AIRCRAFT ACCIDENT REPORT 2/89

Air Accidents Investigation Branch

Department of Transport

Report on the Incident involving BAC 1-11 G-AYWB and Boeing 737 EI-BTZ on 12 April 1988 at Gatwick Airport

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List of Aircraft Accidents Reports issued by AAIB in 1988/9

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Department of Transport
Air Accidents Investigation Branch
Royal Aerospace Establishment
Farnborough
Hants GU14 6TD

3 April 1989

The Right Honourable Paul Channon
Secretary of State for Transport

Sir,

I have the honour to submit the report by Mr M M Charles, an Inspector of Accidents, on the circumstances of the incident involving BAC 1-11 G-AYWB and Boeing 737 EI-BTZ, which occurred at Gatwick Airport on 12 April 1988.

I have the honour to be
Sir
Your obedient servant

D A COOPER
Chief Inspector of Accidents

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Air Accidents Investigation Branch

Aircraft Accident Report No 2/89
(EW/C1065)

Operator:	1	British Island Airways plc
	2	British Airtours Ltd
Registered Owner	1	British Island Airways, West Sussex
	2	Air Tara Ltd, Shannon Airport
Aircraft Type	1	British Aerospace (BAC) One-Eleven 531 FS
	2	Boeing B737-2U4
Aircraft Nationality:	1	United Kingdom
	2	Republic of Ireland
Aircraft Registration:	1	G-AYWB
	2	EI-BTZ
Place of Incident:		Taxiway 2, Gatwick Airport, London
Date and Time:		12 April 1988 at 2123 hrs
		All times in this report are UTC

SYNOPSIS

The incident was notified to the Air Accidents Investigation Branch at 2135 hrs on 12 April 1988 and an investigation began the next day. The AAIB team comprised Mr M M Charles (Investigator in Charge), Mr D J W Mearns (Operations), Mr R D G Carter (Engineering), Miss A Evans (Flight Data Recorders).

The incident occurred when a British Aerospace (BAC) One-Eleven G-AYWB (WB) landed on taxiway 2 at Gatwick Airport after making a night visual approach to runway 08L, and stopped 190 metres short of a Boeing B737 EI-BTZ (TZ). The commander of the Boeing B737 observed the landing lights of the aircraft touching down on the taxiway and attempted to turn off to the side. Immediately the aircraft's port main wheels left the paved surface it bogged down in the soft ground partially blocking the taxiway with its left wing and rear fuselage. There were no injuries.

The report concludes that there were a number of factors which enabled this incident to happen and these are detailed in paragraph 3(b). Nine safety recommendations were made during the course of this investigation.

1 Factual Information

1.1 History of flight

A British Aerospace (BAC) One-Eleven registration G-AYWB (WB) was returning from Venice with a training captain in the right seat and a first officer in the left seat undergoing command conversion training. Throughout the flight the training captain was the handling pilot. The aircraft had departed from Venice at 1936 hrs, 21 minutes late due to an Air Traffic Control (ATC) delay imposed in Italy. Its planned route was via Abbeville with a standard arrival into Gatwick.

Shortly before reaching Abbeville the crew report that they completed the "descent" checks from the check list and discussed the approach to runway 08L (also known as the "emergency runway") which they expected to come into operation at 2100 hrs. Both pilots were familiar with the airfield layout and the runway lighting was not briefed specifically. Just before reaching Abbeville at 2102 hrs the non-handling pilot listened to the Gatwick Automatic Terminal Information Service (ATIS) and obtained Information "Kilo", which included the Gatwick 2045 hrs weather details and gave the landing runway as 08R. While the non-handling pilot was making the required company calls the commander contacted London ATC on 134.45 megahertz (MHz) and informed them that WB was approaching Abbeville at flight level (FL) 310. London ATC responded with an instruction to maintain FL 310 and passed an inbound clearance to Gatwick for a landing on runway 08L which was acknowledged and read back correctly by the commander. At about 2105 hrs the aircraft was given clearance to descend to FL 130 and four minutes later WB was instructed to contact London Control on 123.9 MHz.

After contacting London Control, when WB was descending through FL 200 for FL 130, the crew were told that they would be given "RADAR VECTORS FOR 08 LEFT". While acknowledging this instruction they enquired whether or not speed control was in force at Gatwick and after a few minutes London Control responded with, "THE'RE JUST OPENING THE RUNWAY NOW SO KEEP YOUR SPEED UP AND DESCEND TO FLIGHT LEVEL 60". When the crew answered with "RE-CLEARED TO 60 AND MAINTAIN HIGH SPEED", they were instructed to call Gatwick Approach on 125.87 MHz.

On their first call to Gatwick Approach at 2112 hrs the crew confirmed that they were maintaining high speed, about 285 knots (kt) indicated airspeed (IAS), and that they had received Information "Kilo". At about this time the crew commenced their "approach checks" and shortly afterwards received, and correctly read back, a clearance to 4000 ft when ATC confirmed that it would be a visual approach onto "08 LEFT".

At 2116 hrs WB was descending through 5000 ft at 250 kt IAS when ATC enquired "....WOULD YOU LIKE TO COME VISUALLY INSIDE HORSHAM OR WOULD YOU LIKE TO GO OUTSIDE ?". The commander replied by electing to go around Horsham. At 2118 hrs, as the aircraft was levelling at 3000 ft and reducing speed, it was re-cleared to 2000 ft and asked to report when visual. While passing to the west of Horsham with 4½ minutes to touchdown, flaps 6 was selected followed 30 seconds later by flaps 20, at a height of 2,700 ft above airfield level and at 197 kt IAS.

An ATC closing heading of 060° and re-clearance to 1500 ft was answered by, "RE-CLEARED 1500 FEET.....WE'RE NOW FULLY VISUAL THANKS" and WB was cleared to call Gatwick Tower on 124.22 MHz. On first contacting the Tower and calling "on finals", at a range of 6 nautical miles from touch down, WB was cleared to land on "08 LEFT". The crew replied with, "CLEAR TO LAND 08 LEFT". At 2122 hrs,when the aircraft was at a speed of 170 kt, land flap was selected as the aircraft passed 1000 ft. At this point there was an exchange of conversation on the flight deck initiated by the co-pilot who was uncertain which runway they were approaching. The discussion prompted the commander to change his interpretation of the visual cues of the airfield and realign the aircraft with taxiway 2 believing it to be runway 08L, while continuing to use the PAPI for glide path angle. From the flight data recorder (FDR), a heading change of 5° was noted as the aircraft descended through 750 feet as the track of the aircraft was re-aligned. The aircraft touched down on the taxiway at a speed of 121 kt IAS and was brought to a halt after a ground roll of approximately 960 metres.(see Appendix 1)

While WB was making its descent the crew of a Boeing 737, EI-BTZ (TZ) on Stand 58L at Gatwick, were preparing to start engines. The crew discussed the runway change to 08L and the probable taxiway route. After the aircraft had been pushed back from the stand on schedule at 2115 hrs and had started both engines a taxi clearance was requested and given as "SPEEDBIRD 8764 FOLLOW THE GREENS, TAXIWAY 7 AND 2 FOR HOLDING POINT LIMA FOR RUNWAY 08 LEFT, QNH 1017".

The TZ crew had completed most of the "before take-off" checks while on taxiway 7 and on approaching taxiway 2 were cleared by ATC, "....TO THE RIGHT DOWN TAXIWAY 2, CALL TOWER 124.22". Some 10 seconds after acknowledging this instruction, by which time they had turned onto taxiway 2, the crew observed the landing lights of an aircraft on short finals to land. After a few seconds discussion with his co-pilot about the landing aircraft's track the commander slowed the aircraft, flashed his landing lights on and off and made his

routine initial call to the Tower on 124.22 MHz. The Visual Control Room (VCR) at Gatwick Airport is about 145 feet above ground level and the air controller's south facing position is well placed to observe the main runway and taxiway. The air controller did not reply to TZ's transmission because he had just become aware that WB appeared to be in a slightly unusual position on the approach and he transferred his attention to his Ground Movement Radar (GMR) display. Coverage of the GMR does not extend beyond the airfield boundary and the first return to appear on the edge of the display suggested to the controller that WB was not lined up on runway 08L. The next radar return confirmed it and the controller promptly looked to his right again in time to see WB touching down on the taxiway.

As the TZ commander finished briefing his co-pilot to be ready to pull off the taxiway and the aircraft began turning off to the right, an urgent instruction was received from the air controller, "8764 HOLD POSITION, HOLD POSITION". This was followed some 3 seconds later by another urgent instruction, "WATCH THAT AIRCRAFT, PULL OFF THE SIDE OF THE RUNWAY QUICK". As soon as the aircraft's left mainwheels were off the paved surface the aircraft stopped as it became bogged down, partially blocking the taxiway with the left wing and the rear of the fuselage.

The ATC Watch Manager, alerted to the situation by a comment from the air controller, considered that a collision was inevitable and activated the telephone "crash" line at 21.23:45 hours. It became apparent a few seconds later, when WB stopped approximately 190 metres short of TZ, that a collision had been averted and he cancelled the "emergency" in his first spoken message on the "crash" line.

The commander of TZ later attempted to taxi the aircraft off the grass but, when he discovered that it would not move under its own power, the engines were shut down. The passengers were subsequently disembarked via the forward integral airstairs and taken by coach back to the terminal. The crew of WB were able to turn their aircraft on the taxiway and take an alternative route to the terminal.

1.2 Injuries to persons

There were no injuries to the 6 crew and 112 passengers aboard WB or to the 6 crew and 116 passengers aboard TZ.

1.3 Damage to aircraft

Because the landing gear of TZ had left the paved taxiing surface, the appropriate conditional inspections were performed. The only damage detected was a fuel leak on the upper surface of the left wing, where sealant within the fuel tank had become loose at a skin joint. Paint deterioration in the area indicated that minor leakage had occurred previously and that this had been aggravated in the course of the incident. No damage was sustained by WB.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 G-AYWB

Commander:	Male, aged 47 years
Licence:	United Kingdom Airline Transport Pilot's Licence,Valid until 10 July 1990
Aircraft Ratings:	PA34, HS125, BAC 1-11
Instrument Rating:	Valid until 19 February 1989
Medical Certificate:	Class I renewed 30 October 1987

Flying experience

Total:	6142 hours
Total on type:	1976 hours
Total in last 24 hours:	4 hours
Total in previous 90 days:	170 hours
Rest period before duty on day of incident flight:	18 hours

The commander had operated from Gatwick for approximately 3 years but had never landed on runway 08L.

Co-pilot:	Male, aged 43 years
Licence:	United Kingdom Airline Transport Pilot's Licence, Valid until 26 March 1994
Aircraft Ratings:	Various light twins, HP-7, BAC 1-11
Instrument Rating:	Valid until 26 September 1988
Medical Certificate:	Class I renewed 20 October 1987

Flying experience :

Total:	5,140 hours
Total on type:	494 hours
Total in last 24 hours:	4 hours
Total in previous 90 days:	88 hours
Rest period before duty on day of incident flight:	42 hours

The co-pilot had been based at Gatwick for the previous year but much of this time had been spent operating away from Gatwick. He had never landed on runway 08L.

1.5.2 EI-BTZ

Commander:	Male, aged 47 years
Licence:	Irish Airline Transport Pilot's Licence Valid until November 1988
Aircraft ratings:	B737, F27, DC3, DC4
Instrument Rating:	Valid until November 1988
Medical Certificate:	Class I, renewed 25 January 1988

Flying experience:

Total:	14,950 hours
Total on type:	3,000 hours
Total in last 24 hours:	Nil
Total in previous 90 days:	65 hours

Co-pilot:	Male, aged 27 years
Licence:	Danish Senior Commercial Pilot's Licence
Aircraft Ratings:	Various light twins, E11O, SA36, Boeing 737
Instrument Rating:	Valid until February 1989
Medical Certificate:	Class I, renewed 5 January 1988
Flying experience:	
Total:	3,300 hours
Total on type:	1,300 hours
Total in last 24 hours:	Nil
Total in previous 90 days:	120 hours

1.6 Aircraft information

1.6.1 G-AYWB Leading particulars

Type:	British Aerospace (BAC) One-Eleven 531 FS
Constructor's No:	BAC 237
Date of construction:	May 1971
Certificate of Registration:	G-AYWB, registered to British Island Airways Limited, Crawley, West Sussex.
Certificate of Airworthiness:	Transport Category (Passenger), valid to 28 May 1988.
Maintenance:	B2 check on 6 February 1988, valid to 34,531 airframe hours or to 10 August 1988.
Total airframe hours:	34,175 hours.
Engines:	2 Rolls-Royce Spey 512-14DW turbofan engines.

1.6.2 EI-BTZ Leading particulars

Type:	Boeing B737-2U4
Constructor's No:	22576
Date of construction:	April 1981
Certificate of Registration:	EI-BTZ, registered to Air Tara Limited, Shannon Airport, Republic of Ireland. Leased to British Airways.
Certificate of Airworthiness:	Transport of Passengers 1 Category, Republic of Ireland, valid to 24 March 1989
Maintenance:	AV1 (Annual Visit 1) check performed prior to EI-BTZ entering UK service on 27 March 1988
Total airframe hours:	23,646 hours
Engines:	2 Pratt & Whitney JT8D-15 turbofan engines

1.7 Meteorological information

A high pressure ridge extended south eastwards across the United Kingdom with a cold dry north easterly air stream over south east England. The weather at Gatwick Airport at 2125 hrs on 12 April 1988 was:

Weather:	Nil
Cloud:	Nil
Visibility:	20 km
Winds:	5000 ft - 060°/20 kt
	1000 ft - 060°/25 kt
	Surface - 040°/12 kt

1.8 Aids to navigation

The following extract is taken from the United Kingdom Aeronautical Information Publication (UK AIP) for LONDON/Gatwick, page AGA 2-23-2 dated 11 Feb 1988, and was valid at the time of the incident:

"26 (i) Use of Runway 08L/26R

(iii) Navaids

(a) When Runway 08L/26R is in use the only navigational aids available are:

(1) Surveillance radar

(2) DME

(3) GY and GE NDB's

(4) Middle and outer markers (for departures only)"

The WB crew accepted radar vectors to a visual final for runway 08L. The Mayfield VOR/DME, NDB's GY and GE and the Gatwick DME were also used.

1.9 Communications

WB established communications with London ATC, Hurn sector at 2100 hrs, followed by Terminal Manoeuvring Area South, Gatwick Approach and finally Gatwick Tower, remaining on the latter frequency until after landing at 2123 hrs.

TZ obtained start-up and push back clearance from Ground Movement Control at 2114 hrs and after taxiing out was transferred to Gatwick Tower at 2123 hrs. The aircraft remained on that frequency until asked to transfer to the Gatwick Airfield Fire Service (AFS) discrete frequency of 121.6 MHz.

Transcripts were available of all the above frequencies except for the AFS discrete frequency which was not recorded at Gatwick.

1.9.1 Gatwick Automatic Terminal Information Service.

At aerodromes where ATIS is in operation specific information, listed in the Manual of Air Traffic Services, Part 1,Chapter 1, paragraph 6, is continuously broadcast on published frequencies. Each message is consecutively coded starting each day with 'Alpha' and a new message is broadcast whenever there is a significant change in any of the items. The messages broadcast by the Gatwick ATIS on 12 April 1988 included the following :

At 2050 hrs, information "Juliet" gave the Gatwick 2015 hrs weather details and also the message that the runway in use was 08R and advised that the Emergency Runway Procedures were due to begin at approximately 2100 hrs.

At 2051 hrs, information "Kilo" gave the Gatwick 2045 hrs weather details and a message that the runway in use was 08R.

At 2109 hrs, information "Kilo" continued to give the Gatwick 2045 hrs weather details, but the runway in use had been changed to 08L.

At 2121 hrs, information "Lima" included the Gatwick 2115 hrs weather and a message that the Emergency Runway Procedures were in force.

1.10 Aerodrome information

1.10.1 Runway and taxiway details

Gatwick Airport has essentially a single main runway designated 08R/26L. Parallel to it and displaced to the north by 200 metres, centre line to centre line, is another runway, formerly taxiway 1, sometimes referred to as the "emergency runway" and sometimes as runway 08L/26R. On RTF however, the northern runway is referred to as runway 08L/26R.

Taxiway 2 measures 2875 metres from the Lima holding point to taxiway 6. It is parallel to and displaced 90 metres to the north of runway 08L/26R and is 300 metres longer. A plan of the western end of the airfield is shown at Appendix 1.

1.10.2 Airport lighting

The approach and runway lighting for runway 08L was described in the UK AIP for LONDON/Gatwick, on page AGA 2-23-4, sections 32 to 35, (Appendix 2) dated 17 Dec 87 and valid at the time of the incident. The lights for runway 08L met the International Civil Aviation Organisation (ICAO) standards and the airport was licensed and approved by the Civil Aviation Authority (CAA).

All the elements of the relevant lighting were at their minimum settings appropriate to a visibility in excess of 5 km. The precision approach path indicator (PAPI) for runway 08L was situated between runway 08L and taxiway 2 as shown in Appendix 1 and was in operation.

It should also be noted that in normal circumstances, when runway 08R/26L was in use at night for take-off and landing, runway 08L/26R was used as a taxiway and had green centreline lighting.

1.10.3 AIP aerodrome information

The UK AIP for London/Gatwick, page AGA 2-23-2 dated 11 Feb 1988, which was valid at the time of the incident, contained operational details relevant to the incident and this information was repeated in the Flight Guide carried in the aircraft.

The aerodrome lighting appropriate to runway 08L, was serviceable and as detailed in the UK AIP but with some important exceptions. The taxiway lighting system was serviceable and was described in the AIP as being in an 'ALL GREEN' configuration when runway 08L/26R was in use. Similarly there were references to there being 'NO RED STOP BARS,' at holding points. In addition holding point LIMA situated on taxiway 2 was not shown in the AIP and, in particular, it had not been promulgated that the actual holding point was marked by a line of red bi-directional lights across taxiway 2 at its western end.

Section 26 (g) also stated:

> "Warnings
> (i) In low visibility at night the apron floodlighting may be seen before the approach lights on 26L approach.
> Pilots should continue to fly according to the ILS localiser until they have positively identified the approach lights."

1.10.4 Aeronautical Information Service (AIS) Bulletins

Due to the major reconstruction of runway 08R/26L scheduled to take place at night from 14 March to 12 November 1988 various Notices to Airmen (Notams) were published by the National Air Traffic Service (NATS) AIS in advance of the work commencing. With effect from 14 March 1988, Notam A157 lifted the prohibition of the use of taxiway 2 while aircraft were taking-off or landing on runway 08L/26R. This Notam permitted any aircraft with a wingspan up to and including 30 metres to use taxiway 2 whilst aircraft of any size were taking-off or landing on runway 08L/26R The WB crew also carried daily AIS Bulletins A1, A2 and A3 as part of their briefing information. Bulletin A2 included the following information:

> "AD. Nightly re-surfacing WIP on main runway 26L/08R as follows:
>
> 2100-0445 nightly till 15 May. WIP on main runway 08R/26L including APCH/RWY light being upgraded to CAT 111 standards. Emergency runway 08L/26R will be in service.
>
> Runway 08R/26L. New strobe lighting opr. A pair of white flashing lights installed 400m before each THR to supplement existing lighting aids. The strobe lights are similar to those in use on emergency runway (08L/26R) and will provide additional confirmation and ident on runway in use. The new installation is advisory only pending flight check (A831/88)".

1.10.5 Gatwick Airport - London , Emergency Orders

The following extracts from the Gatwick Airport - London, Emergency Orders, Part 1, were current at the time of the incident:

"5. TYPES OF EMERGENCY

The degree of alertness and scale of emergency services deployed are determined by category of emergency. These are as follows:

5.1 Aircraft Accident/Aircraft Accident Imminent
If an aircraft accident has occurred, or is considered to be inevitable, on or in the vicinity of the Airport.

5.2 Aircraft Ground Incident
When an aircraft on the ground is in trouble, or is involved in an incident (whether or not another aircraft or vehicle, is concerned) which could result in an aircraft accident developing.

5.4 Local Standby
5.4.3 When an aircraft requires inspection by the Airfield Fire Service (AFS)".

The Emergency Orders also contain detailed procedures to cover initiation and cancellation of the above categories. Immediate Action for the first two categories requires a call on the "Crash" line and the reporting of "Aircraft Accident" or "Aircraft Incident" as appropriate. The "Local Standby" category requires a call on the Emergency Line and the reporting of "Local Standby". In each category the appropriate details are passed.

Cancellation of Aircraft Accident, Aircraft Ground Incident or Local Standby is quoted in each category as being "initiated on RT by the AFS Officer in Charge". However, Part 1, paragraph 2.1.2 of the Emergency Orders requires that ATC, "Upgrades, downgrades or cancels the emergency after consultation, if necessary, with the Police Incident Officer and GAL Fire Officer I/C".

1.10.6 Manual of Air Traffic Services Part 2, Gatwick.

The following extract is quoted from the Manual of Air Traffic Services, Part 2 Gatwick, Section 1,Chapter 16, Unintentional Use by Aircraft of Unpaved Surfaces Adjacent to Runways or taxiways, which was current at the time of the incident:

"1. PROCEDURES

(a) GMC/Air

If an aircraft touches down short of the recognised landing area, over-runs or otherwise leaves the paved surface of the manoeuvring area the Air/Ground Movement Controller is to

(i) initiate at least a Local Stand-by (Ground) call"

1.11 Flight recorders

1.11.1 G-AYWB

The aircraft was fitted with a Sundstrand Universal Flight Data Recorder (UFDR) and a Collins type 642C-1 Cockpit Voice Recorder (CVR), both recorders were recovered and successful replays obtained.

The CVR had a recording duration of thirty minutes using an endless loop of plastic based magnetic tape. The CVR circuit breaker was not pulled after the aircraft had landed, thus allowing the recorder to continue and therefore erase all information prior to 2133 hrs.

The replay of the FDR showed that the flaps were deployed according to the schedule with "land" flap selected as the aircraft descended through 1000 feet on the approach. At approximately 750 feet there was a 5° change of heading as the aircraft was re-aligned with taxiway 2. The calculated speed required at the threshold (V_{ref}) for the aircraft landing weight was 123 kt IAS. The IAS on the approach at 300 feet was 136 kt IAS (V_{ref} + 13 kt), with a touchdown speed of 121 kt IAS. Deployment of spoiler, brake application and reverse thrust were not recorded on the FDR.

Figures calculated by British Aerospace for the ground roll from 121 kt at touchdown to stop, based on a dry runway with full braking applied 1.2 seconds after touchdown, did not exceed 490 metres, although the figure achieved depended upon the use of the spoilers and the level of reverse thrust applied. The calculated figures were considerably shorter than the 960 metres achieved during the incident by WB and indicate that maximum braking and/or maximum reverse thrust were not used for the whole of the landing run.

1.11.2 EI-BTZ

The British Airways B737 was fitted with a Collins type 642C-1 CVR, from which a successful replay was obtained. The recording covered the time period from engine start until the commander pulled the CVR circuit breaker after the incident thereby preserving the recording. The recording showed that the crew were complying fully with the ATC clearance to proceed along taxiway 2 to holding point LIMA. It was soon after they entered the taxiway that they saw an aircraft on the approach and became unsure as to its intended landing point and therefore reduced their speed and prepared to turn off the taxiway. They were already in the process of turning off the taxiway to the right when they were instructed by ATC firstly to stop and then, 3 seconds later, to vacate the taxiway.

The FDR was not replayed.

1.12 Wreckage and impact information

1.12.1 G-AYWB touch-down marks

A set of tyre marks were found on taxiway 2 and they corresponded to the track dimensions of a BAC One-Eleven. The first marks from the main landing gear tyres were found 121 metres past the lateral axis of the PAPI (see Appendix 1), a total of 389 metres past the western end of the taxiway, and 14 metres beyond these first marks were heavy spin-up marks. The first nose landing gear marks were found 142 metres beyond those of the main landing gear. The ground roll from touch-down to the position where witnesses stated that the aircraft stopped was approximately 960 metres.

1.12.2 EI-BTZ ground marks

Although no measurements were taken immediately following the incident, runway marks and ground depressions were subsequently found on the north side of taxiway 2 showing the position and angle where TZ had crossed onto the grass surface. The aircraft had left the taxiway some 120 metres to the southwest of the front of the Fire Station, at an angle of approximately 25° to the axis of the taxiway and had come to rest in the position shown at Appendix 1.

1.13 Medical and pathological information

Both crew members of WB held valid Class I medical certificates. Subsequent to the incident both pilots were given a medical check and nothing was found which might have contributed to the accident.

1.14 Fire

Not applicable

1.15 Survival aspects

Although a collision did not occur the two aircraft stopped at the positions shown in Appendix 1, with TZ bogged down in the ground, partially blocking the taxiway, only 120 metres from the fire station and watch-room. The Duty Watch and the fire fighting appliances are housed in this building, behind which is situated Rendezvous Point (RVP) "North", the only rendezvous point available within the airfield boundary at that time.

When the "crash" line was activated by ATC it was promptly answered by the AFS watch-room attendant who was advised to ignore the alarm as the emergency was over. A similar message was passed to the Sussex Police, Gatwick and the West Sussex County Fire Brigade Headquarters. However, when the Gatwick Airport Ltd., Airfield Operations and Safety Unit replied to the alarm they were advised to send some vehicles out to inspect the aircraft on the grass.

When the Officer in Charge of the AFS Watch became aware of an aircraft in an unusual position not far from his watchroom, he decided on his own initiative to go out and investigate at 21.24:47 hrs. A message from him confirming that an aircraft had all its wheels on the grass was passed back to ATC some 2½ minutes after the incident had occurred.

1.16 Tests and research

1.16.1 Photographic flights

A number of aircraft flights were conducted to enable the investigators to witness and film a series of approaches to the airport from the west. On the night following the incident, as the weather conditions were identical and the work on the main runway similar, four approaches and a landing were made on runway 08L. This flight allowed the investigators to observe at first hand some of the lighting features of the airfield.

A further photographic exercise using a helicopter from the Royal Aerospace Establishment (RAE) was carried out on the night of the 24 May 1988. A large number of colour photographs were taken by the RAE professional photographers while the aircraft carried out a slow approach to runway 08L. With the reservation that no photograph can capture the exact detail of the lighting and glare effects surrounding an airport that the eye can perceive, those reproduced in Appendix 3 do illustrate the relevant aspects.

It should be pointed out that although the photographs were taken on the 24 May the weather conditions were similar on the date of the incident. The flood lighting for the work in progress was more clearly visible than on the night of the incident and in addition the strobe lighting was serviceable on runway 08L but does not show up in the photographs because of the camera shutter speed.

1.16.2 Human Factors Report

After the incident both crew members of WB were interviewed by an Inspector of Accidents and also by the Head of the Flight Skills Section of the Royal Air Force Institute of Aviation Medicine whose report is at Appendix 4.

1.17 Other information

1.17.1 Mandatory Occurrence Reports

At various times, since the introduction of the "emergency runway" at Gatwick in 1985, disquiet has been expressed by both pilots and air traffic control officers that the layout of the main runway and the emergency runway was such that confusion could occur between them, especially at night. The CAA Mandatory Occurrence Reporting scheme (MOR) database included a report in August 1988 of a precautionary go-around following a surveillance radar approach to runway 26R after the commander had become confused by the lighting on runway 26R and taxiway 2.

1.17.2 Confidential Human Factors Incident Reporting System

In 1983 the Confidential Human Factors Incident Reporting Programme, CHIRP, similar to the well established US Aviation Safety Reporting System, was introduced to the UK. This established a valuable avenue for the confidential reporting of Human Factors incidents to an independent organisation, the RAF Institute of Aviation Medicine. Appendix 5 contains some of the recent CHIRP reports concerning confusion over the runway in use at Gatwick.

1.17.3 ATC Watch Manager's Log

In addition to the above there were a small number of incidents, recorded in the ATC Watch Manager's Log between March and July 1988, which did not result in either MORs or CHIRP reports. These incidents concerned confusion over taxiway routings and runway identification. There were also comments from landing aircraft that the strobe lights were probably not bright enough (BAA have subsequently stated that they have reports to the contrary) and, from one aircraft that from final approach they looked like a Boeing 747 lined-up for take-off.

2. Analysis

2.1 General

The incident occurred when G-AYWB made a landing on taxiway 2 at Gatwick Airport because the commander mistakenly believed it to be runway 08L. Evidence of the pre-descent briefing and of the conversation on the flight deck of the aircraft during the approach would have greatly assisted the investigation. However, this evidence had been erased by the continued operation of the CVR which records on an endless loop of magnetic tape for a 30 minute period and then re-records over the previous conversation. If the crew had pulled the CVR circuit breaker after landing the evidence would have been preserved but that action was not carried out, as is often the case, in the heat of the moment.

The CAA should actively encourage manufacturers to produce a CVR capable of retaining the information recorded during at least the last two hours of its operation. The Department of Transport and the CAA should make known their intentions to require the fitting of a two hour CVR to aeroplanes of a maximum certificated take-off mass of over 5,700 kg as soon as such a recorder is available, in accordance with the recommendations in paragraph 6.3.8.2 of Annex 6, Part 1, to the Convention on International Civil Aviation.

The crew of WB were experienced and familiar with operating from Gatwick although neither pilot had landed on runway 08L. They were both aware that the active runway at the time of the incident was 08L, nevertheless they convinced themselves that taxiway 2, with standard green taxiway centreline lighting, was runway 08L and landed on it. This analysis examines the reasons why such a fundamental error by the crew could have been possible and how a recurrence might be avoided.

2.2 The approach and landing

The crew stated that they completed a standard briefing for the approach and landing on runway 08L. Both pilots were familiar with the airfield layout and therefore the runway lighting was not briefed specifically. Paying particular attention to the details of airfield lighting is not normally necessary during a pre-descent briefing when returning to home base on a clear night and, in this context, the lack of a specific lighting brief was understandable. On the other hand, runway 08L was not the usual runway and it would have been prudent to have discussed the lighting in detail in view of the current Notams. It was also an unfortunate coincidence that the commander was able to utilise the runway 08L PAPI for an approach to taxiway 2 without being alerted to anything untoward.

With hindsight it is possible that, had the crew studied the airfield lighting in detail at the briefing stage they would have been better able to differentiate between the runway and the taxiway during the final stages of the approach.

The aircraft's approach was typical of an arrival at Gatwick culminating in radar positioning for a visual approach to runway 08L. There was no traffic congestion and, in the absence of delays, there was nothing unusual in the aircraft maintaining a high initial approach speed. In view of this higher speed an abbreviated circuit pattern, made possible by the radar controller's offer to turn the aircraft to the east of Horsham, would have made the approach rushed. The commander therefore made a wise decision in not taking the short cut, but elected to continue around Horsham, thus giving time to deploy the flaps on schedule (confirmed by the FDR) and complete the pre-landing checks.

The approach continued normally until the aircraft was correctly aligned with runway 08L and had descended to approximately 1000 feet. At this point there was an exchange of conversation on the flight deck initiated by the co-pilot who was uncertain which runway they were approaching. The discussion prompted the commander to change his interpretation of the visual cues of the airfield and realign the aircraft with taxiway 2 believing it to be runway 08L.

The aircraft landed on the taxiway and was brought to a halt approximately 190 metres from the stationary TZ (see Appendix 1). The fact that the ground roll of 960 metres was considerably longer than the 490 metres ground roll calculated by British Aerospace indicates that maximum braking and/or maximum reverse thrust were not used for the whole of the landing run. The commander did not realise that they had landed on the taxiway until well into the landing roll.

The evidence suggests that the crew were not under pressure and that the approach was not rushed. Having changed his interpretation of the visual cues at approximately 1000 feet the commander was then convinced that he was making an approach to the correct runway until several seconds after touch down on the taxiway. The human factors report, at Appendix 4, covers the aspect of the relative personalities, roles and status of the flight deck crew in enabling this incident to happen. The more dominant and decisive individual was in command and control, with the more contemplative and less assertive individual in a position of both subordination and evaluation. The report concluded that no specific treatment of the crew was likely to influence the already low probability of their repeating the incident and it is therefore necessary to consider ways of reducing the probability of other crews making similar mistakes.

2.3 Airfield layout

It is not unusual for a runway to have a parallel taxiway. Aircraft landing on such a runway at night would normally expect to see the lights of both the runway and taxiway. In this instance, a brief reference to the chart of the airfield would enable the aircraft crew to differentiate between the two lines of lights. Nevertheless, there have been a number of incidents worldwide where aircraft have mistakenly landed on or, more commonly, taken off from a taxiway.

There are also many major airfields with parallel runways, widely spaced to allow simultaneous operation. In these circumstances the considerable separation of the runways, together with the use of runway approach aids such as ILS, make the probability of confusion less likely, nevertheless incidents have occurred where aircraft have landed on the wrong runway by mistake.

The airfield layout at Gatwick is unusual in having runway 08R, runway 08L and a taxiway all running parallel within a width of 290 metres. There must inevitably be an increased risk of confusion in such circumstances, particularly when the middle of the three strips is used both as a taxiway and a runway. There is evidence from reports (see Appendix 5) and entries in the ATC Watch Managers log to indicate that other crews have had difficulty in identifying the active runway at Gatwick at night, both from the air and while taxiing. It may be that the closeness of the two runways and the taxiway at Gatwick merit special attention and it is therefore of particular importance that the airfield lighting should aid identification of the active runway and minimise ambiguity.

2.4 Airfield lighting

The evidence concerning difficulties experienced in runway identification have not been confined to runway 08L and may partly be the reason for the warnings given in Section 26 (g) of the AIP. The background lighting to the airport includes the well lit South Terminal and associated piers, aircraft parking areas and the large public car park adjacent to the threshold area of runway 26L and 26R. A review of the airfield lighting should be made and should consider all aspects of operations on all runways.

In the case of this specific incident, it is clear from the human factors report, at Appendix 4, that the runway and taxiway lighting at Gatwick played a major part. In particular were cited:

(i) the bi-directional red LIMA stop bar,

(ii) the unnecessarily conspicuous bi-directional green centreline lighting of taxiway 2 and the lack of a curved extension of lights to the runway end,

(iii) the visual similarity of operations on runway 08L and runway 08R,

(iv) the dual use of one paved surface as a runway with edge lighting and as a taxiway with centreline lighting,

(v) and, the invisibility of runway 08R when 08L is in operation.

In addition the PAPI positioned to the left of runway 08L can readily be utilised for landing guidance onto taxiway 2. The photographs at Appendix 3 clearly illustrate the taxiway and stop bar lighting. The fact that the taxiway had green centreline lighting and the runway white edge lighting (in conformity with ICAO lighting standards), did not prevent this crew (and other crews) from being confused. There are several ways in which such confusion might be overcome.

2.4.1 The red LIMA stop bar

The purpose of the LIMA stop bar is to mark the holding point beyond which aircraft must not proceed towards the runway 08 threshold without ATC permission. It has no function in relation to aircraft taxiing in the eastbound direction towards the terminal after completing their landing roll. It was a crucial factor in this incident in that it provided the impression of a threshold and gave width to the straight line of green centreline lights. It is therefore recommended that the stop bar lighting should be made unidirectional to the east, and therefore invisible to aircraft approaching from the west.

2.4.2 The taxiway 2 green centreline lighting

The minimum lighting intensity of the taxiway 2 green lights available at the time of the incident was 30%. This relatively high lighting level made them unnecessarily conspicuous and gave a clear indication of a straight surface terminating at the LIMA stop bar. The provision of a much reduced lighting intensity would make the taxiway less obtrusive, however, unless these lights remain inconspicuous to an aircraft approaching from the west until a very late stage of the approach, the potential for confusion with a runway is still possible. Modification of the green centreline lights to make them unidirectional, but switchable for the direction in use, would eliminate this danger and should be considered as part of the lighting review.

2.4.3 Runway 08L lighting

The same remarks stated in paragraph 2.4.2 are relevant to operations on runway 08R, when 08L is in use as a taxiway marked by green centreline lighting. The modification of these green centreline lights to make them unidirectional, but switchable for the direction in use, and with a much reduced minimum lighting intensity would eliminate potential confusion and should also be considered.

Should it prove to be impractical to modify the centreline greens, other measures should be considered to increase the conspicuity of runway 08L when it is the active runway. Although not illustrated by the photographs at Appendix 3, the visual apperance at night of runway 08R with a green centreline to its left on the taxiway (runway 08L) is similar to runway 08L with a green centreline to its left on taxiway 2. In addition there have been several reports (see paragraph 1.17.3) that the pair of white strobe lights positioned before the threshold of runway 08L are not very conspicuous until at close range and in addition, being close to the runway edges, they can be confused with the wingtip strobes of large aircraft such as the Boeing 747. The installation of an approach light system with sequenced centreline strobe lights would be more distinctive and would provide a more compelling indication of the active runway threshold.

However, if the red LIMA stop bar and the green centreline lights of taxiway 2 (and 08L) were to be made unidirectional, only one illuminated paved surface would be visible during a night approach and further identification of the active runway might not be necessary.

2.5 Runway procedures

As soon as the left main landing gear of the Boeing 737 TZ, left the taxiway the aircraft became bogged down with the left wing and rear fuselage hanging over the taxiway. The aircraft therefore was blocking the taxiway giving potential for a collision if WB had failed to stop in time.

Before the new procedures for the use of taxiway 2 were introduced on 14 March 1988, ATC would have been prohibited from clearing TZ to travel along the taxiway to holding point LIMA while WB was landing. These new procedures, which appear to be designed to speed up the traffic flow, clearly did not envisage the possibility of an aircraft landing on the taxiway. It was therefore recommended to the CAA on 25 April 1988 that the procedures for the use of runway 08L/26R at Gatwick should be re-examined. Although fully meeting ICAO requirements, until such time as the review and modification of the airfield lighting has been implemented, it would seem prudent to revert to the procedures for the use of taxiway 2 which existed before 14 March 1988.

2.6 Runway terminology

The human factors report at Appendix 4 draws attention to the misleading description of runway 08L/26R as an "emergency runway". Such a term could be taken to imply a runway with an inferior standard of lighting to the main runway and could lead crews to accept that the taxiway 2 lighting was actually that of the "emergency runway" to the left of the main runway. It is not possible to say whether this was a sub-conscious factor in the incident, but the use of the term "emergency" is unsatisfactory in this context and should be discontinued.

2.7 The UK Aeronautical Information Publication

Inaccuracies were noted in the UK AIP current at the time of the incident. In particular, the taxiway lighting system was described as being "in the ALL GREEN configuration", and that "there are NO RED STOP BARS" at runway holding points. In addition, the position of holding point LIMA was not shown on the aerodrome chart and the fact that it was marked by a line of red bi-directional lights had not been promulgated.

It is not possible to say whether these inaccuracies played any part in the minds of the crew of WB in conditioning them to accept the red LIMA stop bar and the green centreline lights as being inferior lighting appropriate to an emergency runway. However, the AIP data should be reviewed for accuracy of the lighting information and should be amended to include the holding point LIMA.

Section 26 (g) of the AIP concerns ILS approaches to runway 26L in low visibility and warns that the apron floodlighting may be seen before the approach lights. This acknowledges that there is potential for the crew of an aircraft landing on this runway to be confused by the lighting but it is evident from the reports at Appendix 5 that there are other areas of concern. It is considered that section 26g should also be amended to provide relevant advice for all approaches.

2.8 Automatic Terminal Information Service

Crews approaching Gatwick are required to listen to the ATIS broadcast to obtain the latest weather details and any significant aerodrome information. Information "Kilo", broadcast from 2051 hrs gave the 2045 hrs weather details and the active runway as 08R. At 2109 hrs the active runway in information "Kilo" was changed to 08L but all other details remained the same. The crew of WB contacted Gatwick at 2112 hrs and acknowledged correctly the descent clearance which was for a visual approach to runway 08L. The change in active runway in

information "Kilo" was therefore unlikely to have been a factor in the incident. Such potential confusion could be avoided by ensuring that a new code letter is always used when there has been any change in the content of the broadcast, in accordance with the instructions contained in the Manual of Air Traffic Services. The ATIS could also be used to give details of the relevant airfield lighting systems and in particular to confirm the lighting which positively identifies the active runway.

2.9 Air Traffic Control

Although the air traffic controller had a clear view of the approaches to runway 08, an aircraft making an approach to the taxiway, as opposed to runway 08L, would be almost impossible to identify visually. From the visual control room the angular displacement between the 08L threshold and the equivalent point on taxiway 2 is only 3°. In addition, an accurate range of the aircraft could not be determined by visual means alone. To complicate matters further the surface wind of 040/12kt meant that the aircraft was heading left of track into the wind.

The controller was very quick to consider looking at his ground movement radar display to identify the aircraft's track but, as the equipment is designed for ground movements only, the area of coverage does not extend beyond the airfield boundary. The controller reacted with commendable speed when the conflict was identified by issuing instructions to TZ to hold its position initially and then clear the taxiway.

2.10 Gatwick Emergency Orders

Because of the potential risk of collision between the landing aircraft and TZ on the taxiway the ATC Watch Manager assessed the situation as "Aircraft Accident Imminent" and carried out the correct action by activating the "crash" line. As soon as TZ had left the taxiway it should also have been the subject of a "Local Standby". Outside emergency services who had been alerted by the "crash" line also heard the cancellation and took no further interest. The AFS had specifically been stood down and it was not until the Officer in Charge of the AFS, on his own initiative, investigated TZ and passed back the details, that ATC were fully appraised of the situation some 2½ minutes after WB had landed.

The relief that the Watch Manager must have felt in observing a near disaster resolve itself in front of him is well understood, nevertheless the cancellation of the crash alarm did cause the AFS to stand down. The small fuel leak from the Boeing 737 was not serious but had the aircraft been damaged on leaving the taxiway a serious situation could have developed very rapidly. Any reactivation of an alarm after cancellation could cause difficulties for those required to respond.

The advice in the Emergency Orders that the Watch Manager may cancel such incidents without consultation with the Fire Officer in Charge conflicts with other sections where consultation is stated to be necessary. The Emergency Orders should be amended to require consultation before cancelling any emergency action.

2.11 Recording of Fire Service frequency

The lack of a recording of the radio frequencies used by the AFS did not affect the investigation of this incident. However, such recordings could be vital in the investigation of a serious accident and could possibly also be of value as a training aid in the debriefing of minor incidents and exercises. It is therefore recommended that the radio frequencies used by the AFS should be recorded at all major airports.

3. Conclusions

(a) Findings

(i) Both of the aircraft crews were properly licenced to conduct their respective flights.

(ii) Both of the aircraft had valid Certificates of Airworthiness, Registration and Maintenance.

(iii) Both of the aircraft were serviceable before the incident.

(iv) At approximately 1000 feet the commander of WB changed from an accurate to an inaccurate interpretation of the cues provided to him by the visual scene on the approach to runway 08L, and consequently landed on taxiway 2 believing it to be runway 08L.

(v) The crew failed to brief themselves on the lighting they were expecting to see on the approach to runway 08L.

(vi) The commander did not realise that they had landed on taxiway 2 until well into the landing roll.

(vii) It is not possible to say whether the inaccurate information in the UK AIP concerning the Gatwick airfield lighting was a factor in the incident.

(viii) The change of active runway from 08R to 08L notified in the ATIS broadcast information "Kilo" was unlikely to have been a factor in the incident.

(ix) Both the crew of TZ and the air traffic controller in the visual control room acted promptly in attempting to avert a collision on the taxiway.

(x) In spite of such prompt action TZ obstructed the taxiway and it was fortunate that a collision did not occur.

(xi) The AFS did not attend the incident immediately because the "emergency" was cancelled by the first instruction on the "crash" line.

(b) Causes

A number of causal factors were identified and are listed below, not in order of importance :

(i) The aircraft commander changed from an accurate to an inaccurate interpretation of the cues provided to him by the visual scene on the approach to runway 08L, and consequently landed on taxiway 2 believing it to be runway 08L (the "emergency runway").

(ii) The commander's misinterpretation of the visual cues was facilitated by:

a. The similar visual appearance at night of runway 08R with a green centreline to its left on the taxiway (runway 08L); and runway 08L with a green centreline to its left on taxiway 2.

b. The use of runway 08L both as a runway with edge lighting and as a taxiway with centreline lighting.

c. The red LIMA stop bar on taxiway 2, implying a threshold, and enabling the impression to be formed of taxiway 2 as a poorly lit runway to the left of the apparent main runway.

d. The failure of the crew to brief themselves on the lighting they were expecting to see on the approach to runway 08L.

(iii) The commander's change of interpretation was occasioned by a well-intentioned query from the first officer in an attempt to resolve his personal uncertainty about which runway was being approached.

4. Safety Recommendations

The following Safety Recommendations were made during the course of the investigation :

4.1 The CAA should actively encourage manufacturers to produce a CVR capable of retaining the information recorded during at least the last two hours of its operation.

4.2 The Department of Transport and the CAA should make known their intentions to require the fitting of a two hour CVR to aeroplanes of a maximum certificated take-off mass of over 5,700 kg as soon as such a recorder is available, in accordance with the recommendations in paragraph 6.3.8.2 of Annex 6, Part 1, to the Convention on International Civil Aviation.

4.3 A review of the airfield lighting at Gatwick Airport should be made and should consider all aspects of operations on all runways, in particular:

a) The modification of the red stop bar at the LIMA holding point to make it unidirectional to the east.

b) The provision of a reduced minimum lighting intensity for the green centreline lights of taxiway 2 and runway 08L/26R, to a level considerably below the minimum setting of 30% which existed at the time of the incident.

c) The modification of the green centreline lighting of taxiway 2 to make it unidirectional and switchable for the direction in use.

d) The modification of the green centreline lighting of runway 08L/26R (when it is in use as a taxiway) to make it unidirectional and switchable for the direction in use.

e) The provision of sequenced strobe centreline lighting to identify the active runway.

4.4 Although the runway procedures met ICAO requirements, consideration should be given to reverting to the procedures in operation at Gatwick before 14 March 1988 for the use of taxiway 2, until such time as the review and modification of the airfield lighting has been implemented.

4.5 The use of the term 'emergency' to describe runway 08L/26R at Gatwick should be discontinued.

4.6 The UK AIP data for Gatwick Airport should be reviewed for accuracy of the lighting information and should be amended to include the LIMA holding point. Section 26 'Warnings' should be amended to provide relevant advice for all approaches.

4.7 The ATIS should be used to broadcast details of the relevant lighting systems and in particular to confirm the lighting which positively identifies the active runway.

4.8 The Gatwick Airport Emergency Orders (Part 1, paragraph 2.1.2) should be amended to require the ATC Watch Manager to consult the Airport Duty Fire Officer before cancelling any emergency action.

4.9 The radio frequencies used by the Airport Fire Service should be recorded at all major airports.

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Department of Transport

March 1989