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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2008-077
Final

Wake turbulence event Sydney Airport, NSW 3 November 2008

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Abstract

On 3 November 2008, a SAAB Aircraft Company 340B-229 (SAAB), registered VH-ORX, was conducting a regular public transport flight from Orange, NSW to Sydney. The crew reported that, at about 0724 Eastern Daylight-saving Time, when tracking to join a 7 NM (13 km) final for runway 34 Right (34R), a passenger sustained minor injuries following a possible wake turbulence event that resulted in a momentary loss of control of the aircraft.

Examination of the available radar, meteorological and aircraft operational data identified that the momentary upset probably resulted from wake turbulence, which was generated by an Airbus Industrie A380-800 (A380) that was conducting a parallel approach to runway 34 Left (34L). There was a 35 kt left crosswind affecting both aircraft's approaches.

Airservices Australia (Airservices) reported to the SAAB operator that, as a result of this incident, they had introduced a number of interim minor changes to Sydney parallel runway operational procedures during high crosswind conditions. Those minor changes would have effect while Airservices carried out a review of A380 operations. In addition, the Civil Aviation Safety Authority has opened a regulatory change project to review and update wake turbulence separation information in the Manual of Standards Part 172.

FACTUAL INFORMATION

History of the flight

On 3 November 2008, a SAAB Aircraft Company 340B-229 (SAAB), registered VH-ORX, was conducting a regular public transport flight from Orange, NSW to Sydney with two flight crew, one cabin crew and 33 passengers. At about 0724 Eastern Daylight-saving Time[1], when tracking to join a 7 NM (13 km) final for runway 34 Right (34R), and descending through an altitude of about 2,400 ft above mean sea level (AMSL), the aircraft experienced an uncommanded 52° roll to the left, in conjunction with an 8° nose-down pitching motion. Immediately after, the aircraft rolled through wings level to a 21° right bank angle. The aircraft also experienced an altitude loss of 300 to 400 ft in the 9 to 15-second period during which the crew regained control of the aircraft. The aircraft was about 259 m to the right of the 34R centreline at that time.

As a result of exceeding its operational parameters, the Command Cutout feature ceased giving steering commands to the autopilot. The autopilot was disengaged by the crew who then regained control of the aircraft and manually flew the remainder of the approach.

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Daylight-saving Time, as particular events occurred. Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours.

During the upset, one passenger sustained minor injuries.

A Bombardier Inc DHC-8-400 (DHC8) was 2 minutes and 10 seconds, or 6.5 NM (12 km) ahead of the SAAB on final approach for 34R. In addition, radar recordings showed that there was an Airbus Industrie A380-800 (A380) about 3.7 nm (7 km) on final approach to runway 34 Left (34L) ahead of, and to the left of the SAAB at the time of the upset. The A380 had passed left abeam the upset location slightly above, and 72 seconds ahead of the SAAB. The crew of the SAAB reported that they were aware of both aircraft and, at the time, considered separation was adequate.

Weather conditions

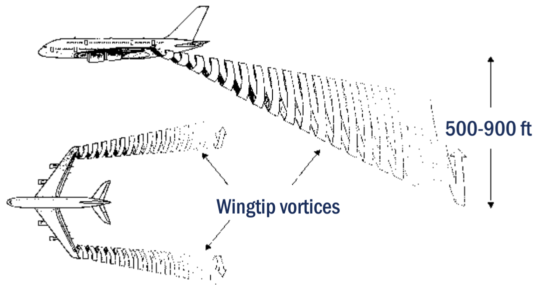
The surface wind at the time was 270° at 8 kts. The A380 flight data records indicated that the wind increased gradually with altitude, and at 2,400 ft was 246° at 35 kts. That represented a 35 kt crosswind from the left on final approach.

The recorded aerodrome information advised that 'independent visual approaches' and 'parallel runway operations' were in progress at Sydney, with no cloud reported below 5,000 ft, and visibility in excess of 10 km.

Wake turbulence

Wake turbulence is the result of wingtip vortices that are created when a wing creates lift (Figure 1).[2] The magnitude and intensity of the vortices is determined by four factors; the amount of lift that is being generated by the wing, the aircraft's wing span, the air density, and the airspeed of the aircraft that is generating the turbulence.

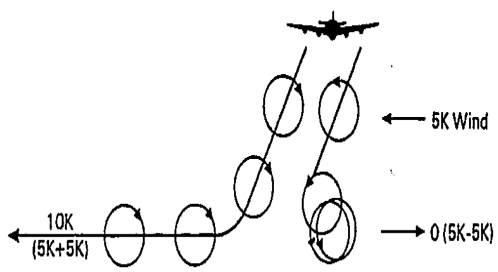
Figure 1: Effects of wake turbulence



Generally, the larger the aircraft, the larger the diameter of the vortex created. There are two factors that affect the dissipation of wingtip vortices; the aircraft's configuration and the prevailing atmospheric conditions.

Studies have determined that vortices in still air move outwards at a rate of about 5 kts, and descend at about 300 to 500 ft/min. The studies also showed that a crosswind increased the lateral transportation (drift), or sideways displacement of the vortices (Figure 2).[2]

Figure 2: Crosswind effect on wake turbulence



The Civil Aviation Authority of New Zealand, in a recent pilot education document advised:[3]

> ... when encountering wake vortices pilots can expect induced roll and yaw with smaller aircraft experiencing severe rolling motions with more than 30 degrees of roll and loss of control. If the aircraft is flown between the vortices, high roll rates can coincide with very high sink rates in excess of 1000 ft per minute.

Calculations based on the recorded crosswind component of 35 kts at an altitude 2,400 ft, indicated that it would take 72 seconds for the wingtip vortices to cover the combined 1,037 m spacing between the parallel runways and 259 m

2 *Wake Turbulence*; Aeronautical Information Circular, AIC 17/1999; Civil Aviation Authority; United Kingdom.

3 *Good Aviation Practice – Wake Turbulence*; Civil Aviation Authority of New Zealand; www.caa.govt.nz

that the SAAB was displaced from the centreline (1,296 m total). That was about the elapsed time interval between the A380 passing abeam the upset point, and the SAAB reaching it.

Air traffic control procedures

The SAAB and DHC8 were in the 'Medium[4]' wake turbulence category. The Manual of Air Traffic Services (MATS) did not require the application of wake turbulence separation between similar category aircraft.

At the time of the occurrence, the A380 was classified within the 'Heavy[5]' wake turbulence category. On 19 November 2008, in response to guidance material provided by the International Civil Aviation Organization (ICAO), MATS and the Aeronautical Information Publication were amended to identify the A380 as a 'Super' wake turbulence category aircraft. That category was a subset of the Heavy category, attracting additional separation requirements.

Independent approaches to the Sydney parallel runways in visual conditions were permitted by the MATS in accordance with ICAO requirements.

The final approach path for 34R was displaced 1,037m to the east of 34L, and the location of the threshold of 34R was 961 m earlier in the approach than for 34L, which meant that aircraft on final for 34R normally operated below the height of aircraft on final for 34L. The Australian and International standards for the independent operation of parallel runways with centreline spacing of greater than 760 m, did not cater for the possible lateral drift of wake turbulence due to high crosswind conditions, and vertically-staggered approach paths.

Traffic information and wake turbulence separation was not required to be provided by Air Traffic Control in respect to aircraft operations on the adjacent parallel runway.

4 The Medium category included aircraft with a maximum certified take-off weight (MTOW) of less than 136,000 kg but more than 7,000 kg. The SAAB had a MTOW of 13,155 kg.

5 The Heavy category included aircraft with a MTOW of 136,000 kg or more. The A380 had a MTOW in excess of 560,000 kg.

ANALYSIS

The apparently normal approach by the preceding DHC-8, together with the magnitude of the upset in the SAAB, reduced the likelihood that the momentary loss of control by the SAAB's crew was a result of the ambient conditions. The lack of any reported avionics or other anomaly in the SAAB suggested that the upset was not a function of those aircraft systems. The estimated time for the crosswind to have drifted vortices from the A380 approach path to that of the SAAB, and the norm for wake turbulence to descend from the generating aircraft or wing, suggested the probability that the SAAB upset was a result of wake turbulence from the upwind, and previously higher A380.

The Manual of Air Traffic Services (MATS) and Aeronautical Information Publication wake turbulence categories and separation standards for aircraft operations to the parallel runways at Sydney, were consistent with international standards and were applied correctly by Air Traffic Control (ATC). In this case, the lack of any requirement for ATC to apply a wake turbulence separation standard meant that no account was taken of the potential effect of any lateral drift of the A380's wake turbulence towards the downwind and following SAAB.

In this instance, the SAAB flight crew's awareness of the A380 on runway 34 Left marginalised the potential safety benefit of a requirement for ATC to provide traffic information on the A380. However, the SAAB crew was not aware of the risk of wake turbulence drift in high crosswinds, and it was probable that the significant difference in the maximum take-off weights of the SAAB and A380 magnified any turbulence effects on the smaller SAAB.

FINDINGS

From the evidence available, the following findings are made with respect to the turbulence event involving the SAAB Aircraft Company 340B-229 aircraft, registered VH-ORX, at Sydney Airport, NSW on 03 November 2008 and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- There was no requirement for wake turbulence separation to be provided by Air Traffic Control in respect of aircraft operations on the adjacent parallel runway. *[Safety issue]*
- The strong crosswind caused the wake turbulence that was generated by the Airbus Industrie A380-800 (A380) operating on runway 34 Left (34L), to drift across to the final approach path for runway 34 Right (34R).
- Due to the location of the respective runway thresholds, the approach path for 34L was higher than the approach path for 34R at a fixed distance from the airport, resulting in the drifted A380 wake turbulence descending onto the SAAB's final approach path.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Provision of wake turbulence separation

Safety issue

There was no requirement for wake turbulence separation to be provided by Air Traffic Control in respect of aircraft operations on the adjacent parallel runway.

Safety action taken by Airservices Australia

In response to this occurrence, Airservices Australia (Airservices) conducted a review of parallel runway operations at Sydney involving the Airbus Industrie A380-800. Airservices subsequently issued the following instruction to controllers:

> Parallel Approach Limitations
>
> When a Super wake turbulence category aircraft is making an approach to a parallel runway, provide wake turbulence distance separation to the adjacent runway when the aircraft making an approach to the adjacent runway has a MTOW less than 25,000 kg.

ATSB assessment of safety action taken by Airservices Australia

The ATSB is satisfied that the action taken by Airservices adequately addresses the safety issue.

Safety action taken by the Civil Aviation Safety Authority

In response to this occurrence, the Civil Aviation Safety Authority has opened a regulatory change project to review and update wake turbulence separation information in the Manual of Standards Part 172.

ATSB assessment of safety action taken by the Civil Aviation Safety Authority

The ATSB is satisfied that the action taken by CASA adequately addresses the safety issue.

Safety action taken by the Australian Transport Safety Bureau

In response to this occurrence, the Australian Transport Safety Bureau (ATSB) will distribute this report to the:

- International Civil Aviation Organization (ICAO)
- European Aviation Safety Agency
- US National Transportation Safety Board
- aircraft manufacturer.

SOURCES AND SUBMISSIONS

Sources of Information

The main sources of information during the investigation included:

- the aircraft operator
- the SAAB crew
- the SAAB 340B Aircraft Operations Manual
- the operator of the A380-800 (A380)
- flight recorder data from the SAAB, and quick access recorder data from the A380
- Airservices Australia
- the Bureau of Meteorology
- the Civil Aviation Authority of New Zealand
- the International Civil Aviation Organization.

References

Civil Aviation Authority of New Zealand publication; *Good Aviation Practice – Wake Turbulence*; July 2008; www.caa.govt.nz

Aeronautical Information Circular, *Wake Turbulence*, AIC 17/1999; UK Civil Aviation Authority, ATM Policy and Development. Hounslow, Middlesex. TW6 1JJ.

Submissions

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

A draft of this report was provided to the crew and operator of the SAAB, Airservices Australia, and the Civil Aviation Safety Authority. Submissions were received from the captain of the aircraft, Airservices Australia and the Civil Aviation Safety Authority. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.