

No. 23

Skyways Coach Air Limited, Avro 748 Series I, G-ARMV, accident at Lympne Aerodrome, Kent, England, on 11 July 1965. Report No. EW/C/0106, dated June 1966, released by the Board of Trade, United Kingdom, C.A.P. 264

1. - Investigation1.1 History of the flight

The aircraft was on a scheduled international flight from Beauvais, France, to Lympne, England. Before taking off the pilot-in-command obtained a weather report from Lympne as follows: Cloud ceiling: 250 ft. Visibility: 2 000 m. Surface wind: 220° at 18 kt. It departed Beauvais at 1551 hours GMT on an IFR flight plan. As the aircraft passed Abbeville, radio contact was established with Lympne and a weather report was obtained which gave a visibility of 1 000 m in drizzle, cloud ceiling of 250 ft and surface wind 220/18 kt gusting to 26 kt. The airline's limits for landing on runway 20 were 1 100 m RVR and cloud ceiling 200 ft. The pilot-in-command again checked landing conditions at Lympne before commencing an instrument approach and, although conditions had not altered significantly since the previous report, he was informed of a "slight improvement" but the wind was still gusting.

The final instrument approach to runway 20 using radar began at 4 miles from touchdown; the aircraft was in cloud, flying at 1 100 ft, in turbulent conditions. Three and a half miles from touchdown the pilot-in-command began to descend at 350 to 400 ft/min, the equivalent of a 3° glide path in the prevailing conditions. As there was no radar glide path the Lympne radar controller advised the pilots of the height at which the aircraft should have been at each mile before touchdown.

When the aircraft was about 5/8 of a mile from touchdown the radar controller gave a final heading correction and at half a mile, when the talkdown finished, he told the pilots that the aircraft was lined up with the right-hand edge of the runway. The rest of the approach was made visually but the radar controller continued to track the aircraft. He observed it deviate further to the right of the extended centre line as it neared the touchdown point.

The pilot-in-command stated that he could see the ground from 250 ft, and at 220 ft when half a mile from touchdown he could see the far boundary of the aerodrome through heavy drizzle. Height was maintained at 220 ft for 3 or 4 seconds, then the descent was resumed and at a quarter of a mile from touchdown and at 150 to 200 ft, full flap was selected and power reduced to 10 600 rpm.

At this stage turbulence became severe. The pilot-in-command realized that the aircraft was going to the right of the runway but he decided not to try to regain the centre line as this would require a turn at low altitude. As the aircraft approached the aerodrome boundary the airspeed indicator was fluctuating and an attempt was made to maintain 92 kt the starboard wing was held down slightly to compensate for port drift.

The pilot-in-command stated that he began the flare-out 30 to 40 ft above the ground at an IAS of 88 kt but as he closed the throttles the starboard wing went down suddenly. Although he was aware that the aircraft was descending rapidly, he was initially more concerned about restoring lateral level; only at the last moment did he attempt to check the rate of descent with elevator control but the aircraft struck the ground heavily on its starboard undercarriage.

After the impact, the starboard wing, engine nacelle and undercarriage became separated from the main structure: the aircraft rolled over to starboard and slid along the grass inverted, coming to rest after having swung through approximately 180°.

The accident occurred at 1633 hours.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal			
Non-fatal		3	
None	4	45	

1.3 Damage to aircraft

The aircraft was substantially damaged.

1.4 Other damage

None.

1.5 Crew information

The pilot-in-command, aged 41, held a valid airline transport pilot's licence endorsed for Avro 748 aircraft. He had satisfactorily completed a six-monthly competency check on this type of aircraft on 1 June 1965. He had flown a total of 6 799 hours including 2 732 hours as pilot-in-command, of which 1 096 hours were on Avro 748. He had flown 430 hours during the last 6 months as pilot-in-command on Avro 748 and had been on duty for 9 hours at the time of the accident.

The co-pilot, aged 25, held a valid commercial pilot's licence endorsed for Avro 748 aircraft with instrument rating. His last competency check on Avro 748 took place on 6 June 1965. He had flown a total of 980 hours, including 192 hours as co-pilot on the Avro 748. At the time of the accident he had been on duty for 5 hours.

Also aboard were a stewardess and a supernumerary crew member.

1.6 Aircraft information

The aircraft had a valid certificate of airworthiness and had been maintained in accordance with an approved maintenance schedule. At the time of the accident it had flown 3 432 hours.

The weight and centre of gravity of the aircraft were within authorized limits.

The type of fuel being used was not stated in the report. Before leaving Beauvais on the last flight, the aircraft was refuelled to 400 imperial gallons capacity.

1.7 Meteorological information

At Lypne the weather was overcast with slight rain and drizzle, and throughout the afternoon the visibility had varied between 1 000 and 2 000 m in rain or drizzle. Cloud ceiling was 200 to 250 ft with occasional fractostratus at 100 to 150 ft. The surface wind was from 210 to 220°, 15 to 20 kt with gusts between 26 and 29 kt.

The weather observed by Air Traffic Control immediately after the accident was:

Surface wind: 200/18 kt gusting to 26 kt
Visibility: 1 000 m, drizzle
Cloud: 8/8 at 250 ft

An aftercast of the weather by the meteorological office indicated the probability of vertical wind shear. Wind strength and gusts recorded at the time of the accident could also have resulted in vertical wind components of up to 700 ft/min, and there would have been turbulent air streaming across the aerodrome to the approach to runway 20.

Runway visual range was not measured at Lypne but observations were made by the duty controller who determined the visibility by reference to objects at known distances from the control tower. The minimum RVR laid down by the operator for landing on runway 20 was 1 100 m but, as the visibility of 1 000 m passed to the aircraft was not RVR, the pilot was entitled to make an approach down to his critical height of 200 ft and assess the actual visual range for himself. On reaching his critical height he considered the visibility was sufficient to enable him to complete his approach and at half a mile from touchdown he could see the far end of the aerodrome which would put the visibility from that position at about 3/4 of a mile.

At the time of the accident the operator had proposed an amendment to his operations manual. This amendment would have prohibited an approach in meteorological visibilities of less than 1 100 m. However, the operations manual carried in the aircraft had not been amended and the pilot-in-command was not aware of the impending change.

1.8 Aids to navigation

Not pertinent to this accident.

1.9 Communications

No communications difficulties were reported.

1.10 Aerodrome and ground facilities

The altitude of Lypne Aerodrome is 349 ft. The whole of the usable surface of the aerodrome was grass covered and there were two designated take-off and landing strips for public transport aircraft: 20/02 and 16/34: these were referred to as 'runways'.

Runway 20 had a published landing distance of 2 625 ft (800 m) and it was 300 ft wide. Its direction and outline had at one time been marked out by rectangles cut into the surface, thus exposing the chalk subsoil. At the time of the accident most of these marks were obliterated, having been overgrown by grass but there were two marker boards indicating the commencement of the landing threshold area. There was no approach or runway lighting for this runway. The northern boundary, where the accident took place, fell away into a valley for about half a mile at a gradient of about 1-in-40.

It was stated by the operator that pilots can land anywhere on Lympe aerodrome and were not necessarily confined to the designated runways, providing the direction chosen did not invalidate performance requirements and that reasonable lateral clearance to any obstruction could be maintained.

1.11 Flight recorders

Not mentioned in the report.

1.12 Wreckage

Inspection at the scene of the accident showed that the aircraft first struck the ground on its starboard undercarriage in a starboard wing down attitude, 150 ft inside the airfield boundary and 170 ft to starboard of the right-hand edge of the runway.

1.13 Fire

There was no fire.

1.14 Survival aspects

The five emergency light units fitted in the roof of the passenger cabin are designed to operate if an excess of 3 g is applied in a fore and aft direction. As retardation forces were less than this and as the initial impact was in a vertical plane, none of the lights operated.

Rescue vehicles and personnel were quickly on the scene but there was some delay in getting all the passengers out since many of them, disregarding the risk of fire, would not leave the aircraft cabin without their personal belongings.

1.15 Tests and research

An analysis of the structural failure sequence was undertaken by the K.A.E. and Hawker Siddeley Aircraft Limited; data was also provided by component and system manufacturers. It was established that the aircraft had made a heavy landing, producing a reaction on the starboard undercarriage leg of 81 000 lb with an associated drag of 17 500 lb. This would have produced forces 50% in excess of the fully factored design requirements and indicated a vertical descent velocity of 16.6 ft/sec against the design velocity of 10 ft/sec (ultimate value 12 ft/sec). The effect was to cause a shear failure of the rear spar web to which the majority of the undercarriage loads are applied. Subsequently, the starboard wing tore away from the fuselage inboard of the undercarriage and the aircraft then rolled over to starboard under the action of the lift forces of the port wing.

It was estimated that the approximate time lapse between the closing of the throttles and the impact was about 3 seconds. Tests were conducted on a similar type of aircraft using the same flap setting, airspeed and engine rpm as stated by the pilot. On these tests it was found that 3 seconds after closing the throttles the rpm had fallen from 10 600 to 8 500 and calculations based on this rpm, using the distance between the propeller slash marks, indicated an impact ground speed between 75 and 80 kt. The ensuing ground slide of just over 600 ft would have resulted in retardation forces of about 5 "g".

A mathematical analysis of the final flight path from the quarter mile point to touchdown, based on the available evidence and performance data, showed that the aircraft's flight angle would have been about 7° to the horizontal. Calculations showed that if this flight path was maintained without flaring, the aircraft would contact the ground at a vertical speed of 16.4 ft/sec and at a horizontal ground speed of 79 kt. These figures agreed very closely with those estimated from the propeller slash marks and the structural failure analyses. It was also calculated that the aircraft's fore and aft attitude on impact would be level or very slightly nose-up and that the ground distance covered from the position where the throttles were closed would be between 120 and 150 ft.

Calculations also showed that to flare the aircraft at a height of about 30 ft from a 7° flight path at 88 kt, the pilot would need to use full "up" elevator. The aircraft would rotate nose-up and about 2 seconds afterwards a stall would result, but by then the aircraft would be less than 5 ft above the ground and its rate of descent less than 5 ft/sec. It is considered that the stall occurring in this way would be too late in the flare to have any serious effect. In addition, the aircraft would travel a distance of about 210 ft horizontally from the point where the flare was commenced, and not 150 ft as actually happened. An earlier stall could have occurred if the aircraft had encountered a gust of the greatest magnitude envisaged by the meteorological expert, but at the height under consideration vertical gusts of such intensity are unlikely.

2. - Analysis and Conclusions

2.1 Analysis

Evidence revealed that the undercarriage was down and locked and examination of the port and starboard flap mechanism showed that both wing flaps were fully extended and symmetrical at the moment of impact, and were capable of normal operation before the wing became detached. Examination of the Pitot static system and the airspeed indicators revealed no fault; the airspeed indicators were functioning within permitted tolerances of accuracy.

Nothing untoward was found during the examination of the flying and engine control systems and both engines and propellers were functioning normally. There was no evidence of bird strike, fire in the air, defective materials or electrical malfunction.

Evidence revealed that, following a steeper than normal approach, the aircraft landed heavily on its starboard undercarriage and the resulting overstress caused the starboard wing rear spar to fail. The steep approach was due to the fact that, at approximately half a mile from touchdown, the pilot-in-command discontinued his descent for 3 to 4 seconds, then to arrive at an acceptable height over the threshold, his rate of descent from a quarter of a mile had to be considerably greater than normal.

Consideration was given to the possibility that in the existing conditions of turbulence and wing shear, the aircraft stalled and the pilot was unable to complete the flare, but the evidence indicated that this was unlikely to have occurred. To flare

an aircraft successfully from a steeper than normal flight path calls for fine judgement. On this occasion the pilot's task was made more difficult: his windscreen was partly obscured by rain and after commencing the flare his attention was diverted by the starboard wing going down. As a result he may not have appreciated that the descent had not been checked until it was too late.

The landing weight of the aircraft computed before take-off complied with landing distance requirements at Lympne. The target threshold speed (1.3 VSO) was 87 kt. The maximum target threshold speed for the weight was 101 kt and at this speed there was no additional margin of landing distance available.

As the aircraft approached the landing threshold its speed was only 2 kt above the normal target threshold speed; it was considered that this was an inadequate margin in the existing conditions. Control would have been improved by a suitable increase but it was noted that at the upper limit of 101 kt it would have needed all the available runway for the landing.

The pilot stated that he made the approach to the right of the runway but did not intend to land so far to the right. At the time of the accident, with a visibility of 1 000 m in heavy drizzle and without runway markers or lighting, a precise visual approach would not have been an easy matter. Combined with the severe turbulence, this could have made excessive demands on the pilot's attention. In the event, it appeared that it would have been wiser if this approach had been abandoned and overshoot action taken.

2.2 Conclusions

Findings

The pilots were properly licensed.

The documentation of the aircraft was in order and it had been properly maintained in accordance with an approved maintenance schedule.

The aircraft's weight and load distribution were within authorized limits.

There was no evidence of pre-crash failure or malfunction of the aircraft.

The aircraft encountered severe turbulence and wind shear during the final stage of the approach to land.

The aircraft's threshold speed gave an inadequate margin for control having regard to the steepness of the approach and the conditions of turbulence and wind shear.

The aircraft struck the ground with its starboard wheels at a rate of descent greater than the fully factored design requirement.

Cause or Probable cause(s)

The accident resulted from a heavy landing following an incomplete flare from a steeper than normal approach.

3. - Recommendations

None were contained in the report.