Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2007-045
Final

Ground Strike - Sydney Kingsford Smith Airport, NSW
13 October 2007
VH-EEB
Embraer-Empresa Brasilia EMB-120 ER

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Abstract

On the evening of 13 October 2007, an Embraer-Empresa Brasilia EMB-120 ER, registered VH-EEB, was taxiing at Sydney Kingsford Smith Airport, NSW, to take off on a freight charter flight to Melbourne, Vic. The aircraft was lined up with the left edge of the runway. Shortly after the take-off roll commenced, the crew reported feeling two or three bumps on the runway, after which time the crew's attention was drawn to an electrical burning smell in the cockpit, followed by a high-speed warning. The smell dispersed and the flight continued as normal to Melbourne.

Pre-flight checks for the return flight to Sydney revealed damage to the aircraft, which was subsequently found to have been caused by impact with the runway edge lighting on the left side of Sydney runway 16R, where the aircraft had started its take-off run. The aircraft was grounded at Melbourne for repair.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external organisations.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

FACTUAL INFORMATION

Sequence of events

At 1930 Eastern Standard Time[1] on 13 October 2007, the crew of an Embraer-Empresa Brasilia EMB-120 ER, registered VH-EEB (EEB), with two flight crew on board, was being taxied at night at Sydney Kingsford Smith Airport, NSW prior to departure for a freight charter flight to Melbourne, Vic. The pilot in command (PIC) taxied from Domestic Terminal 5 via taxiways G and B4, planning for an intersection departure on runway 16R (Figure 1). The crew received clearance for takeoff shortly before reaching the holding point to enter the runway. The crew stopped the aircraft at the runway holding point for a short period as the checklist procedures were completed, then entered the runway and turned in the direction for takeoff. The aircraft was stopped again for approximately 10 seconds to complete the line-up actions. The copilot then took control of the aircraft and commenced the take-off roll.

Shortly after the take-off roll commenced, the crew reported feeling two or three bumps while accelerating on the runway, similar to those made when the aircraft rolls over embedded runway centreline lights. Shortly after feeling these consecutive bumps, the crew's attention was drawn to an electrical burning smell that had occurred in the cockpit. This smell was followed by an aural high -speed warning as the aircraft accelerated through V_1[2]. The smell dispersed and the warning was determined to be erroneous. With no indications that any abnormal event had occurred, the pilots continued the flight to Melbourne.

After landing at Melbourne and while conducting pre-flight checks before returning to Sydney, the crew discovered damage to the left propeller, the underside of the fuselage (including a beacon light), and to the nosewheel tyres. The damage was subsequently found to have been a result of impact with the runway edge lighting on the left side of Sydney runway 16R, where the aircraft had commenced the take-off roll. The aircraft was grounded at Melbourne for repairs.

Flight crew procedures

The PIC had taxied the aircraft on to the runway and then stopped. The line-up checks were completed and, approximately 10 seconds after the aircraft had stopped, control of the aircraft was handed over to the copilot. The handover procedure did not include a verification of the aircraft's position, nor was this required by procedures. The copilot was required to steer the aircraft during the takeoff, and cross-check calls were made by the PIC, who was the non-flying pilot. The copilot reported this to have been his first opportunity to scan his external environment and believed the aircraft was on the runway centreline as there were

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

2 V_1 is the decision speed during takeoff beyond which, should the critical engine fail, safety is no longer assured in a rejected takeoff and the flight should be continued.

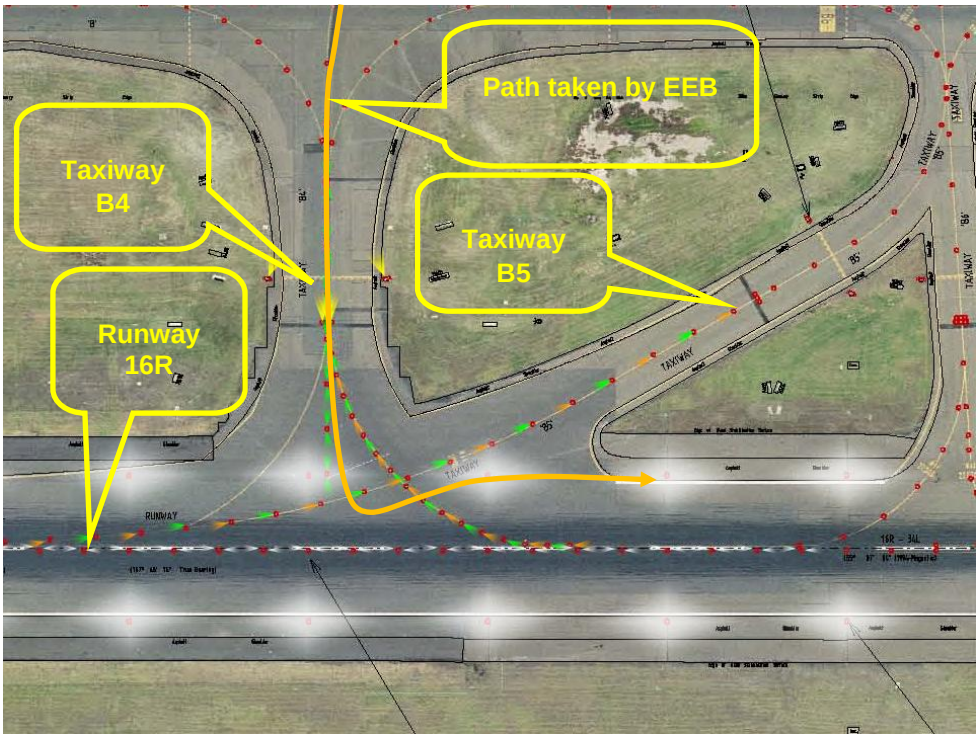
no visual cues to indicate the aircraft was anywhere other than on the runway centreline. The PIC's workload moved inside the cockpit as he monitored the aircraft's performance during the takeoff. Standard operating procedures did not require both pilots to independently verify or cross check their location on the runway before the take-off roll.

No indication was found that the crew were adversely affected by fatigue or undue time pressures associated with the flight.

Runway layout

Taxiway B4 was used to enter the runway. It was located beside taxiway B5 as it entered runway 16R (Figure 1). Taxiway B5 was a rapid exit taxiway to the left of Runway 16R aligned at an angle of 30 degrees from the runway. An area of tarmac of approximately half the runway's width extended to the left of runway 16R between taxiways B4 and B5, providing a greater area of tarmac to the left of runway 16R centreline in that location compared with most of the remainder of the runway.

Figure 1. An overhead photograph depicting runway and taxiway lighting in the area near runway 16R, taxiway B4, taxiway B5 and the path taken by EEB.



Runway and taxiway lighting

At the time of the occurrence, high intensity white runway edge lights were illuminated on both sides of runway 16R at 60 m intervals. The runway lights were directed to provide maximum illumination toward the runway threshold and were omnidirectional. The runway edge lights located at the taxiway were embedded, so that an aircraft could roll over them without damage, whereas the other runway edge lights were frangible and stood proud of the runway. Bidirectional white

runway centreline lights were embedded in the centre of the runway at 15m intervals.

Orange and green taxiway lights extended in a curve from close to the runway centreline to guide aircraft off runway 34L using taxiway B4. This lead-off lighting was difficult to see by anyone entering runway 16R from taxiway B4 because the lights were unidirectional, pointing away from an aircraft entering the runway. There were no lights to lead an aircraft off runway 16R to taxiway B4 as taxiway B5, which was located adjacent to B4, was more suitable for exiting. Green taxiway centreline lighting extended in a straight line along taxiway B4 and stopped on the edge of runway 16R to act as lead-on guidance for aircraft entering the runway. There was no taxiway on the opposite side of runway 16R from taxiway B4 that would have provided an illuminated visual cue to assist any crew entering the runway from taxiway B4 to perceive the width of the runway as they entered it.

Runway and taxiway markings

Due to the additional area of tarmac associated with the intersection of taxiways B4 and B5, the B4 taxiway left edge line met with the high speed exit taxiway B5 left edge line and therefore did not extend to the runway edge line as would normally be the case. The B4 left edge line would therefore not act as a guide for entering the runway. There was no information to alert flight crew to this taxiway marking arrangement.

Runway 16R had solid runway edge lines and broken runway centre line markings, all of the same width. Further along the runway in the direction of takeoff, the left edge line was repeatedly broken due to the entrance of several taxiways to the east of runway 16R.

Surface movement radar records of the taxiing aircraft

Sydney Airport had a surface movement radar system with a rapid refresh rate that enabled air traffic controllers to use the return signal from an aircraft's transponder to provide an accurate depiction of an aircraft's location on the ground. Recorded images from the surface movement radar indicated that the PIC of the Brasilia initially steered the aircraft towards the centre of the runway. However, the path of the aircraft was then altered, taking the aircraft to the left side of the runway, aligning it with left side of runway 16R for the takeoff (Figures 2 and 3).

Figure 2. Radar image of VH-EEB as it entered runway 16R

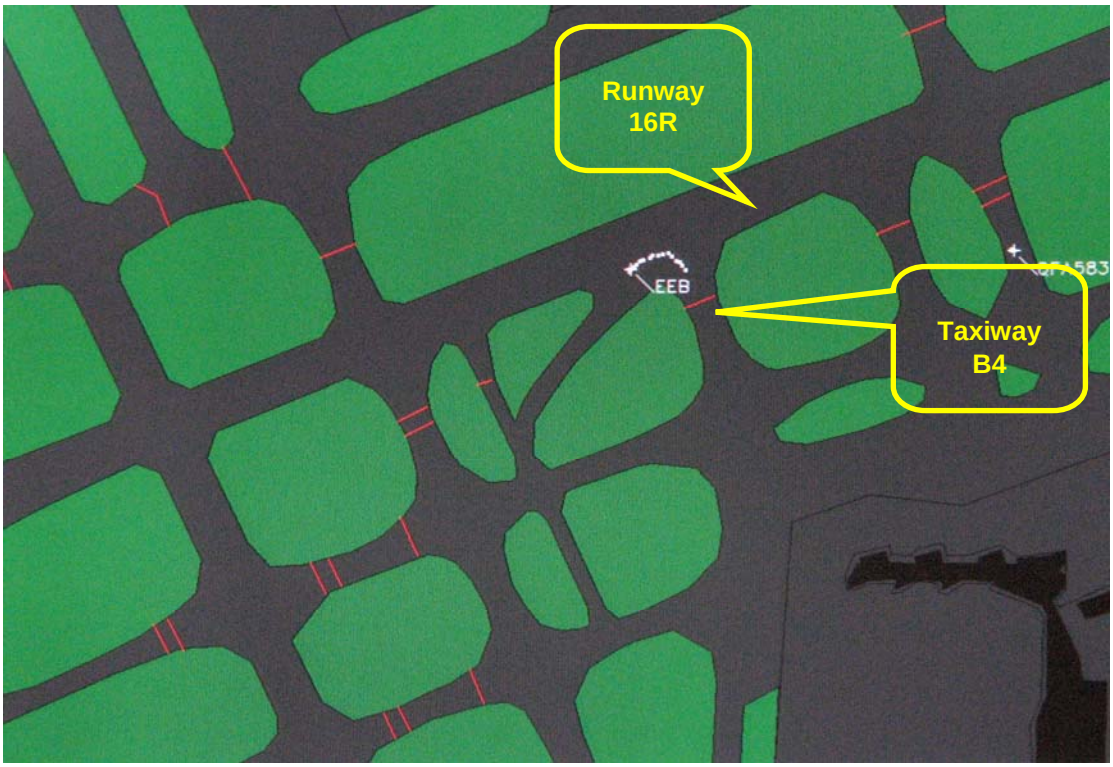
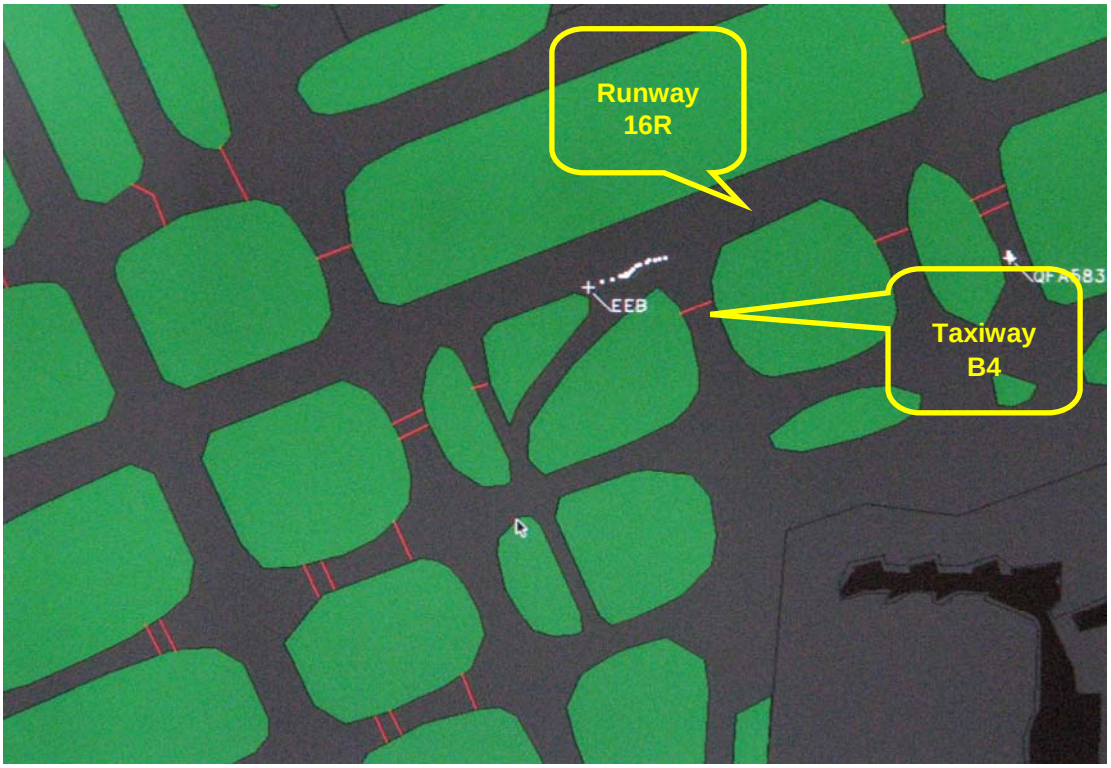


Figure 3. Radar image of VH-EEB during the initial stages of takeoff



ANALYSIS

When pilots taxi and take off during daylight conditions, they normally have a wide range of visual cues by which they can navigate and verify their location. At night however, the amount of visual information available is markedly reduced. Pilots rely more on the taxiway and runway lighting patterns presented to them and what can be seen in the field of the aircraft's taxi and landing lights.

The additional area of tarmac to the left of runway 16R at the intersections of taxiways B4 and B5, the runway markings leading to taxiway B5 and the absence of a solid runway edge line that led directly from the taxiway in use to the runway, may have given the impression to the crew that the aircraft had proceeded further towards the centre of the runway than it actually had. This may explain why the aircraft was turned onto the left side of the runway and aligned with the left edge.

Although the original misalignment of the aircraft could potentially be attributed to the arrangement of marking and light patterns giving the pilots a picture similar to that expected when lining up in the normal position on the centreline, the investigation could not determine why the crew did not detect the misalignment prior to takeoff. At this point, two sets of white lights (centreline and runway side lights) would have extended down the runway to the right of the aircraft and there would have been no row of white lights visible to their left.

FINDINGS

From the evidence available, the following findings are made with respect to the ground strike involving Embraer-Empresa Brasilia EMB-120 ER, registered VH-EEB,at Sydney Kingsford Smith Airport, NSW on 13 October 2007 and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The taxiway B4 left edge marking led onto taxiway B5, instead of runway 16R.
- Neither of the flight crew noticed the aircraft was not aligned with the runway centreline prior to commencing the take-off roll.
- An additional area of tarmac adjacent to the runway between taxiways B4 and B5, combined with reduced visual cues associated with night operations, probably created the impression that the aircraft had proceeded further into the runway than it actually had.

SOURCES AND SUBMISSIONS

Sources of information

Flight crew of VH-EEB

Aircraft operator

Sydney Airports Corporation Limited

Airservices Australia

Civil Aviation Safety Authority

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the aircraft flight crew, aircraft operator, airport operator, Airservices Australia and the Civil Aviation Safety Authority (CASA). Submissions were received from CASA, the pilot in command and the aircraft operator. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.