INCIDENT

Aircraft Type and Registration:	Airbus A320-233, SP-HAI	
No & Type of Engines:	2 IAE V2527-A5 turbofan engines	
Year of Manufacture:	1999 (Serial no: 1007)	
Date & Time (UTC):	21 February 2016 at 1311 hrs	
Location:	Birmingham International Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - 99
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	61 years	
Commander's Flying Experience:	13,952 hours (of which approximately 10,000 were on type) Last 90 days - 60 hours Last 28 days - 23 hours	
Information Source:	AAIB Field Investigation	

Synopsis

Shortly after landing at Birmingham Airport, the aircraft failed to negotiate a 90° taxiway turn and ran on to the adjoining grass. The taxiway condition was damp and the aircraft had entered the turn above the maximum speed given in the relevant operating manuals. The nosewheels lost traction and skidded, causing the flight crew to lose full directional control of the aircraft.

History of the flight

The aircraft departed from Katowice in Poland at 0915 hrs on the morning of the incident. It flew without passengers to Paderborn in Germany, where 99 passengers boarded for the flight to Birmingham. The aircraft departed Paderborn on schedule, at 1140 hrs, with the aircraft commander as the handling pilot.

The 1250 hrs meteorological observation at Birmingham Airport gave a surface wind from 260° at 14 kt. It was variable in direction, between 220° and 280°. Visibility was good and there was broken cloud at 1,800 ft. The flight crew flew an ILS approach to Runway 33, later describing the conditions as gusty and turbulent. Because of these conditions, the approach and landing were flown with a reduced flap setting. When the aircraft was given landing clearance, ATC reported the surface wind as being from 260° at 14 kt, gusting to 25 kt.

The aircraft appeared to the ATC Tower controller to touch down in the normal landing zone. As the aircraft slowed and approached the runway exit at Taxiway Bravo, the controller passed taxi instructions, the initial part of which was to turn right onto Taxiway Bravo and then right onto Taxiway Alpha. These were correctly acknowledged by the first officer.

Vacating at Taxiway Bravo (which was routinely used as a runway exit for this category of aircraft) required a 90° right turn. It then only allowed a straight taxi for about 100 m before a further 90° right turn onto Taxiway Alpha, which ran parallel to the runway and back towards the main apron. As the aircraft vacated the runway, the first officer commenced his after-landing actions in order to configure the aircraft for the taxi phase.

The aircraft commenced its right turn onto Taxiway Alpha but failed to negotiate it successfully and ran on to the adjoining grass. The aircraft came to a stop substantially off the taxiway, with only a small part of the outer right-hand mainwheel touching the hard surface. The Tower controller saw what had happened and initiated an Aircraft Ground Incident. The flight crew communicated with the controller to confirm the situation and advise that a passenger evacuation was not intended.

There was some subsequent disruption to airport operations, as the normally used exit at Taxiway Bravo and sections of Taxiway Alpha were rendered unusable for a period.

The passengers were subsequently disembarked via steps placed at the rear right door. The aircraft was then pulled rearwards onto the taxiway and taken to an on-site maintenance facility for a detailed inspection.

Flight crew reports

The flight crew, who were both adequately rested before the flight and familiar with Birmingham Airport, reported that the aircraft was serviceable prior to the incident. Neither pilot recalled any failure or abnormal indications, either prior to or after the event.

The crew thought that the aircraft had skidded in the turn after the steering input had been applied to turn on to Taxiway Alpha. They described having an impression of the aircraft being moved sideways, which they attributed to a combination of the gusting wind, the aircraft's relatively light weight and a slippery surface. The commander, who described the taxiway surface as damp, did not recall what the aircraft's speed was prior to the turn but did not think that it had been excessive or inappropriate (a continuous display of current groundspeed is shown on each pilot's navigation display).

The first officer reported that he had looked to the right in the direction of Taxiway Alpha to check it was clear prior to the final turn, but then he had looked down to continue his after-landing actions. He looked up again when the commander made a brief exclamation, by which time the taxiway excursion was taking place.

Aircraft examination

A detailed inspection of the aircraft by the operator's contracted maintenance company confirmed the flight crew's report that it was serviceable prior to the incident. A number of items relating to the main undercarriage were cleaned or changed and the engines were inspected for foreign object damage, none being found. The aircraft was subsequently returned to service.

Incident site photographs

Photographs taken shortly after the incident confirm the commander's report that the taxiway surfaces were damp. There was a dry strip along the outer edge of Taxiway Alpha, across which could be seen moisture tracks left by the aircraft's mainwheel tyres (Figure 1).

From the distinctive nosewheel skid marks and furrows in the grass, it was clear that the nosewheels had begun to skid very soon after the turn started, and that it adopted, and remained at, a high angle of deflection.

Figure 1

Incident site immediately following excursion.
Note nosewheel skid marks, mainwheel tracks, taxiway condition and nosewheel angle
(*photo courtesy of Birmingham Airport*)

Aircraft operating procedures

The aircraft operator's procedures were based on the Flight Crew Manuals produced by the aircraft manufacturer. These procedures stated that taxi speed should be less than 10 kt for turns of 90° or more.

Recorded data

Flight data recorder

Replay of the aircraft's flight data recorder showed that the aircraft vacated the runway onto Bravo with groundspeed falling to about 17 kt, under light braking. Brakes were then released and groundspeed increased slightly to reach 19 kt whilst on Bravo. Approaching the turn to Alpha, light braking was applied (approximately 500 psi) and speed reduced, but only to 18 kt by the start of the turn. Wheel braking ceased within two seconds of the turn starting, with the speed at 14 kt. There was no further braking and the nosewheel left the paved surface at a groundspeed of 13 kt.

Lateral acceleration for the turn onto Alpha reached 0.13g (compared to 0.16g when the aircraft turned off the runway). Turn rate increased quickly to about 8°/second, and remained nearly constant until the nosewheels left the paved surface.

As the nosewheel left the paved surface, the thrust levers were advanced together to 16.9° (Climb detent is 22.5° and Flex / MCT detent is 33.75°). The thrust levers were retarded to idle four seconds later, after the aircraft had come to a stop.

The flap lever was moved out of the Config 3 position (used for landing) three seconds after the turn on to Alpha started. Nosewheel steering angle and tiller position were not recorded parameters.

Cockpit voice recorder

From replay of the cockpit voice recorder, comments made by the flight crew during the landing roll were consistent with the demanding landing approach they later described. The first officer acknowledged the taxi instructions and there was no further communication between the two pilots until the incident occurred.

A distinctive background noise could be heard for about three seconds before the nose left the paved surface. The noise was consistent with the nosewheel 'scrubbing' (ie at too great an angle for the aircraft's speed, causing it to skid).

After the incident, there was only a brief discussion between the pilots directly relating to the possible cause, when the commander asked "WHAT WAS OUR SPEED?" The first officer replied to the effect that he did not know as he was carrying out his after-landing actions.

Taxiway surface conditions

The Tower controller reported that there had been showers at the airport that morning, but no steady precipitation. The runway had been declared WET earlier, but had quickly dried in the brisk wind. At the time of the incident the runway was declared DRY. The taxiways concerned, which were described by the commander as damp and slippery underfoot when he walked on them after the incident, had been anti-iced earlier in the day.

ATC reported 36 movements that day, all of which except two had vacated Runway 33 at Taxiway Bravo. The most recent was also an A320, only four minutes before the incident. No other crew had reported any difficulty or adverse taxiway conditions. The taxiways in the area concerned were surfaced with asphalt, marked with yellow centreline markings and equipped with taxiway lights.

Taxiway friction measurement

Unlike runways, there is no specific requirement for routine friction testing of taxiways. At AAIB request, a surface friction test was carried out using Continuous Friction Measuring Equipment (CFME). There were some limitations in testing due to the geometry of the taxiways, which meant that test runs were confined to that part of Taxiway Alpha where Taxiway Bravo joined it. The test area was 200 m long (centred on the intersection with Taxiway Bravo) and 9 m either side of Taxiway Alpha centreline.

The test was not carried out in controlled dry conditions, in that there was residual runway de-icing fluid present on the surface. This would have had the effect of depressing the measured friction values.

The test identified a small area of relatively poorer friction values for that part of Alpha where the centreline of Bravo joined it, roughly equating to the path the nosewheels would have initially taken in the incident. However, values beyond the centreline of Taxiway Alpha were comparable to the rest of the measured area. The measured coefficient of friction values in the poorer area were at or above 0.40. For comparison, ICAO Annex 14 Volume 1 equates this value to a braking action of GOOD for an aircraft landing on a snow- or ice-covered runway[1].

Analysis

Although the surface friction test identified a small area of reduced friction values, these were not excessively low. The area concerned had been negotiated successfully by numerous aircraft that morning, including a similar type only four minutes before the incident to SP-HAI. Similarly, although the surface wind was brisk and gusty, it was well within the aircraft's normal operating limits and would not be expected to cause issues with ground manoeuvring.

Footnote

[1] 'GOOD' in this context is a comparative term, intended to mean that aeroplanes should not experience directional control or braking difficulties, especially when landing. It is not meant to equate to conditions that might be found on a clean, dry runway.

The taxiway marks indicated that the nosewheels had started to skid relatively early in the turn and had remained in this state until they left the paved surface. This is supported by the FDR data, which shows that the rate of turn was approximately constant from the initiation of the turn. It was evident from the nosewheel skid pattern and the furrow in the grass that the nosewheels had adopted a high angle of deflection, which was maintained until the aircraft had come to a stop. There was limited wheel braking and no visible evidence of mainwheel skidding.

The aircraft's speed (18 kt) was considerably higher than that given in the aircraft operating procedures (less than 10 kt) for a 90° turn. The procedures do not necessarily take into account degradation in friction qualities such as could be experienced on a damp surface, so it is arguable that an even lower speed might have been prudent. Given the relatively high speed that the turn was entered, it is probable that nosewheel steering angle was increased rapidly to maximum, and that this contributed to the early skid. This is again supported by the FDR data, which shows that the rate of turn was approximately constant throughout the turn.

From the flight crew accounts, the CVR data and the lack of significant wheel braking, it is clear that the flight crew did not appreciate that the aircraft's speed was too high for the 90° turn. The commander did not recall any distractions immediately beforehand, although it is possible that his attention may have been diverted briefly: to refer to a taxi chart, or to monitor the first officer's actions, for example. The first officer's primary role at the time would have been to monitor the aircraft to ensure a safe taxi, and his attention was diverted from this task by performing the after-landing actions at that time. There would have been no particular urgency to these actions, which could have been delayed until the aircraft was safely on Taxiway Alpha.

The difficult approach and landing offers a possible explanation as to why the experienced crew attempted the turn at too high a speed. Landing safely after a period of intense high workload, it is possible that the crew inadvertently but prematurely relaxed their normal level of vigilance.

Conclusion

The aircraft entered a 90° turn on a damp taxiway at a speed that was too high for the conditions and geometry of turn. The nosewheels lost traction and skidded, causing the flight crew to lose full directional control of the aircraft.