF but within 04 sec the Rate of Descent (ROD) reduced from 650 ft/min to 0 ft/min (at 15 ft RA). Below 15 ft RA, ROD increased again to 592 ft/min and at touchdown it was 560ft/min.

At around 19 ft RA, leftward rudder pedal up to 2/3 of full deflection and left roll stick inputs were applied by PF to counteract the lateral deviation. But these actions did not change the aircraft trajectory to avoid a touchdown out of the runway. The heading of the aircraft was decreased from 266^0 to 258^0 between 15ft to touchdown. These inputs along with the increase of crosswind led to an increase of the drift angle. Further, it is also observed that for the last 03 seconds (i.e. from 16 ft to touchdown), tail wind component prevailed was above 10 kts and left crosswind component was 29.31 kts. The Localizer deviation was approximately ½ DOT to the right and the drift angle was +12.39° at touchdown.

The nose down input was applied at around 10 ft RA, which resulted in increase of rate of descent prior to touchdown and also the late stick orders (full back) did not enable to change the aircraft trajectory before touchdown to avoid the firm landing (VRTG = +1.81G). After touch down, PM asked for "centreline" twice at 6^{th} second and at 15^{th} second. Since no change noticed by PM, he took over the control immediately and brought back the aircraft on the runway and vacated via Taxiway C3 on its own power. During the process of bringing back the aircraft to the centreline, runway edge lights R 1-8 and R 2-8 were damaged by RH MLG.

During landing roll, the Nose Wheel Steering (NWS) tiller was used from 126 kts, wherein at high ground speeds the commanded NWS angle is limited and as per the FCOM, (i.e. above 80 kts of ground speed, a NWS tiller order is inhibited).

. *M/s. Airbus is of the opinion that the* Aircraft lateral deviation to the right increased significantly in the last 50 ft to finally touchdown out of the runway.

As per the FCOM's stabilization criteria and FCTM guidelines on final approach, if stabilization criteria is not satisfied until landing, the flight crew must initiate a go-around. As runway 09 was not available for UL 167's landing, crew were in urgency to go for immediate landing on the runway 27 by breaking the landing sequence without properly assessing the deteriorating weather condition.

From the above it is evident that the aircraft handling by the crew was a factor.

2.2 Engineering / Maintenance Aspect of the Aircraft:-

As per the maintenance records, all the required maintenance tasks were carried out by the airline. No snag witnessed by the crew during the incident sector as well.

At the time of landing, wheels #4 and #8 were out of the runway and skidding, the anti-skid released the pressure on those wheel positions to escape from the skidding conditions. Few seconds later, wheel speeds of #4 and #8 matched the other wheel speeds (most probably when the wheels were back on the paved surface). The braking system behaved as expected given the lateral excursion.

Hence, the maintenance of the aircraft was not a factor.

2.3 Weather Aspects:-

Along with the landing clearance, surface winds direction and speed details passed by the Controller was 180°/08 kts and as per the METAR report the visibility was between 3000 m to 1500 m. Below 50ft RA, rain & strong left crosswind gust was prevailed. During approach crew experienced rain with strong cross wind. When crew enquired about rain to the controller, it was informed that rain almost stopped.

As per the DFDR data, wind at the time of touchdown was 161°/31 kts with cross wind component of 29.31 kts and tail wind component of 10 kts which were within FCOM the limits. However just 03 seconds prior to touchdown (i.e. from 16ft RA to touchdown), tail wind component was around 12.5 kts which is above the FCOM limitation (i.e. 10 kts). There was a sudden changes in the wind pattern during last phase of the flight.

This indicates that the weather condition prevailed at the time of landing was also a factor of the incident.

2.4 Runway condition

Runway friction test was carried out in May 2018 and the friction value was 0.66. Runway 27 was fully serviceable for the aircraft operations and all the aids and runway lights were working during the time of landing. As per the airport surveillance camera, at the time of landing it was drizzling. No standing water on the runway during the time of landing.

Hence, runway condition was not a factor.

3. CONCLUSION

3.1 . FINDINGS

1. The aircraft was released under fully airworthy condition.
2. Crew were fully qualified to operate the flight.
3. Pilot-In-Command was performing Pilot Monitoring duty and Co-Pilot was carrying out Pilot Flying duties.
4. Initially, crew requested for runway 27 for direct in to Cochin. But as runway in use was 09, the aircraft was cleared for runway 09.
5. As visibility reduced below their minima at FL110, UL167 aircraft requested for ILS27, without informing the reason to the controller. The aircraft was cleared for runway 27 via ‘C’ ‘I’ ‘B’ route as requested by the crew.
6. Aircraft did not ask for visibility condition on runway 27 deliberately if the visibility reduced to their minima on runway 27 it may affect their landing at Cochin.

7. When the aircraft was at 11miles to touch down, Cochin tower informed the aircraft that the runway condition as wet and wind 210°/04 kts and rain almost stopped.

8. When the aircraft was at 04 miles, landing clearance was granted and the aircraft was informed about the current surface wind condition as 180°/ 08 kts.

9. The final approach up to 50 ft RA was stabilized and below 50ft RA, rain & strong left crosswind gust was prevailed.

10. PF at approx. 20 ft RA tried to align with the runway centreline. However, the left yaw and roll orders applied by PF to recover the aircraft was insufficient and the increase of cross wind has resulted the aircraft to drift off to the right side of the centreline and RH MLG to touchdown on the unpaved surface. The Localizer deviation was approximately ½ DOT to the right of the localizer at touchdown.

11. Nose down input applied at around 10 ft RA increased the rate of descent prior to touchdown resulted firm landing (VRTG was 1.81G) of the aircraft.

12. For the last 03 seconds (ie from 16ft RA to touchdown), tail wind component prevailed was around 12.5 kts which is above the FCOM limitation (i.e. 10 kts)

13. At the time of touchdown, wind speed was 31 kts with cross wind component of 29.31 kts and tail wind component of 10 kts which were with in the limits.

14. The Nose Wheel Steering (NWS) tiller was used from 126 kts during roll out by PF. But, above 80 kts, NWS orders are inhibited.

15. PM took over the controls and brought back the aircraft to the centre line of the runway.

16. Runway edge lights R 1-8 and R 2-8 were damaged by RH MLG during the process of bringing back the aircraft to the centreline.

17. Aircraft tyres numbered #3, #4, #7 and #8 got damaged.

18. There was no injury to the aircraft's occupants or any ground personnel.

19. Runway friction test was carried out in May 2018 and the friction value was 0.66 which is within the limits.

20. *M/s. Airbus is of the opinion that the* Aircraft lateral deviation to the right increased significantly in the last 50 ft to finally touchdown out of the runway. The flight crew must consider to perform a go-around if the stability is not maintained until landing.

3.2 . PROBABLE CAUSE

Lapses in the Decision Making by the PM to land under deteriorated weather condition & inadequate landing maneuvers carried out by the PF to correct the deviation of the aircraft in the last 50ft to touchdown was the probable cause of the incident.

Weather was a contributory factor.

4. RECOMMENDATIONS

Action as deemed fit by DGCA in view of the finding and probable cause.

(R. RAJENDRAN)

Chennai. R. Rajendran
18/05/2020 Investigator In-Charge