# AIRCRAFT SERIOUS INCIDENT REPORT AND EXECUTIVE SUMMARY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **Reference:** | | | **CA18/3/2/1383** | |
| **Aircraft Registration** | **ET-AYB** | **Date of Incident** | 6 November 2021 | | | **Time of Incident** | 1055Z |
| **Type of Aircraft** | Airbus A350-900 | | **Type of Operation** | | | Air Transport Operations (Part 121) | |
| **Pilot-in-command Licence Type** | Airline Transport Pilot Licence (Aeroplane) | | **Age** | 38 | | **Licence Valid** | Yes |
| **Pilot-in-command Flying Experience** | **Total Flying Hours** | | 10641.3 | | | Hours on Type | 1738.0 |
| **Pilot Monitoring Licence Type** | Commercial Pilot Licence (Aeroplane) | | **Age** | 29 | | **Licence Valid** | Yes |
| **Pilot Monitoring Flying Experience** | **Total Flying Hours** | | 2322.5 | | | **Hours on Type** | 983.1 |
| **Last Point of Departure** | Addis Ababa International Airport (HAAB), Ethiopia | | | | | | |
| **Next Point of Intended Landing** | O.R. Tambo International Airport (FAOR), South Africa | | | | | | |
| **Damage to Aircraft** | Minor | | | | | | |
| **Location of the incident site with reference to easily defined geographical points (GPS readings if possible)** | | | | | | | |
| Runway 03R adjacent taxiway Tango at FAOR at Global Positioning System (GPS) co-ordinates determined to be 26°09'22.29" South 028°15'3.47" East, at an elevation of 5 534ft | | | | | | | |
| **Meteorological Information** | FAOR 061100Z 32016KT 280V340 9999 FEW045 28/11 Q1021 NOSIG= | | | | | | |
| **Number of People On-board** | 2+10+68 | **Number of People Injured** | 0 | **Number of People Killed** | 0 | **Other (On Ground)** | 0 |
| **Synopsis** | | | | | | | |

On 6 November 2021, an Airbus A350-900 aircraft with registration ET-AYB and the call sign ET809 (Ethiopian) was on a scheduled international flight from Addis Ababa International Airport (HAAB) in Ethiopia, to O.R. Tambo International Airport (FAOR) in South Africa.

On final approach for Runway 03R at FAOR, air traffic control (ATC) advised the crew that the wind was 300° at 20kts. At 30 feet (ft) above ground level (AGL) the captain, who was the pilot flying (PF), flared the aircraft by applying adjusted crosswind landing technique which required retarding the thrust. The PF attempted to touch down on the touchdown zone but was unable to. He concluded that they must be caught in a wind shear condition, and therefore, decided to execute a go-around. The crew related to the ATC that they had encountered a wind shear condition on final approach.

During the initial stages of the go-around, the aircraft over-banked to the right. The ATC instructed the PF to maintain runway heading and to climb to an altitude of 8000ft before vectoring them for landing Runway 03L. The PF was able to land the aircraft safely on Runway 03L. At 1126Z, the chocks were placed against the aircraft's wheels at the parking bay, thereafter, the crew and the passengers disembarked. During the transit check, the crew noticed the damage on the right-side wing tip and right winglet.

The occupants on-board the aircraft were not injured. The aircraft sustained minor damage during the serious incident.

| **Probable Cause and Contributory Factors** | | | |
|---|---|---|---|
| Probable cause:<br>The pilot applied excessive right rudder input whilst attempting to align to the runway centreline, which caused the aircraft to over-drift to the right and experience a significant sideslip build-up and roll departure on the right. Subsequently, the right-wing tip contacted the runway despite the left sidestick input.<br><br>Contributory factors:<br>• There was a left crosswind component which reduced closer to the ground.<br>• Early flare initiation caused the aircraft to float over the runway, and thus, the aircraft missed the touchdown zone.<br>• No evidence of wind shear even though the pilot stated its presence. | | | |
| SRP Date | 8 November 2022 | Publication Date | 10 November 2022 |

**Occurrence Details**

| | |
|---|---|
| **Reference Number** | **:** CA18/3/2/1383 |
| **Occurrence Category** | **:** Category 1 |
| **Type of Operation** | **:** Air Transport Operations (Part 121) |
| **Name of Operator** | **:** Ethiopian Airlines Group |
| **Aircraft Make and Model** | **:** Airbus A350-900 |
| **Nationality** | **:** Ethiopian |
| **Registration** | **:** ET-AYB |
| **Place** | **:** Runway 03R at O.R. Tambo International Airport (FAOR) |
| **Date and Time** | **:** 6 November 2021, 1055Z |
| **Injuries** | **:** None |
| **Damage** | **:** Minor |

**Purpose of the Investigation:**

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to apportion blame or liability.*

*All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.*

**Investigation Process:**

The Accident and Incident Investigations Division (AIID) of the South African Civil Aviation Authority (SACAA) was notified of the occurrence on 6 November 2021 at approximately 1400Z. The occurrence was classified as a serious incident according to the CAR 2011 Part 12 and ICAO STD Annex 13 definitions. The notifications were sent to the State of Registry, Operator and Manufacturer in accordance with the CAR 2011 Part 12 and ICAO Annex 13 Chapter 4. The State of operator and the state of manufacturer appointed an accredited representative and advisor. Investigators dispatched to the incident site on 8 November 2021.

*Notes:*
*1. Whenever the following words are mentioned in this report, they shall mean the following:*

*Serious Incident — this investigated serious incident*
*Aircraft — the Airbus A350-900 involved in this serious incident*
*Investigation — the investigation into the circumstances of this serious incident*
*Pilot — the pilot involved in this serious incident*
*Report — this serious incident report*

*2. Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.*

**Disclaimer:**

**Table of Content**

| Abbreviation | Description |
|---|---|
| ° | Degrees |
| °C | Degrees Celsius |
| AFM | Airplane Flight Manual |
| AGL | Above Ground Level |
| AIID | Accident and Incident Investigations Division |
| AMO | Aircraft Maintenance Organisation |
| AMSL | Above Mean Sea Level |
| AOC | Air Operator Certificate |
| ATC | Air Traffic Control |
| ATIS | Automatic Terminal Information Services |
| ATPL | Airline Transport Pilot Licence |
| CAR | Civil Aviation Regulations |
| CAVOK | Cloud and Visibility OK |
| CVR | Cockpit Voice Recorder |
| DFDR | Digital Flight Data Recorder |
| DME | Distance Measuring Equipment |
| DVOR | Doppler Very High Frequency Omni-directional Range |
| EMS | Electrical Management System |
| FAOR | O.R. Tambo International Airport |
| FL | Flight Level |
| FO | First Officer |
| FDR | Flight Data Recorder |
| ft | Feet |
| GPS | Global Positioning System |
| HAAB | Addis Ababa International Airport |
| hPa | Hectopascal |
| ICAO | International Civil Aviation Organisation |
| ILS | Instrument Landing System |
| LAME | Licensed Aircraft Maintenance Engineer |
| m | Metre |
| METAR | Meteorological Aerodrome Report |
| MHz | Megahertz |
| PAPI | Precision Approach Path Indicator |
| PIC | Pilot-in-command |
| PF | Pilot Flying |
| PM | Pilot Monitoring |
| PWS | Predictive Wind Shear |
| QNH | Barometric Pressure Adjusted to Sea Level (Query Nautical Height) |
| SACAA | South African Civil Aviation Authority |
| SAWS | South African Weather Service |
| TBO | Time Between Overhaul |
| UTC | Co-ordinated Universal Time |
| VAPP | Approach Velocity |
| VFR | Visual Flight Rules |
| VHF | Very High Frequency |
| VQAR | Virtual Quick Access Recorder |
| WXR | Weather Radar |
| Z | Zulu (Term for Universal Coordinated Time – Zero Hours Greenwich) |

## 1. FACTUAL INFORMATION

### 1.1. History of Flight

1.1.1 On 6 November 2021, an Airbus A350-900 aircraft with registration ET-AYB and the call sign ET809 (Ethiopian) was on a scheduled international flight from Addis Ababa International Airport (HAAB) in Ethiopia, to O.R. Tambo International Airport (FAOR) in South Africa. On-board the aircraft were two flight deck crew members, 10 crew members and 68 passengers.

1.1.2 The captain, who was the pilot flying (PF), stated that upon his first contact with Johannesburg air traffic control (ATC), he was cleared for OKPIT 4A standard instrument landing system (ILS) approach for Runway 03R. The weather conditions broadcasted by the Automatic Terminal Information Service (ATIS) were as follows — wind direction of 300° at 22 knots (kts), ceiling and visibility OK (CAVOK), temperature at 27°C, dew point at 11°C and query nautical height (QNH) at 1021 hectopascal (hPa). The PF stated that he had prepared for the arrival and had briefed the approach to the pilot monitoring (PM) as per their company briefing checklist. He stated that he had anticipated a left crosswind upon landing, therefore, he added 5kts on the approach velocity (Vapp) of 137kts as per the aircraft's Operation Manual when landing in a strong crosswind condition. The flaps were configured to the Flaps Lever Position 3 (slats 24°/flaps 26°). Thereafter, the crew established ILS 03R approach and stabilised before 1000 feet (ft) above ground level (AGL). On final approach, the ATC reported that the wind direction was 300° at 20kts. At 50ft AGL, a crabbed approach was conducted; and at 30ft AGL, the PF initiated the flare and retarded the thrust. The PF attempted to touch down on the touchdown zone, but the aircraft was unable to; it remained airborne (floating) above the runway. The PF concluded that they must be caught in wind shear condition and decided to execute a go-around. The crew related to the ATC that they had encountered wind shear on final approach.

1.1.3 During the initial stages of the go-around, the aircraft over-banked to the right, and the right-wing tip together with the right winglet contacted the runway surface. The ATC instructed the PF to maintain runway heading and to climb to an altitude of 8000ft before vectoring the aircraft for landing Runway 03L. The PF was able to land the aircraft safely on Runway 03L. At 1126Z, the chocks were placed against the aircraft's wheels at the parking bay. Thereafter, the crew and the passengers disembarked the aircraft. During the transit check, the crew noticed the damage on the right-side wing tip and right winglet.

1.1.4 None of the occupants on-board was injured. The aircraft sustained minor damage during the serious incident.

1.1.5 The serious incident occurred during day light at FAOR Runway 03R, adjacent taxiway Tango at Global Positioning System (GPS) co-ordinates determined to be 26°09'22.29" South, 028°15'3.47" East, at an elevation of 5 534ft.

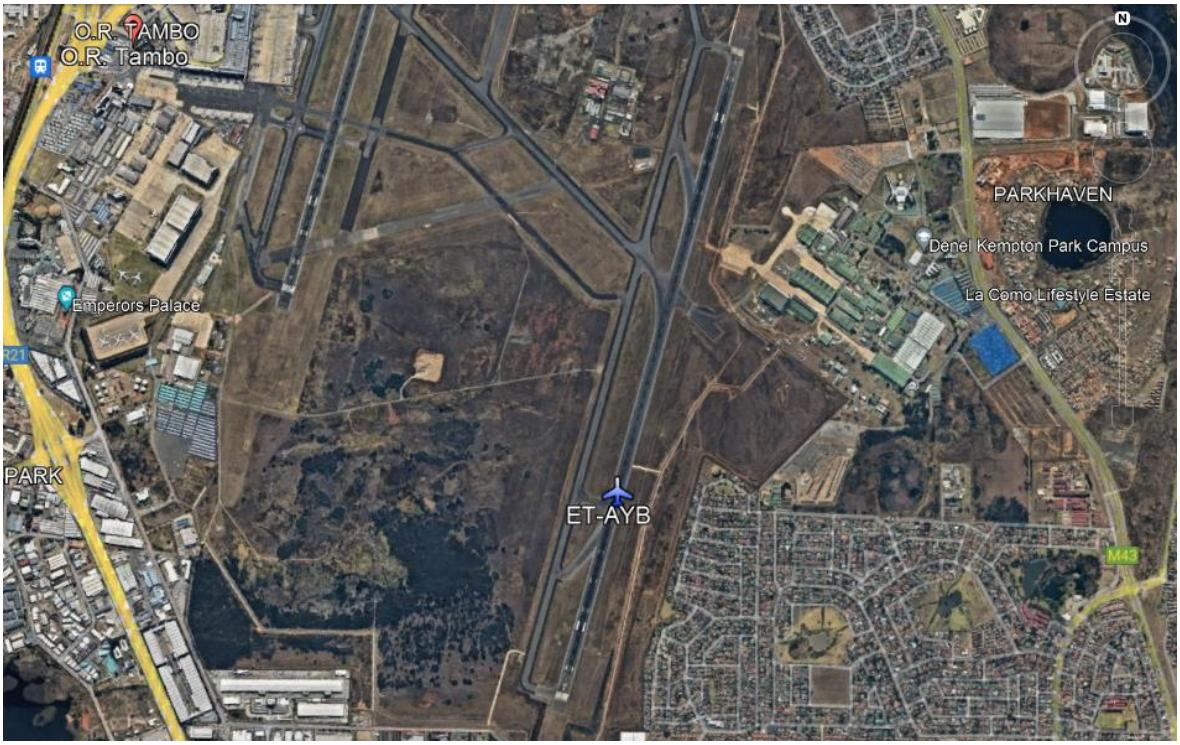



**Figure 1:** The blue aircraft represents the location of impact on the runway. (Source: Google Earth)

## 1.2. Injuries to Persons

| Injuries | Pilot | Crew | Pass. | Total On-board | Other |
|---|---|---|---|---|---|
| Fatal | - | - | - | - | - |
| Serious | - | - | - | - | - |
| Minor | - | - | - | - | - |
| None | 2 | 10 | 68 | 80 | - |
| Total | **2** | **10** | **68** | **80** | - |

Note: Other means people on the ground.

## 1.3. Damage to Aircraft

1.3.1 The right-winglet, right-wing tip and outer aileron sustained minor damage during the serious incident sequence.

**Figure 2:** Underside damage on the right-wing tip.

**Figure 3**: Upper side damage on the right-wing tip and winglet.

## 1.4. Other Damage

1.4.1 None.

## 1.5. Personnel Information

### Pilot-in-command (PIC) – Pilot Flying

| | | | | | |
|---|---|---|---|---|---|
| Nationality | Ethiopian | Gender | Male | Age | 38 |
| Licence Type | Airline Transport Pilot Licence (ATPL) Aeroplane | | | | |
| Licence Valid | Yes | Type Endorsed | Yes | | |
| Ratings | Instrument | | | | |
| Medical Expiry Date | 20 October 2022 | | | | |
| Restrictions | None | | | | |
| Previous Accidents | None | | | | |

Note: Previous accidents refer to past accidents and/or serious incidents the pilot was involved in, when relevant to this incident.

**Flying Experience:**

| | |
|---|---|
| Total Hours | 10 641.3 |
| Total Past 90 Days | 163.2 |
| Total on Type Past 90 Days | 163.2 |
| Total on Type | 1738.0 |

1.5.1 The PF was initially issued an Airline Transport Pilot Licence (ATPL) on 15 December 2009 in accordance with Part 61 of the Ethiopian Civil Aviation Regulations (ECAR). His last licence validation was carried out on 20 October 2021, and the licence was reissued on the same date with an expiry date of 19 October 2022. The PF's flight hours in the above table are as per the hours submitted by him through the pilot questionnaire.

1.5.2 The PF was issued a Class 1 medical certificate on 20 October 2021 with an expiry date of 20 October 2022.

1.5.3 The PF was issued an A350 rating on 17 July 2019 to act as a pilot-in-command or co-pilot. He also had Boeing 737, B767, B777 and B787 rating variants.

**First Officer (FO) – Pilot Monitoring**

| | | | | | |
|---|---|---|---|---|---|
| Nationality | Ethiopian | Gender | Male | Age | 29 |
| Licence Type | Commercial Pilot Licence (CPL) Aeroplane | | | | |
| Licence Valid | Yes | Type Endorsed | Yes | | |
| Ratings | Instrument | | | | |
| Medical Expiry Date | 23 July 2022 | | | | |
| Restrictions | None | | | | |
| Previous Accidents | None | | | | |

Note: Previous accidents refer to past accidents and/or serious incidents the pilot was involved in, when relevant to this incident.

**Flying Experience:**

| | |
|---|---|
| Total Hours | 2322.5 |
| Total Past 90 Days | 254.0 |
| Total on Type Past 90 Days | 254.0 |
| Total on Type | 983.1 |

1.5.4 The PM was initially issued a Commercial Pilot Licence (CPL) on 16 July 2018 in accordance with Part 61 of the ECAR. His last licence validation was carried out on 23 July 2021, and his licence was reissued on the same date with an expiry date of 22 July 2022. The PM's hours in the above table are as per the hours submitted by him through the pilot questionnaire.

1.5.5 The PM was issued a Class 1 medical certificate on 23 July 2021 with an expiry date of 22 July 2022.

1.5.6 The PM was issued an A350 rating on 22 June 2020 to act as the co-pilot only. He also had a Boeing 737 rating variant.

## 1.6. Aircraft Information

1.6.1. *The A350 is innovative, from the wing design that morphs and changes shape in-flight for optimal efficiency to the Airbus-pioneered fly-by-wire flight controls and on-board systems for reduced pilot workload.*

*Its airframe uses more than 70% advanced materials such as composites, titanium, and modern aluminium alloys to create a lighter and more cost-efficient aircraft, while increasing resistance to corrosion and reducing maintenance.*

*The A350 is powered by two Trent XWB turbofan engines that result from a very close collaboration between Airbus and the powerplant's manufacturer, Rolls-Royce.* (Source: Airbus)

**Airframe:**

| | | |
|---|---|---|
| Manufacturer/Model | Airbus A350-900 | |
| Serial Number | 0412 | |
| Year of Manufacture | 2020 | |
| Total Airframe Hours (At Time of Incident) | 3567.4 | |
| Last Inspection (Date & Hours) | 3366.6 | 13 October 2021 |
| Airframe Hours Since Last Inspection | 200.8 | |
| CRS (Issue Date) | 13 October 2021 | |
| C of A (Issue & Expiry Date) | 1 November 2021 | 31 October 2022 |
| C of R (Issue Date) Present Owner | 6 November 2021 | |
| Operating Category | Air Transport Operations (Part 121) | |
| Type of Fuel Used | Jet A1 | |
| Previous Serious Incidents/Accidents | None | |

Note: Previous serious incidents/accidents refer to past serious incidents/accidents the aircraft was involved in, when relevant to this incident.

1.6.2 According to available information, the aircraft was first registered to the present owner on 6 November 2020 and the aircraft was reissued a Certificate of Release to Service (CRS) on 13 October 2021.

1.6.3 Based on the aircraft's maintenance records, the last scheduled maintenance (2A-MO6-EO) was carried out on 12 October 2021 at 3366.6 airframe hours. The aircraft had accumulated an additional 200.82 airframe hours in operation since the last inspection, and no defects were recorded.

1.6.4 According to available documents, the aircraft's maximum take-off weight (MTOW) is 278 000 kilograms (kg). At the time of the incident flight, the aircraft's weight was 204 000kg at take-off at HAAB. The landing weight was 178 200kg at FAOR, which was below the maximum landing weight (MLW) of 207 000kg.

1.6.5 The aircraft was ferried back to HAAB with the right winglet removed.

**Engine No. 1:**

| | |
|---|---|
| Manufacturer/Model | Rolls Royce Trent XWB-84 |
| Serial Number | 21748 |
| Hours Since New | 3 592.9 |
| Hours Since Overhaul | TBO not reached |

**Engine No. 2:**

| | |
|---|---|
| Manufacturer/Model | Rolls Royce Trent XWB-84 |
| Serial Number | 21791 |
| Hours Since New | 3 592.9 |
| Hours Since Overhaul | TBO not reached |

1.6.6 Maximum demonstrated crosswind as per the aircraft type (Source: Airplane Flight Manual [AFM])

**MAXIMUM DEMONSTRATED CROSSWIND AT TAKEOFF AND LANDING**

Ident.: **PERF-GEN-00019586.0001001 / 13 JUN 16** **APPROVED**
Criteria: 350-941

*Note: The demonstrated crosswind values exceed the maximum crosswind values permitted for the engines as defined in the limitations chapter. Refer to LIM-70 Crosswind*

Maximum demonstrated crosswind:
- At takeoff: 41 kt (gust included)
- At landing: 42 kt (gust included).

1.6.7 Aircraft wind shear system:

1.6.7.1 *Predictive Wind shear System as per the Flight Crew Operating Manual (FCOM)*

*The Predictive Windshear (PWS) function:*
*- Detects windshears:*
*• At least 10 s before a possible encounter*
*• Between 0.5 NM and 5 NM in front of the aircraft*
*- Triggers alerts.*

*Depending on the flight phase, and on the aircraft's distance from the windshear, the PWS function will trigger: a warning, or a caution, or an advisory.*
*At landing:*
*- All alerts are inhibited, if the aircraft is below 50ft*
*- Visual and aural warnings are downgraded to cautions from 370ft AGL to 50ft AGL and range from 0.5 NM to 1.5 NM.*

*1.6.7.2 Reactive Wind shear System as per the FCOM*

*A wind shear alert triggers when the aircraft encounters wind gradients during take-off and landing, which could reduce the margin toward stall.*
*The windshear alert consists of:*
*- A red wind shear message displays on both PFDs. It flashes for 9 seconds, then remains steady, as long as the windshear is detected.*
*- An aural alert "WINDSHEAR" (Synthetic Voice)*

*The reactive windshear detection is available:*
*- During landing: from 1 300ft to 50ft*
*- If the actual aircraft configuration is above 0, or the FLAPS lever is at least selected to 1.*

*1.6.7.3 Crew response to windshear as per the Flight Crew Training Manual (FCTM)*

*<u>Suspected windshear or predictive windshear – APPROACH</u>*
*If "Monitor Radar Display" or the visual alert appears, or in case of suspected windshear, the crew should either delay the approach or divert to another airport. However, if the flight crew decides to continue the approach, they should:*
- *Assess the weather severity with the radar display*
- *Consider the most appropriate runway*
- *Select FLAPS 3 for landing in order to optimise the climb gradient capability in the case of a go-around*
- *Use managed speed because it provides the GS mini function*
- *Increase the approach speed (VAPP) displayed on the FMS PERF APP page up to a maximum of VLS +15kt, in case of strong or gusty crosswind greater than 20kt. Use the LDG PERF application of the EFB for VAPP determination*
- *Consider using the VV pb, for an earlier detection of vertical path deviation.*

*In the case of "GO-AROUND, WINDSHEAR AHEAD" triggering, the PF must set take-off/go-around (TOGA) for a go-around. The flight crew can change the aircraft configuration, provided that the windshear is not entered. Full back stick should be applied, if required, to follow the SRS, or to minimise the loss of height.*

*<u>Reactive windshear or windshear detected by Flight Crew Observation</u>*
*In the case of a windshear, the PF must set TOGA for a go-around.*
*The flight crew must pay attention to the following:*
- *The flight crew should not change the configuration, until the aircraft is out of the windshear, because operating the landing gear doors causes additional drag*
- *The PF must fly speed reference system (SRS) pitch orders rapidly and smoothly, but not aggressively, and must consider pulling full back stick, if necessary, to minimise height loss*
- *The PM should call out the wind variations from the navigational display (ND) and V/S and, when clear of the windshear, report the encounter to the ATC.*

## 1.7. Meteorological Information

1.7.1. The weather information below was obtained from the Meteorological Aerodrome Report (METAR) that was issued by the South African Weather Service (SAWS) recorded at FAOR on 6 November 2021 at 1100Z.

FAOR 061100Z 32016KT 280V340 9999 FEW045 28/11 Q1021 NOSIG=

| | | | | | |
|---|---|---|---|---|---|
| Wind Direction | 320° | Wind Speed | 16kts variable 280°-340° | Visibility | 9999m |
| Temperature | 28°C | Cloud Cover | 1-2 Oktas | Cloud Base | 4500ft |
| Dew Point | 11°C | QNH | 1021hPa | | |

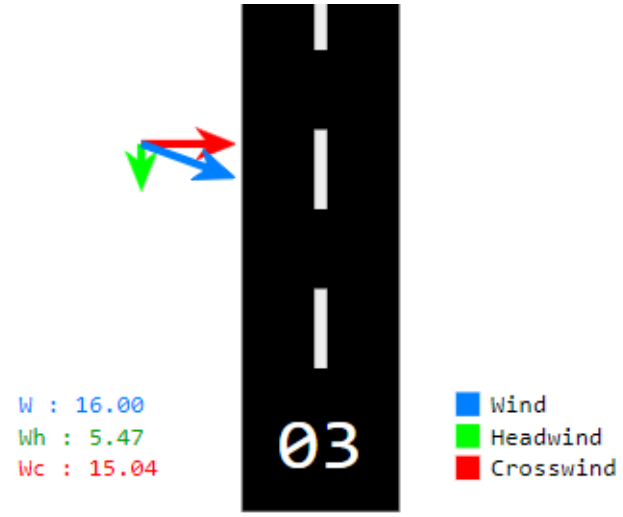
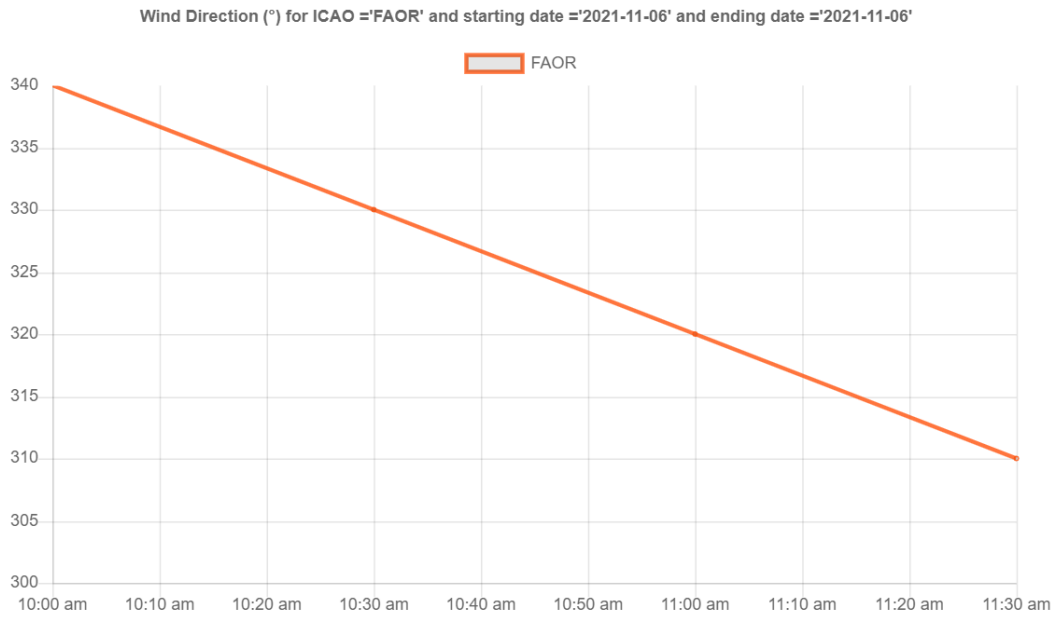
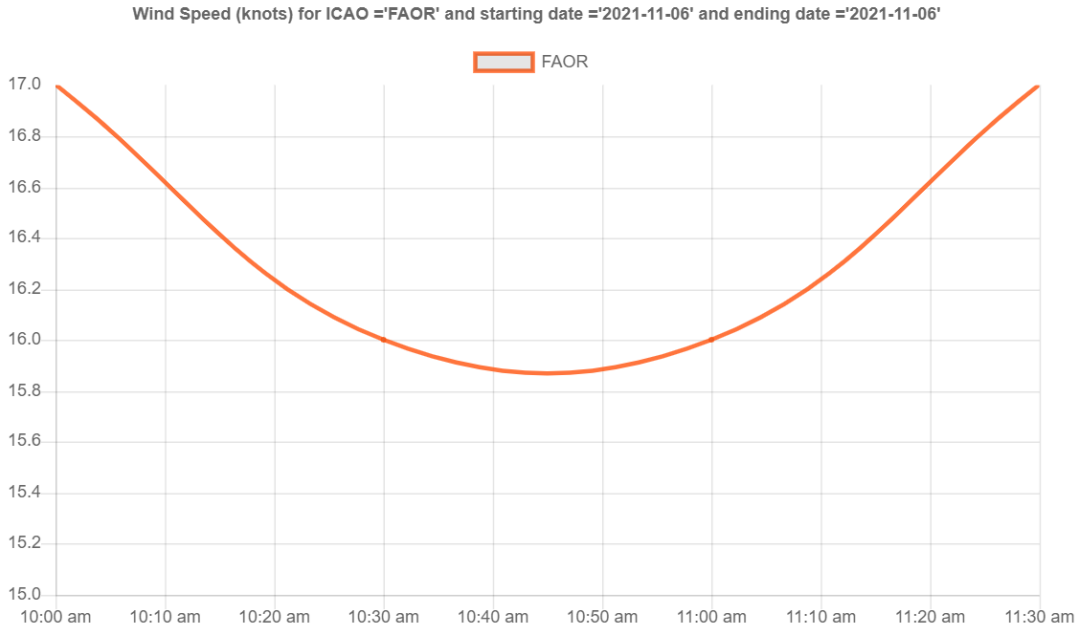



**Figure 4:** The crosswind component as per the weather report. (Source: https://e6bx.com)

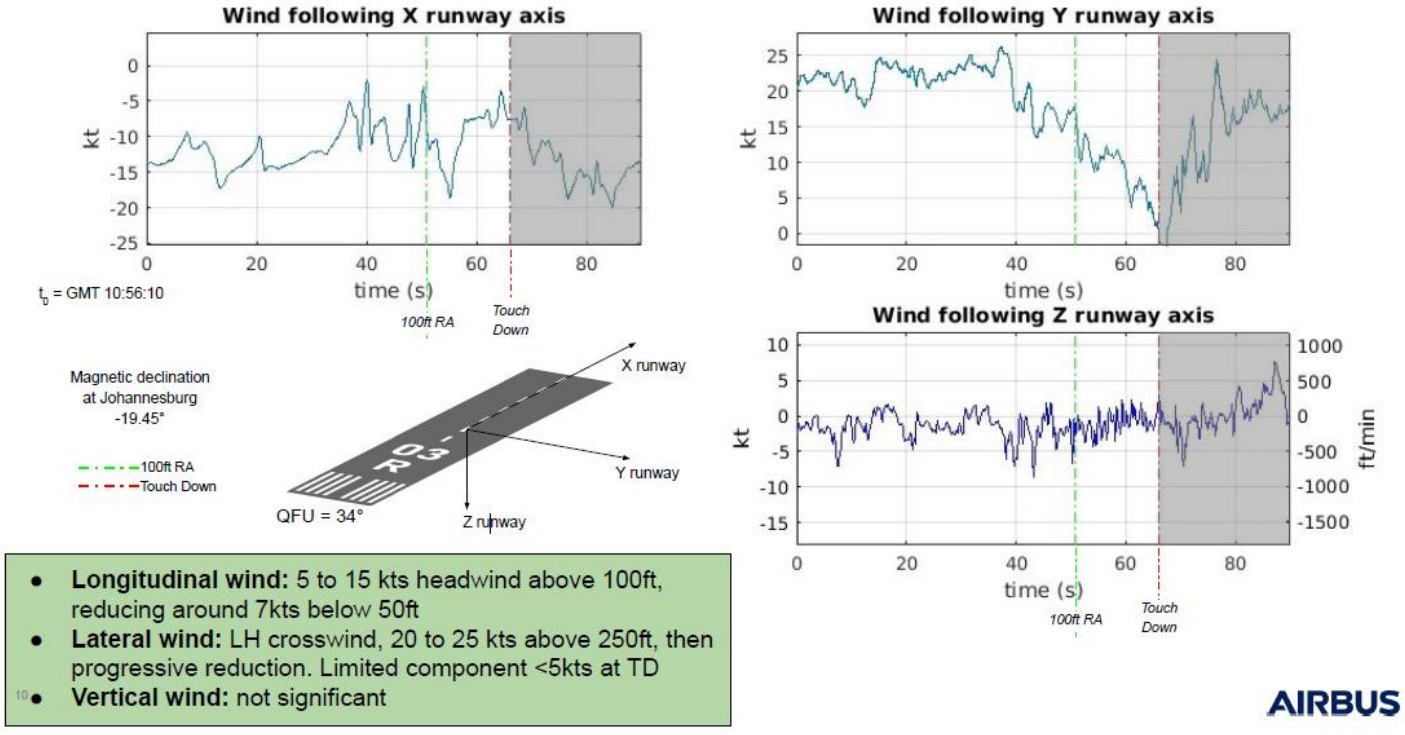
1.7.2. FAOR tower wind recordings issued by the Air Traffic Navigation Services (ATNS) recorded at FAOR on 6 November 2021 from 1000Z until 1130Z revealed the following:






1.7.3. Wind Speed and Direction recorded by the flight data recorder (Source: Airbus)

*Limited headwind component*
*Medium crosswind component, reducing when closing to the ground*
*No significant vertical wind component*
*No evidence of windshear presence as there was no recorded triggering from Predictive & Reactive Windshear Systems and no evidence from recomputed wind components.*




## 1.8. Aids to Navigation

1.8.1. The aircraft was equipped with standard navigational equipment as approved by the Ethiopian CAA. There were no records indicating that the navigation system was unserviceable prior to the serious incident.

## 1.9. Communication

1.9.1. The aircraft was equipped with a standard communication system as approved by the Ethiopian CAA. No defects that could render the communication system unserviceable were recorded before the serious incident flight.

## 1.10. Aerodrome Information

1.10.1. The serious incident occurred at FAOR on Runway 03R.

| | | |
|---|---|---|
| Aerodrome Location | Johannesburg, Gauteng Province, South Africa | |
| Aerodrome Status | Licensed | |
| Aerodrome GPS Co-ordinates | 26°08'01.30" South 028°14'32.34" East | |
| Aerodrome Elevation | 5 558ft | |
| Runways | 03R/21L | 03L/21R |
| Dimensions of Runway Used | 3 405m x 60m | |
| Heading of Runway Used | 03R | |
| Surface of Runway Used | Asphalt | |
| Approach Facilities | Runway lights, PAPI, DVOR / DME (JSV), ILS LOC and ILS GP | |
| Radio Frequency:<br>Tower Frequency (West)<br>Tower Frequency (East) | <br>118.10 MHz<br>118.60 MHz | |

## 1.11. Flight Recorders

1.11.1 The A350 incident aircraft was equipped with two recording systems:

1. The Flight Data Recorder (FDR) which records all mandatory flight data parameters on:
    - The Digital Flight Data Recorder (DFDR)
    - The Virtual Quick Access Recorder (VQAR)
2. The Cockpit Voice Recorder (CVR) which records:
    - All voice communications to and from the flight deck between the aircraft and any other station or aircraft, all voice communications between cockpit crew members, all aural warnings and the cockpit environment and Datalink communication.
    - The recording system operates automatically:
      On-ground: During aircraft power-up, the recording system runs for 5 minutes and then stops. As soon as the first engine is started, the recording system runs and continue to record until 5 minutes after the last engine is shut down.
      In-flight: The recording system runs continuously, with or without the engines running. The maximum duration of recording is two hours.

1.11.2 This aircraft was fitted with a L-3 Model Communication Digital Flight Data Recorder (DFDR), a Virtual Quick Access Recorder (VQAR) and a Cockpit Voice Recorder (CVR).

| | DFDR | VQAR | CVR |
|---|---|---|---|
| Type | FA2100 | FA2100 | FA2100 |
| Part Number | 2100-4245-00 | 17TES0043 | 2100-1227-02 |
| Serial Number | 002026284 | 000673836 | 001215035 |

1.11.3 QAR Analysis Summary (Source: Airbus)

*• Manual ILS approach*

*– Captain PF*

*– FDs & ATHR ON*

*– Stable at 1000ft and 500ft gates*

*– CONF3*

*– LH Crosswind component*

*• Early flare at around 50ft RA*

*• A/C floating over the runway*

*• Decrab with significant RHS rudder pedal input, up to stop, maintained close to stop for ~6s*

*• LH roll inputs resulting in TD at 8.4° LH bank angle*

*• Transient LH MLG contact <1s ⇒ flight control transition from flight to ground*

*• Rudder deflection increase up to RHS stop (during 1.5s)*

*• Go-around initiated with rudder pedal input maintained*

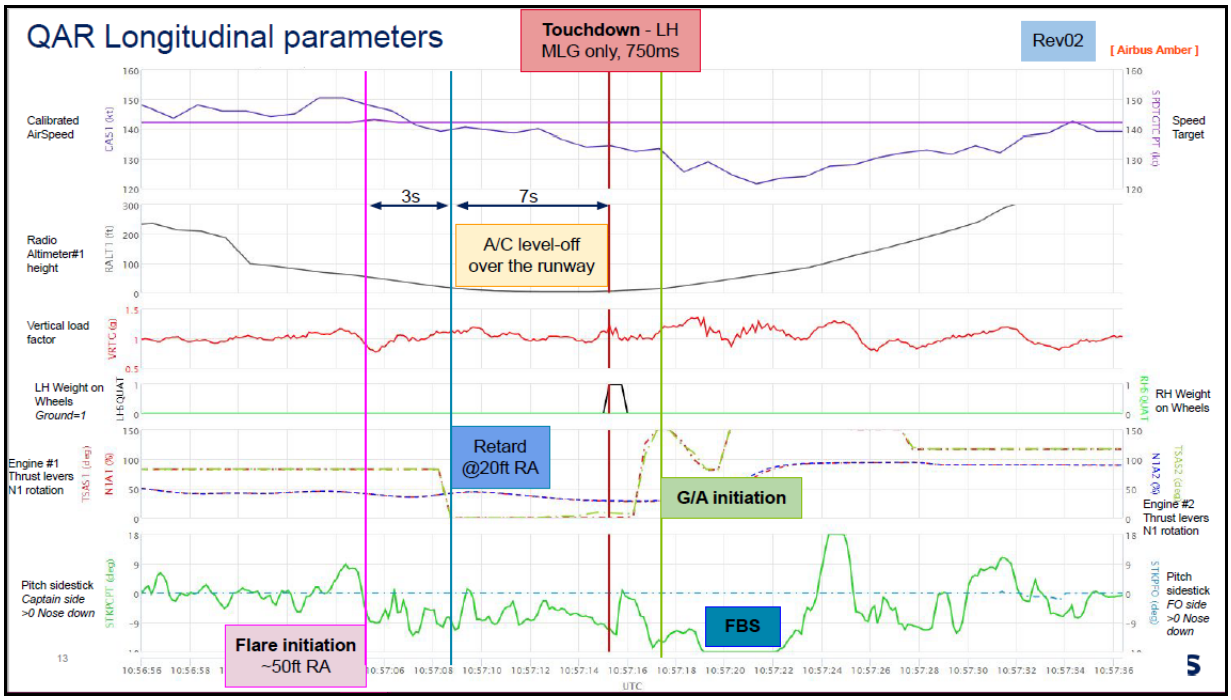
*• Progressive increase of drift angle & sideslip until ~15° ⇒ significant induced roll due sideslip*

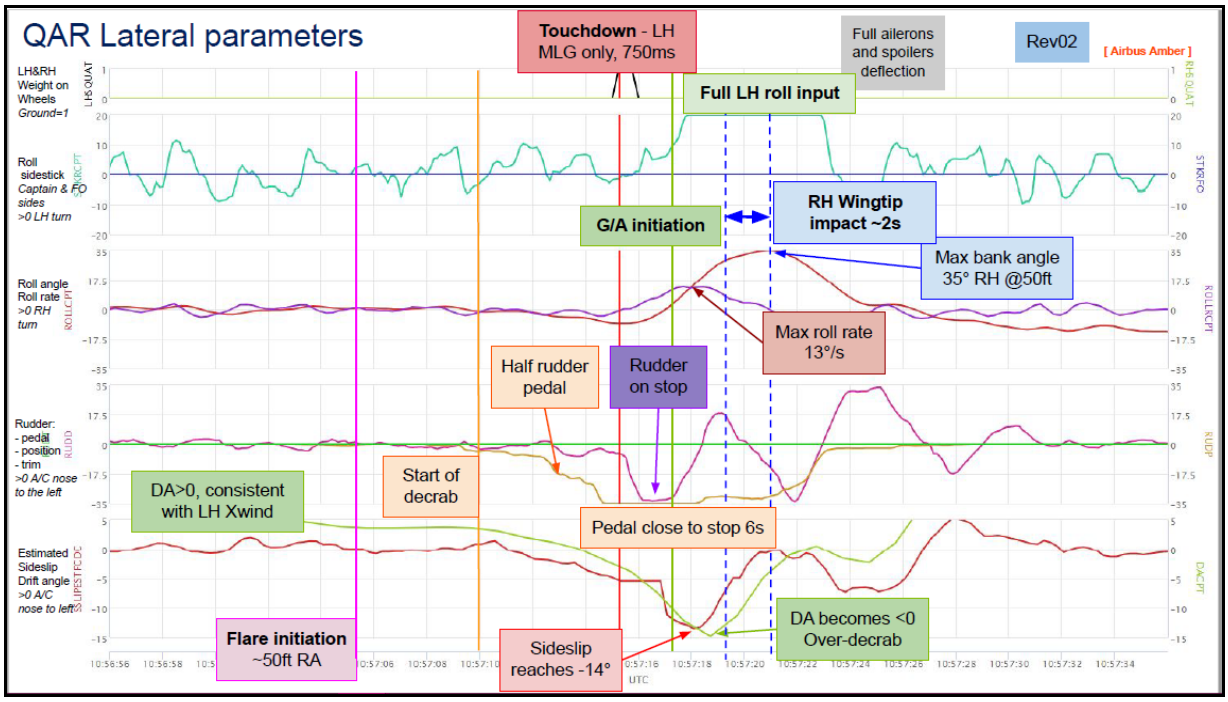
*• RH roll rate build-up ~13°/s max, countered by full LH roll input - ailerons & spoilers deflected accordingly*

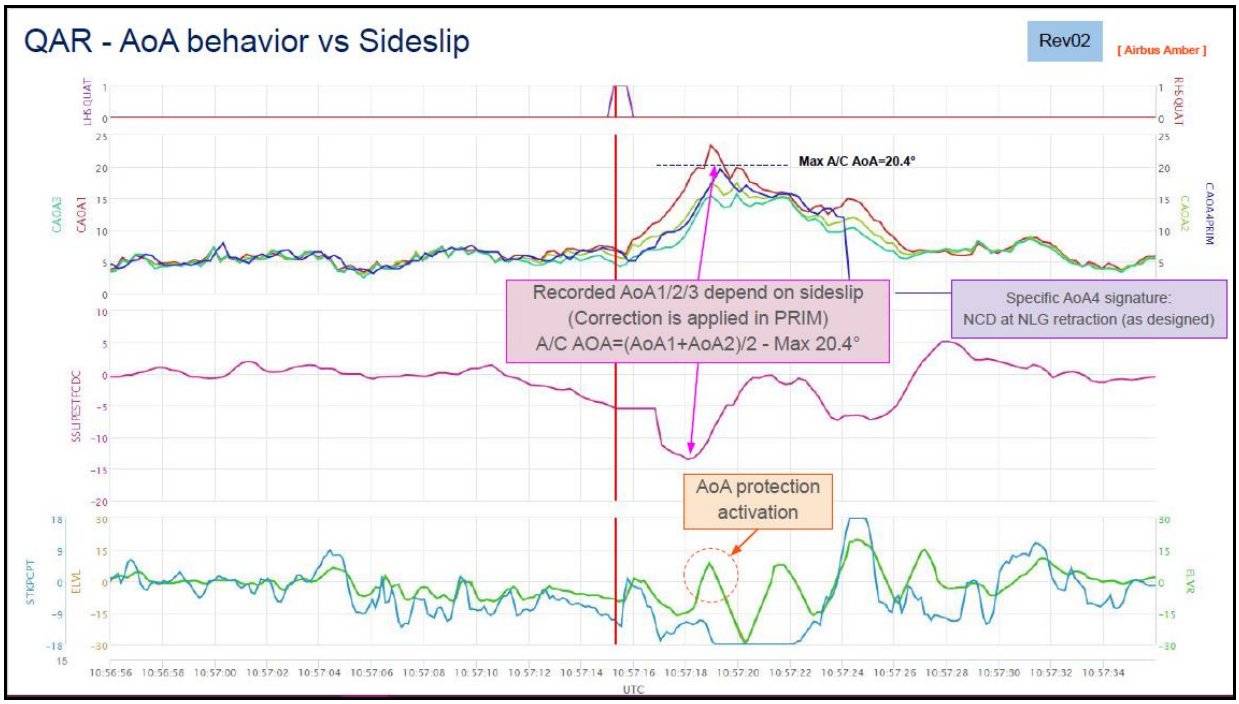
*• Max bank angle reached 35° RH at ~50ft - probable time of RH wingtip contact with runway*

*• Rudder pedal input released*

*•Second uneventful approach with auto land*


QAR Longitudinal parameters
Touchdown - LH MLG only, 750ms
Rev02
[ Airbus Amber ]
Calibrated AirSpeed
Speed Target
3s
7s
A/C level-off over the runway
Radio Altimeter#1 height
Vertical load factor
LH Weight on Wheels Ground=1
RH Weight on Wheels
Retard @20ft RA
Engine #1 Thrust levers N1 rotation
G/A initiation
Engine #2 Thrust levers N1 rotation
Pitch sidestick Captain side >0 Nose down
FBS
Pitch sidestick FO side >0 Nose down
Flare initiation ~50ft RA
UTC


QAR Lateral parameters
Touchdown - LH MLG only, 750ms
Full ailerons and spoilers deflection
Rev02
[ Airbus Amber ]
LH&RH Weight on Wheels Ground=1
Full LH roll input
Roll sidestick Captain & FO sides >0 LH turn
G/A initiation
RH Wingtip impact ~2s
Max bank angle 35° RH @50ft
Roll angle Roll rate >0 RH turn
Max roll rate 13°/s
Half rudder pedal
Rudder on stop
Rudder: - pedal - position - trim >0 A/C nose to the left
DA>0, consistent with LH Xwind
Start of decrab
Pedal close to stop 6s
Estimated Sideslip Drift angle >0 A/C nose to left
DA becomes <0 Over-decrab
Flare initiation ~50ft RA
Sideslip reaches -14°
UTC




• *Environmental conditions:*

*– Crosswind component, but reducing close to ground*

*– No evidence of windshear*

• *Full rudder pedal input before touchdown and maintained during the go-around*

*– Significant sideslip build-up resulting in induced roll, bank angle excursion and wingtip contact*

• *Engineering simulations showed that:*

*– The amplitude of the rudder input was the primary contributor to the observed behaviour. When landing is compressed, the lateral law changes from AIR to GROUND (PRIM computer) at touch down which allows more rudder deflection authority.*

*– The increased transition time (AIR to GROUND) introduced in PRIM P13 (certified end of 2021) would have reduced the rudder deflection dynamic, reduce the rudder maximum deflection, reduce the left sideslip and thus limited the bank angle excursion in such scenario*

1.11.4 According to the licensed aircraft maintenance engineer (LAME), the crew did not deactivate the CVR circuit breaker following the serious incident, and the entire recording data was overwritten. Therefore, no data could be retrieved for this incident. The investigation was, therefore, conducted without the CVR information. The flight data was successfully downloaded by the operator's LAME through Virtual Quick Access Recorder (VQAR).

## 1.12 Wreckage and Impact Information

1.12.1 The aircraft was programmed for OKPIT 4A standard instrument landing system (ILS) approach for Runway 03R. The pilot attempted to touch down on the touchdown zone when the aircraft banked sharply to the right and, subsequently, caused the right-wing tip to skid on the runway surface for approximately 110m.


**Figure 5:** The aircraft post-incident.

**Figure 6:** Runway scar mark left by the wing tip as it contacted the runway surface.

1.12.2 The ground radar recordings revealed the following data: *the aircraft was flying over the hangars to the east of the runway at 10:59:29Z when the ATC instructed the pilot to climb to 8000ft and to maintain runway track.*


**Figure 7:** Induced right-side roll. (Source: ATNS)


**Figure 8:** Induced right-sideroll continues to the east of the airport. (Source: ATNS)

1.12.3 *On the second attempt, the aircraft approached Runway 03L FAOR and the ATC read the wind to be 330°/22kts (which was also a crosswind from the left). The aircraft landed safely on Runway 03L at 11:15:37Z.*

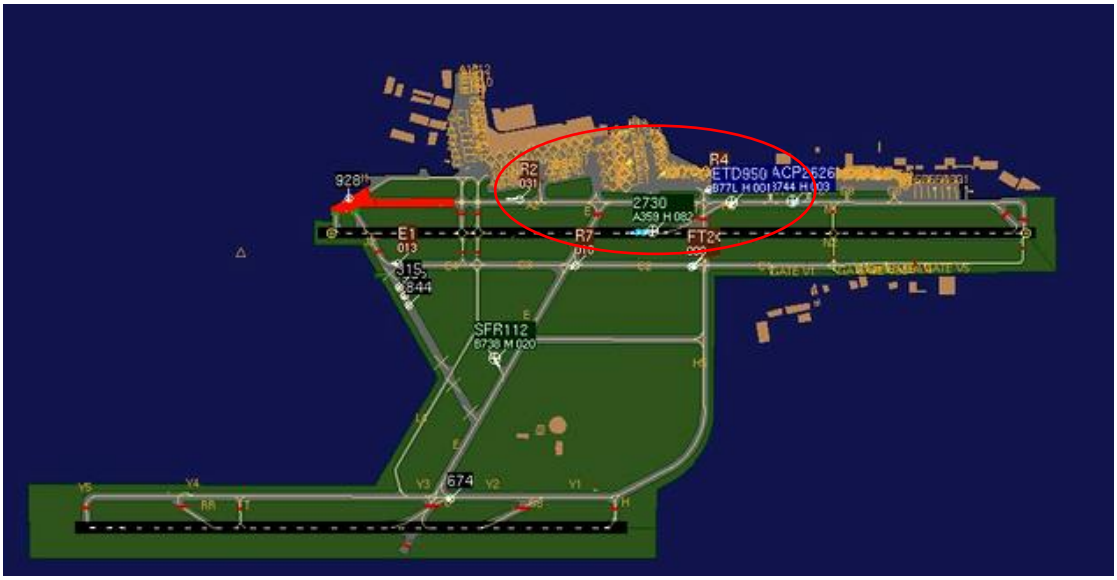



**Figure 9:** The aircraft safely landed on Runway 03L. (Source: ATNS)

## 1.13 Medical and Pathological Information

1.13.1 Not applicable.

## 1.14 Fire

1.14.1 There was no pre- or post-impact fire.

## 1.15 Survival Aspects

1.15.1 The serious incident was survivable as the crew was able to recover the aircraft and initiate a go-around which lasted approximately 20 minutes. The aircraft landed safely on Runway 03L at approximately 1115Z.

## 1.16 Tests and Research

1.16.1 None.

## 1.17 Organisational and Management Information

1.17.1 This was a scheduled international flight from HAAB to FAOR with 12 crew members and 68 passengers on-board. The flight was operated under Part 121. The aircraft had a valid Certificate of Airworthiness (CoA) that was issued by the Ethiopian Regulator on 1 November 2021 with an expiry date of 31 October 2022.

1.17.2 The operator was initially issued an Air Operating Certificate (AOC) by the State of Registry and State of Operator, Ethiopia, on 27 February 1995. The AOC was reissued on 17 November 2021 with an expiry date of 16 November 2022.

1.17.3 The aircraft maintenance organisation (AMO) approval certificate was issued to the operator on 27 July 2021 with an expiry date of 26 July 2022.

### 1.18 Additional Information

1.18.1 None.

### 1.19 Useful or Effective Investigation Techniques

1.19.1 None.

## 2. ANALYSIS

### 2.1. General

From the available evidence, the following analysis was made with respect to this incident. This shall not be read as apportioning blame or liability to any organisation or individual.

### 2.2. Analysis

2.2.1. Man (Crew)

The PF was qualified to act as pilot-in-command; he had a valid ATPL and a Class 1 medical certificate. He was issued an A350 rating to act as a pilot-in-command or co-pilot. The PM was qualified to act as co-pilot; he had a valid CPL and a Class 1 medical certificate. He was issued an A350 rating to only act as a co-pilot.

2.2.2. Aircraft

The last scheduled maintenance – 2A-M06-EO – was conducted on 12 October 2021 at 3366.6 airframe hours. The aircraft had accumulated an additional 200.8 airframe hours in operation since the last maintenance inspection. The aircraft was issued the CRS with an expiry date of 13 October 2021. On-site investigation and further post-incident inspection of the aircraft (airframe and engine) revealed no pre-existing failures prior to the serious incident; all damage was caused during the serious incident. Records indicated that the aircraft was airworthy and there were no recorded defects prior to the serious incident flight.

2.2.3. Weather

The METAR for FAOR for 6 November 2021 at 1100Z predicted wind of 320° at 16kts with a crosswind component of 15kts. The crew stated that during the final approach, ATC reported the wind to be 300° at 20kts. The crew landed at a heading of 030°. They used the METAR weather which measured a left crosswind component of 15kts. The PF conducted the crab method of approach to compensate for the left crosswind as well as stated that he elected to go-around due to the wind shear condition when they were at 30ft AGL. The QAR recorded a crosswind that was reducing closer to the ground; no evidence of wind

shear was triggered by the Predictive and Reactive Wind Shear Systems. This system detects wind shear below 1300ft until 50ft at approach.

2.2.4. Mission

The aircraft was on a scheduled passenger international flight from HAAB to FAOR. The crew was using manual ILS approach for landing Runway 03R. The ATC reported the wind to be 300° at 20kts which would result in a crosswind from the left. On final approach, the PF anticipated the left crosswind and, therefore, initiated the crab method. The PF successfully crabbed the aircraft during approach. He then flared the aircraft at approximately 50ft AGL. The crew applied the left roll inputs, likely to counter the effect of the left crosswind and to maintain the aircraft on the runway centreline. The right rudder pedal was depressed to maximum and was maintained in that position for approximately 6 seconds to align the aircraft to the centreline whilst the PF simultaneously rolled the aircraft to the left to sideslip the aircraft into the wind.

The QAR reading indicated that the aircraft touched down with the left main landing gear for 1s at an 8.4° left bank angle. The PF stated that at this point (30ft AGL) there was a wind shear condition that caused him to have an unstable touchdown and, therefore, initiated the go-around. According to the QAR recordings, there was no wind shear. During the decrab manoeuvre at approximately 7ft AGL, the pilot applied excessive right rudder input whilst attempting to line up to the runway centreline which caused a progressive increase of drift angle and right sideslip, and the subsequent roll departure at a maximum roll rate of 13° per second, reaching a maximum of 35° right roll angle. The transition from air to ground on touchdown allowed more rudder deflection authority as per intended design on ground. As the rudder pedal input was maintained, the left sideslip and the subsequent induced right roll continued to increase.

The PF corrected this by rolling wings to the left and releasing the right rudder. The ATC instructed the PF to maintain runway heading and to climb to an altitude of 8000ft before vectoring them for landing Runway 03L. The PF was able to land the aircraft safely on Runway 03L approximately 20 minutes later with a slightly stronger left crosswind of 330° at 22kts.

## 3. CONCLUSION

### 3.1. General

From the available evidence, the following findings, causes and contributing factors were made with respect to this incident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this incident. The findings are significant steps in this incident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions or a combination thereof, which led to this incident.
- **Contributing factors —** are actions, omissions, events, conditions or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the incident occurring, or would have mitigated the severity of the consequences of the incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

### 3.2. Findings

3.2.1 The PF had an Airline Transport Pilot Licence (ATPL). According to the hours derived from the pilot questionnaire, he had flown a total of 10 641.3 hours of which 1 738.0 hours were on the aircraft type.

3.2.2 The PF was issued a valid Class 1 aviation medical certificate on 20 October 2021 with an expiry date of 20 October 2022.

3.2.3 The PM had a Commercial Pilot Licence (CPL). According to the hours derived from the pilot questionnaire, he had flown a total of 2 322.5 hours of which 983.1 hours were on the aircraft type.

3.2.4 The PM was issued a valid Class 1 aviation medical certificate on 23 July 2021 with an expiry date of 22 July 2022.

3.2.5 The aircraft was first registered to the current owner on 6 November 2020. The aircraft had a valid Certificate of Airworthiness (CoA) that was issued on 1 November 2021 with an expiry date of 31 October 2022. The aircraft's Certificate of Release to Service (CRS) was reissued on 13 October 2021.

3.2.6 The operator was initially issued an Air Operating Certificate (AOC) by the State of Registry and State of Operator, Ethiopia, on 27 February 1995; it was reissued on 17 November 2021 with an expiry date of 16 November 2022.

3.2.7 The aircraft had a valid AMO certificate that was issued on 26 July 2021 with an expiry date of 27 July 2022.

3.2.8 The last maintenance inspection was carried out on 12 October 2021 at 3366.6 airframe hours. The aircraft had accumulated an additional 200.8 airframe hours in operation since the last inspection. No major defects were recorded prior to the serious incident flight.

3.2.9 The aircraft was equipped with a Weather Radar with Predictive Wind Shear and Turbulence detection and localisation functions for atmospheric disturbance hazards.

3.2.10 The aircraft was equipped with Navigation Displays (NDs) and Vertical Displays (VDs) which show the weather information and discriminate between relevant and non-relevant weather information in automatic mode.

3.2.11 During the aircraft power-up, the aircraft's recording system runs for 5 minutes and then stops. As soon as the first engine is started, it runs and continue to record until 5 minutes after the last engine is shut down.

3.2.12 The meteorological aerodrome report (METAR) for FAOR on 6 November 2021 at 1100Z was as follow: FAOR 061100Z 32016KT 280V340 9999 FEW045 28/11 Q1021 NOSIG=. The ATC informed the crew that the wind was 300° at 22kts and the incident aircraft indicated a wind speed of 25kts.

3.2.13 The pilot overcompensated when recovering from the crab technique; he also assumed that there was a wind shear condition. The aircraft's wind shear system did not detect or sound a warning of the presence of such a condition.

3.2.14 The operator had a valid AOC certificate that was issued by the State of Registry, which is the same as the State of Operator. The AOC was reissued on 17 November 2021 with an expiry date of 16 November 2022.

### 3.3. Probable Cause/s

3.3.1 The pilot applied excessive right rudder input whilst attempting to line up to the runway centreline, which caused the aircraft to over-drift to the right and experience a significant sideslip build-up and roll departure on the right. Subsequently, the right-wing tip contacted the runway despite the left sidestick input.

### 3.4. Contributory Factors

3.4.1 There was a left crosswind component which reduced closer to the ground.

3.4.2 Early flare initiation caused the aircraft to float over the runway and, thus, the aircraft missed the touchdown zone.

3.4.3 No evidence of wind shear even though the pilot stated its presence.

## 4. SAFETY RECOMMENDATIONS

### 4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

### 4.2. Safety Recommendation/s

4.2.1 None.

## 5. APPENDICES

5.1 Appendix 1: Landing Techniques Crosswind Landings

**This report is issued by:**

**Accident and Incident Investigations Division**
**South African Civil Aviation Authority**
**Republic of South Africa**

**Appendix 1**

*Landing Techniques Crosswind Landings (Source: Airbus Flight Operations Briefing Note)*

***I Introduction***

*Operations in crosswind conditions require strict adherence to applicable crosswind limitations or maximum recommended crosswind values, operational recommendations and handling techniques, particularly when operating on wet or contaminated runways. This Flight Operations Briefing Note provides an overview and discussion of operational factors involved in planning and conducting the approach and flare under crosswind conditions.*

***II Statistical Data***

*Adverse wind conditions (i.e., strong crosswinds, tail winds and wind shear) are involved in 33 % of approach-and-landing accidents. Crosswind in association with runway condition is a circumstantial factor in nearly 70 % of runway excursion events. 85 % of crosswind incidents and accidents occur at landing.*

***III Runway Condition and Maximum Recommended Crosswind***

*The maximum demonstrated crosswind and maximum computed crosswind, discussed in Flight Operations Briefing Note* ***Understanding Forecast / ATC / Aircraft Wind Information*** *are applicable only on dry or wet runway.*

***IV Final Approach Technique***

***Figure 1*** *shows that depending on the recommendations published in the aircraft operating manual, the final approach under crosswind conditions may be conducted:*

*• With wings-level (i.e., applying a drift correction in order to track the runway centerline, this type of approach is called a crabbed approach* ***[Airbus recommended technique]****), or*

*• With a steady sideslip (i.e., with the aircraft fuselage aligned with the runway centerline, using a combination of into-wind aileron and opposite rudder to correct the drift).*

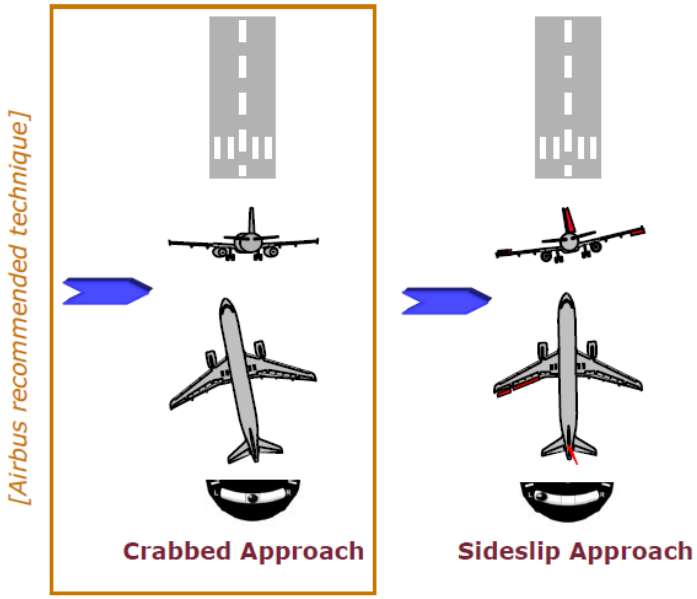



**Figure 1**

*Crabbed Approach versus Sideslip Approach*

***V Flare Technique***

*The objectives of the lateral control of the aircraft during the flare are to land on the centerline, and to minimize the loads on the main landing gear. During the flare, rudder should be applied as required to align the aircraft with the runway heading. Any tendency to roll downwind should be counteracted by an appropriate input on the sidestick (or control column, as applicable). In the case of a very strong crosswind, the aircraft may be landed with a residual drift/crab angle (maximum 5°) to prevent an excessive bank (maximum 5°). Consequently, combination of the partial decrab and wing down techniques may be required.*

***VI Understanding Crosswind Landing Limitations***

*The following discussion of flight dynamics can provide an enhanced understanding of the various crosswind landing techniques (i.e., final approach, flare and align phases).*

***Crosswind Landing Capability – Design Factors***

*• Bank angle at a given crab angle or crab angle at a given bank angle:*

*− Positive crab angles reflect normal drift corrections and sideslip conditions (i.e., with the aircraft pointing into wind). Negative crab angles result from an excessive rudder correction (i.e., aircraft pointing away from wind direction) and require a more-than-desired bank angle to maintain a steady-sideslip.*

*• Aircraft geometry limitation:*

*− This limitation reflects the maximum pitch attitude and/or bank angle that can be achieved without incurring a tail strike or scrapping the engine nacelle, the flaps or the wingtip (as applicable). Geometry limits usually are not a concern in high crosswinds as the roll and rudder authority is reached before any aircraft-to-ground contact occurs. This assumes achieving a steady sideslip without overcontrol (i.e., without excessive rudder and roll inputs) during the decrab / align phase.*

*• Ailerons / rudder authority:*

*− This limitation reflects the aircraft maximum capability to maintain a steady sideslip under crosswind conditions.*

***VII Understanding Touchdown and Rollout***

***Touchdown***

*Upon touchdown of the main landing gear, the aircraft transitions from the "laws of flight dynamics" to the "laws of ground dynamics".*

***VIII Factors Involved in Crosswind-Landing Incidents and Accidents***

*The following factors often are involved in crosswind-landing incidents and accidents:*

*• Failure to recognize changes in landing data over time (i.e., wind direction shift, wind velocity or gust increase)*

*• Reluctance to divert to an airport with less crosswind conditions*

*• Lack of time to observe, evaluate and control the aircraft attitude and flight path in a highly dynamic situation.*