Final Report

AIRBUS A320, REGISTRATION 4R-ABN
DAMAGE TO RUNWAY EDGE LIGHTS
ON LANDING

21 MARCH 2019

AIB/AAI/CAS.178

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

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The Transport Safety Investigation Bureau of Singapore

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GLOSSARY OF ABBREVIATIONS

ADIRU	Air Data Inertial Reference Unit
AGL	Above Ground Level
ATIS	Automatic Terminal Information Service
DAR	Digital Aircraft Condition Monitoring System Recorder
FCTM	Flight Crew Training Manual
FO	First Officer
ILS	Instrument Landing System
NWS	Nose Wheel Steering
PF	Pilot Flying
PIC	Pilot-in-Command
PM	Pilot Monitoring
RET	Rapid Exit Taxiway
RVR	Runway Visual Range

SYNOPSIS

On 21 March 2019, at about 1853 hours local time, an Airbus A320 aircraft veered momentarily off the right edge of the runway after landing on Runway 02L at Singapore Changi Airport. The flight crew managed to steer the aircraft back to the centre of the runway.

A runway edge light was damaged as the aircraft veered off the runway edge. There was no injury or damage to the aircraft in this occurrence.

The Transport Safety Investigation Bureau classified this occurrence as an incident.

AIRCRAFT DETAILS

Aircraft type	:	A320
Operator	:	Sri Lankan Airlines
Aircraft registration	:	4R-ABN
Numbers and type of engines	:	2 x CFMI CFM56-5B4/P
Date and time of incident	:	21 March 2019 1853 hours
Location of occurrence	:	Singapore Changi Airport
Type of flight	:	Scheduled Passenger
Persons on board	:	122

1 FACTUAL INFORMATION

All times used in this report are Singapore Local Time (LT) unless otherwise stated. Singapore Local Time is eight hours ahead of Coordinated Universal Time (UTC).

1.1 History of the flight

1.1.1 On 21 March 2019, a Sri Lankan-registered Airbus A320 aircraft flew from Colombo Bandaranaike International Airport, Sri Lanka to Singapore Changi Airport. The flight was uneventful until the landing phase of the flight. The Pilot-In-Command (PIC) was the Pilot Flying (PF) and the First Officer (FO) was the Pilot Monitoring (PM).

1.1.2 The flight crew established communication with Air Traffic Control (ATC) at Changi Tower at 18:49:30. ATC advised the flight crew that there was rain over the airfield, that the runway surface was wet and that the flight crew of the preceding flight had reported that they established visual contact with the approach lights at about four nautical miles from touchdown. At 18:50:39, the flight crew was informed by Changi Tower that the runway visual range (RVR)[1] was 1,700 metres.

1.1.3 The flight crew received the landing clearance for Runway 02L at 18:51:37 with a reported surface wind condition of 310 degrees at 12 knots (crosswind from the left). They read back the clearance and continued with the approach.

1.1.4 The flight crew conducted the Instrument Landing System (ILS) precision approach with the autoflight system engaged. The aircraft was aligned with the runway centreline. After passing decision height, the flight crew continued with the approach as they had sighted the runway despite the rain and were able to maintain visual reference to the runway.

1.1.5 At 18:52:18, the flight crew disengaged the autopilot system when the aircraft was 190 feet above ground level (AGL). Within one second of the autopilot disengagement, the PF provided both pitch and roll commands through his control sidestick, and rudder deflection commands through the rudder pedal. From 190 feet AGL to touchdown, the PF provided predominately right roll input with the right roll angle reaching a maximum of six degrees. Also, one second after the autopilot disengagement, the aircraft started to deviate progressively

[1] Runway visual range (RVR) is a ground based system using sensors that measure the visibility, background luminance, and runway light intensity to determine the distance a pilot should be able to see down the runway.

to the right, away from the runway centreline.

1.1.6 At 18:52:29 when the aircraft was about 70 feet AGL, the PF initiated the flare[2]. The wind direction and speed was 303 degrees and 13 knots respectively (crosswind from the left). According to the flight crew, they encountered a gust of wind at this point.

1.1.7 At 18:52:33, when the aircraft was about 13 feet AGL and to the right of the runway centreline, the PF provided a left roll input resulting in the aircraft returning to almost wings level. At the same time, he provided a left rudder input. However, the aircraft continued to deviate to the right, away from the runway centreline.

1.1.8 At 18:52:39, the aircraft first touched down to the right of the runway centreline, with the nose of the aircraft pointing to the left of the runway.

1.1.9 After the touchdown, the aircraft skidded towards the right edge of the runway. The PF applied right rudder input. Thereafter, the aircraft heading aligned with the runway heading.

1.1.10 The thrust reversers were deployed at 18:52:46 with maximum reverse thrust applied for the subsequent 19 seconds. At 18:52:48, when the ground speed of the aircraft was around 110 knots, the PF applied left rudder and provided left steering inputs to the nose wheel steering (NWS) tiller. In the meantime, the right main gear of the aircraft travelled past the right runway edge line.

1.1.11 Subsequently, the PF managed to steer the aircraft back to the centre of the runway before exiting the runway via Taxiway W4 and arrived at the parking bay without further incident.

1.1.12 The flight crew indicated that they did not consider executing a go-around during the entire approach and landing sequence. A routine post-flight inspection was carried out by maintenance personnel and no abnormality was found.

1.1.13 Six hours later, at 0058LT in the early morning of 22 March 2019[3], an aerodrome runway inspection team discovered a damaged runway edge light near rapid exit taxiway (RET) W7 during a routine inspection. The recording of the aerodrome's runway surveillance camera showed that the aircraft had contacted and broken the runway edge light.

[2] The flare follows the final approach phase and precedes the touchdown. In the flare the aircraft's nose is raised, slowing the descent in anticipation of the touchdown.

[3] By then the aircraft had departed for its return flight to Sri Lanka.

1.2 Injuries to persons

1.2.1 There was no injury to any persons.

1.3 Damage to aircraft

1.3.1 There was no damage to the aircraft.

1.4 Other damage

1.4.1 One runway edge light near rapid exit taxiway (RET) W7 was damaged (**Figure 1**). There were tyre marks on the runway pavement leading to the damaged edge light. (**Figure 2**).

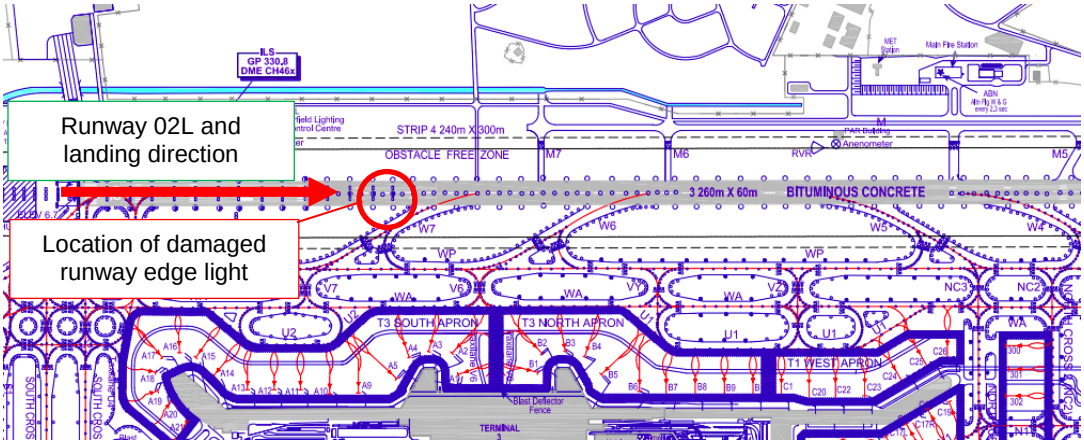

Figure 1. Location of damaged runway edge light

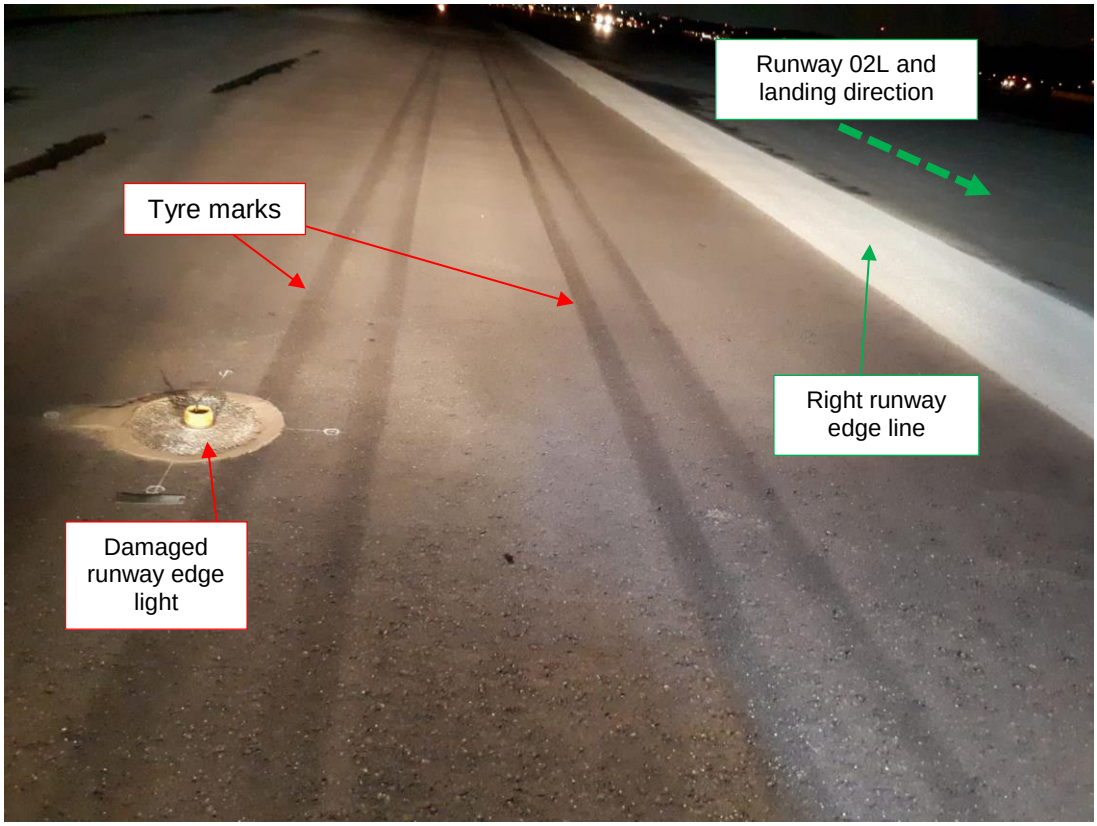

Figure 2. Damaged runway edge light and tyre marks

1.5 Personnel Information

1.5.1 Pilot-in-Command (PIC)

Gender	Male
Age	53
Licence	Air Transport Pilot License
Issuing Authority	Civil Aviation Authority of Sri Lanka
Licence validity	31 December 2019
Medical certificate	Class ONE Medical Certificate Restriction: Nil
Total flying experience	5,055 hours
Total hours on A320	2,959 hours
Flying in last 24 hours	0 hour
Flying in last 7 days	15 hours 7 minutes
Flying in last 28 days	70 hours 38 minutes
Flying in last 90 days	250 hours 36 minutes

1.5.2 First Officer (FO)

Gender	Male
Age	26
Licence	Commercial Pilot License
Issuing Authority	Civil Aviation Authority of Sri Lanka
Licence validity	14 February 2020
Medical certificate	Class ONE Medical Certificate Restriction: Nil
Total flying experience	2,216 hours
Total hours on A320	1,850 hours
Flying in last 24 hours	0 hour
Flying in last 7 days	10 hours 13 minutes
Flying in last 28 days	54 hours 19 minutes
Flying in last 90 days	224 hours 56 minutes

1.5.3 Training records provided by the operator indicated that the most recent training on go-around below minima accomplished by the PIC and FO was on 20 November 2018 and 15 October 2018 respectively.

1.6 Meteorological information

1.6.1 According to the meteorological service, between 1840LT and 1855LT, the weather over Changi Airport deteriorated from moderate to intense thundery showers. The weather gradually improved after 1855LT.

1.6.2 The Automatic Terminal Information Service (ATIS)[4] in effect at the time of the aircraft's landing was issued at about 1845LT, seven minutes prior to the aircraft's touchdown. The ATIS indicated surface wind from 330 degrees at eight knots with variable direction between 260 and 350 degrees. The visibility was two kilometres with heavy rain showers.

1.6.3 The last weather information received by the flight crew, from Changi Tower, prior to the landing was surface wind from 310 degrees at 12 knots and RVR of 1,700 metres.

[4] Automatic Terminal Information Service (ATIS) is an airport broadcast of aerodrome-related information (e.g. current weather information, active runway information, NOTAMs), which pilots will be able to receive over the radio or through datalink. ATIS is usually updated every hour or when there is a sudden weather change at the airport.

1.7 Aerodrome information

1.7.1 Runway 02L was 4,000 metres in length and 60 metres in width. Runway edge lights were installed along Runway 02L, 2.5 metres away from the runway side stripe marking. The purpose of the runway edge lights was to define the lateral limits of the runway to aircraft during periods of darkness or reduced visibility conditions.

1.7.2 The lights could be set to five different levels of intensity, namely 1%, 3%, 10% 30% and 100%. The lights were set at 30% intensity during the occurrence, as required by the air traffic services' procedures.

1.8 Recorded data

1.8.1 The recording of the aerodrome's runway surveillance camera showed that the aircraft had contacted the runway edge light causing the light to be broken and flung into the air.

1.8.2 The aircraft was installed with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR). However, the aircraft had operated for 86 hours between the occurrence and the time the operator was informed by the aerodrome operator of the occurrence, and the relevant data in the FDR and CVR had been over-written[5].

1.8.3 The operator made the recording of the aircraft's Digital Aircraft Condition Monitoring System Recorder (DAR) available to the investigation team. The DAR which contained a copy of the FDR data was decoded by the aircraft manufacturer, and information around the time of the occurrence was available. The recorded data relating to the PF's inputs were useful for the investigation team to analyse the occurrence.

1.8.4 The wind information computed by the Air Data Inertial Reference Unit (ADIRU) was recorded in the DAR data. The data showed that after the aircraft had descended past 100 feet AGL, the left crosswind increased by approximately eight knots over the next 10 seconds. This was consistent with the flight crew's recollection that they experienced a gust of wind when flare was initiated (see paragraph 1.1.6).

1.9 Other Information

1.9.1 Consideration for go-around

[5] The Flight Data Recorder (FDR) had a recording duration of 25 hours and the Cockpit Voice Recorder (CVR) had a recording duration of two hours.

1.9.1.1 The operator's policy regarding go-around was as follows:

a) The flight crew must consider to perform a go-around if a stable approach is not maintained until landing.

b) If destabilisation occurs just prior to flare, a go-around (or rejected landing) should be performed.

c) In the event where a stable approach becomes destabilised, the PM should verbalise "go-around" and an immediate go-around should be initiated.

d) A go-around can be initiated any time during the approach as long as the use of the thrust reversers has not been selected.

1.9.1.2 According to the manufacturer[6], if the aircraft's lateral flight path starts drifting away from the runway centreline, especially when the aircraft is close to the ground, a safe practice would be to go-around.

1.9.2 Nose Wheel Steering (NWS)

1.9.2.1 The NWS can be commanded by the flight crew by depressing the rudder pedals or rotating the tiller located in the flight deck.

1.9.2.2 When using the rudder pedals, the NWS angle is ±six degrees up to about 40 knots groundspeed. As groundspeed increases, the NWS angle decreases progressively to zero degree at 130 knots.

1.9.2.3 When using the tillers, the NWS angle is ±75 degrees up to about 20 knots groundspeed. As the groundspeed increases, the angle decreases progressively to zero degree at 80 knots. At groundspeed above 80 knots, the NWS tiller input is inhibited. In any case, the NWS tiller should not be used when the aircraft's groundspeed is above the maximum taxiing speed of 30 knots as prescribed by the operator.

1.9.3 Occurrence reporting

1.9.3.1 The operator required their flight crew to report accident, serious incident, incident, as well as unlawful interference.

1.9.3.2 The PIC and FO indicated that they were aware of the operator's occurrence reporting requirement.

1.9.3.3 According to the flight crew, as they did not notice anything unusual during the landing and no abnormality was reported by the engineer during the post-flight

[6] Information published by Airbus in its safety magazine, Safety First issue 20

maintenance inspection, they did not deem it necessary to file an occurrence report to ATC or to their company or the Sri Lankan regulatory authority.

2 ANALYSIS

2.1 Consideration for go-around

2.1.1 It is a general practice that a flight crew should execute a go-around should the approach to land become destabilised. The operator had a similar policy (see paragraph 1.9.1.1).

2.1.2 In this occurrence, the aircraft had become destabilised during its approach to land (see paragraphs 1.1.5 to 1.1.7). The flight crew did not carry out a go-around. They appeared not to have recognised that the approach had become destabilised despite the following signs:

a) The aircraft was on a continuous right deviation from the point of autopilot disengagement until touchdown.

b) The PF provided a significant left roll input in an attempt to bring the aircraft to a wings level attitude and pilot the aircraft back towards the centre of the runway, about 17 feet AGL, just moments before touchdown.

2.1.3 This occurrence highlighted the need for a go-around to be performed when the approach is destabilised. There appears to be room for the operator to enhance its training of pilots to ensure that they can recognise when an approach has become destabilised.

2.2 Use of NWS tiller

2.2.1 As mentioned in paragraph 1.1.10, two seconds after deploying the thrust reversers, when the groundspeed of the aircraft was around 110 knots, the PF applied left rudder and used the NWS tiller seemingly to try to steer the aircraft towards the left.

2.2.2 The use of the NWS tiller by the PF was unusual. At that phase of the landing roll and at an aircraft groundspeed of 110 knots, maintaining directional control of the aircraft would normally be by means of rudder. The NWS tiller would normally be used for directional control only after the aircraft has slowed to below the maximum taxiing speed. In any case, the tiller would not have been available at the ground speed of 110 knots (see paragraph 1.9.2.3).

2.2.3 It was highly likely that the PF was aware of the drifting of the aircraft to the right edge of the runway prior to the aircraft touching down. As soon as the aircraft landed, the PF used the NWS tiller seemingly in the hope that the large NWS angle afforded by the tiller (as compared with the NWS angle if the rudder was used) would allow him to steer the aircraft back quickly towards the runway

centreline, but forgetting that the NWS tiller was actually inhibited at that time, given the aircraft groundspeed of 110 knots.

2.3 Occurrence reporting

2.3.1 The damage to the runway edge light was discovered approximately six hours later by the aerodrome operator during its scheduled runway maintenance. The damaged edge light could potentially have been a foreign object debris (FOD) hazard to other aircraft using the runway.

2.3.2 While the flight crew might not know that their veering aircraft had damaged the runway edge light, the use of the NWS tiller almost immediately after touch down suggests that they were aware of the aircraft's drifting to the right edge of the runway. It would have been prudent on the part of the pilots to report the abnormal landing to ATC. This would have allowed ATC or the aerodrome operator to inspect the runway and remove any FOD as soon as possible.

3 CONCLUSIONS

From the information gathered, the following findings are made. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

3.1 Shortly after disengaging the autopilot, the aircraft started to deviate to the right, away from the centre of the runway. This was the cumulative effect of a series of right roll inputs from the PF and the left crosswind that was increasing in strength.

3.2 The aircraft touched down to the right of the runway centreline and veered past the right runway side stripe marking, damaging a runway edge light in the process.

3.3 The flight crew was aware that they should go-around if the approach was destabilised. However, they appeared not to have recognised that the approach had become destabilised.

3.4 The PF used the NWS tiller in an apparent attempt to steer the aircraft back towards the centre of the runway, despite the aircraft groundspeed being higher than the normal range of speed to operate the tiller.

3.5 The flight crew did not file an occurrence report. Without such a report, the damaged runway edge light posed a FOD hazard to other aircraft using the runway until it was detected and removed during a routine runway inspection six hours later.

4 SAFETY ACTIONS

4.1 Arising from its own investigation into this occurrence, the Civil Aviation Authority of Sri Lanka initiated a number of safety actions:

a) Requiring the operator to provide additional training for landing in wet and poor visibility conditions to the two pilots involved in the occurrence.

b) Requiring the training department of the operator to review training policies and procedures to enhance the effectiveness of the role of the PM in identifying and verbalising situations where an approach becomes destabilised.

4.2 The operator implemented the following recommendations made by the Civil Aviation Authority of Sri Lanka:

a) Reviewed pilot training syllabus and operational documents to enhance low visibility approach operations and reinforce the requirement to perform go-around or reject landing below 80 feet AGL.

b) Requiring its pilots to demonstrate the ability to operate an aircraft safely below 500ft AGL and perform landing on wet runway in maximum approved crosswind conditions during proficiency checks for each instance of licence renewal.

5 SAFETY RECOMMENDATIONS

A safety recommendation is for the purpose of preventive action and shall in no case create a presumption of blame or liability.

It is recommended that:

5.1 The operator review its procedures to ensure an occurrence report is duly submitted by the flight crew to the ATC, or the company, or the Civil Aviation Authority of Sri Lanka at the end of a flight following a significant occurrence. (TSIB Recommendation RA-2020-005)