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## Wake turbulence, Boeing 737-33A, G-OBMJ

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**Micro-summary:** This Boeing 737-33A rolled sharply in the wake turbulence from a 747-400, injuring two flight attendants

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**Event Date:** 1997-06-04 at 1048 UTC

**Investigative Body:** Aircraft Accident Investigation Board (AAIB), United Kingdom

**Investigative Body's Web Site:** <http://www.aaib.dft.gov/uk/>

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# Boeing 737-33A, G-OBMJ

## AAIB Bulletin No: 9/97 Ref: EW/C97/6/2 Category: 1.1

<b>Aircraft Type and Registration:</b>	Boeing 737-33A, G-OBMJ
<b>No &amp; Type of Engines:</b>	2 CFM56-3B1 turbofan engines
<b>Year of Manufacture:</b>	1989
<b>Date &amp; Time (UTC):</b>	4 June 1997 at 1048 hrs
<b>Location:</b>	London Heathrow Airport
<b>Type of Flight:</b>	Public Transport
<b>Persons on Board:</b>	Crew - 8 - Passengers - 105
<b>Injuries:</b>	Crew - 2 (Minor) - Passengers - None
<b>Nature of Damage:</b>	None
<b>Commander's Licence:</b>	Airline Transport Pilot's Licence
<b>Commander's Age:</b>	42 years
<b>Commander's Flying Experience:</b>	9,221 hours (of which 6,400 were on type) Last 28 days - 50 hours
<b>Information Source:</b>	AAIB Field Investigation

## History of flight

The aircraft was on a scheduled flight from Edinburgh to London Heathrow Airport; the first officer was the handling pilot. The flight proceeded normally and, from Bovingdon, the aircraft was given radar vectors to the ILS for Runway 09L; the preceding aircraft was a Boeing 747-400.

The first officer disconnected the autopilot and autothrottle and flew the approach manually. The aircraft established on the ILS, with 10° flap selected and the landing gear lowered; suddenly it rolled rapidly to the left to an estimated bank angle of 35°. The first officer immediately increased thrust on both engines, and aggressively applied opposite aileron to level the wings. Shortly afterwards the aircraft rolled rapidly to the right to a similar bank angle; again the first officer took recovery action. Flap 15° was selected and the speed was reduced to 150 kt; the remainder of the approach was uneventful and the aircraft landed at 1051 hrs.

The catering equipment had been stowed when the event occurred and the cabin staff were about to respond to the chimes from the flight deck and take their seats for landing. Two cabin attendants in the rear galley were thrown to the floor by the initial roll to the left and were then thrown from side to side during the initial recovery and subsequent roll and recovery. One sustained severe bruising during this time, the other being protected to some extent by falling onto her colleague.

### **Analysis of RTF transcripts and radar data**

The Flight Recorders had been overwritten by the time the incident came to the notice of the AAIB. However, recorded speech tapes/transcripts of the Heathrow approach and tower frequencies, and recorded data from Heathrow radar head were available.

The intonation of the commander's initial call on the tower frequency and his report shortly afterwards that the aircraft had just experienced " - - forty five degree bank both ways in wake", indicated that the event occurred at about 1047:45 hrs, at which time 'MJ' was at about 9 nm and 2,500 feet. A plot of radar height (based on 1013 Hp) against range from the radar head was produced. Three aircraft were shown, a Boeing 777 which landed at about 1047 hr, the Boeing 747 which landed at about 1049 hrs and 'MJ'. The Boeing 777 and 'MJ' follow approximately the same descent path whereas the Boeing 747 starts to descend about 1.8 nm after passing through the glidepath; its rate of descent is about 1,500 fpm, and it intercepts the normal glidepath at about 5 nm.

Although the lateral radar separation at 1047:45 hrs, the time of the upset, was slightly over the required 5 nm, the flightpath of the Boeing 747 was initially above that of 'MJ' and it had passed 7.4 nm, 2,500 feet at 1046:23 hrs, only 1 minute 20 seconds before the event.

### **Meteorology**

An aftercast was obtained from the Meteorological Office at Bracknell. The synoptic situation showed an area of high pressure centred off East Anglia which produced a light easterly surface airflow over the London Heathrow area. There was little or no cloud and the wind and temperature profile with height was:

Surface 070°/6 kt + 17°C

500 feet 110°/8 kt + 10°C

1,500 feet + 6°C

2,000 feet 120°/10 kt +12°C

3,000 feet +9°C

The above shows a marked temperature inversion between 1,500 and 2,000 feet.

The appropriate data was passed to the Meteorological Office for analysis and comment by an expert in the field of wake vortices who in turn consulted colleagues in the USA with similar expertise. The precise altitude of the two aircraft was critical. The upset occurred just above the inversion; there are precedents for vortices persisting for over two minutes in and above inversions, away from ground effect. It was considered entirely possible for the vortex to have descended the

height difference between the two aircraft in the time observed. It was primarily the geometry of their relative positions which made 'MJ' vulnerable to a wake vortex upset from the preceding Boeing 747; this could not have occurred if both aircraft had been on the same descent path.