Agusta Bell 206B, G-BFJW

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Aircraft Type and Registration:	Agusta Bell 206B, G-BFJW
No & Type of Engines:	1 Allison 250-C20 turboshaft engine
Year of Manufacture:	1973
Date & Time (UTC):	16 December 1996 at 1920 hrs
Location:	Private landing site, Ledbury, Herefordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - 2
Injuries:	Crew - 1 fatal - Passengers - 2 fatal
Nature of Damage:	Helicopter destroyed
Commander's Licence:	Airline Transport Pilot's Licence
	(Helicopters and Gyroplanes)
Commander's Age:	66 years
Commander's Flying Experience:	13,700 hours approximately (of which over 2,000 hours were on type)
	Last 90 days - Not known
	Last 28 days - Not known
Information Source:	AAIB Field Investigation

History of Flight

On the morning of the accident, the pilot left his home near Andoverat approximately 1100 hrs and drove to Bournemouth Hurn Airportwhere the helicopter was hangared. At about 1330 hrs he flewto the operator's warehouse facility at Ledbury with two seniorcompany executives as passengers. After a 30 minute stopoverthe helicopter flew to the private home of the owner and chiefexecutive of the company with the owner himself and another seniorcompany executive on board in addition to the original two passengers. This flight was over a distance of approximately five miles andthey arrived at the house at 1530 hrs.

The landing area at the owner's home was an unmarked lawn orientednorth to south and approximately 35 metres long by 20 metres widesituated at the rear of the house. Tall fir trees lined the westernand northern sides of the lawn, and the three storey house wason the eastern side. To the

south the ground sloped away downhillwith trees some 80 metres from the edge of the lawn. There wasno lighting on the landing area; some illumination came from theroom lighting within the house. Because of the obstacles aroundthe lawn, the approach had to be made from the south; the helicopterwas then turned in a low hover and left to face south in preparationfor the next departure which would also be to the south. A strongsoutherly wind would preclude use of the landing site.

For the next 3 1/2 hours,the pilot waited while his passengers were involved in a companybusiness meeting. At 1900 hrs, having confirmed that the weatherwas suitable for the return flight to Bournemouth, the pilot andhis two original passengers went out to the aircraft. After theengine had been started and therefore the rotor was turning, thepassenger occupying the front left seat remembered that he hadleft his overnight bag in the house and went back to collect it. When he returned to the helicopter, he put his bag on the rearseat beside his colleague and then strapped himself into the frontpassenger seat. The helicopter then took off.

The company owner and the remaining executive watched the departureof the helicopter from a ground floor room which looked out directlyonto the lawn. The helicopter was seen to climb in the hoverto a height of about 20 feet The anti-collision light, strobeand landing lights were 'ON'. They then saw it move slowly backwardsand upwards until one of the main rotor blades was heard to hita tree. The force of this collision caused the rotor to detachitself and the helicopter was turned and thrown rearwards. Themain rotor and the top of the tree were found on the lawn andthe helicopter with its occupants still strapped in, was foundin the tennis court on the other side of the trees.

One of the eyewitnesses went immediately to the crash scene whilethe other telephoned for the emergency services. The front seatpassenger was found to be dead but the pilot and the rear seatpassenger were still alive but unconscious. The first eyewitnessto reach the aircraft noted that the anti-collision light wasstill operating although the landing light was not illuminated. He then opened the forward right hand door and switched off thebattery switch and shut off the fuel. He was aware that the fuelhad already drained out across the tennis court. There was nofire.

Recovery of the occupants.

Shortly afterwards, the local fire service arrived and after somediscussion as to the dangers inherent in the site due to the spilledfuel, one of the firemen assisted the owner in supporting therear seat passenger who was suspended by his seat harness. Some10 minutes later the police and ambulance crew also arrived atthe scene. After further discussion of the fuel spillage, thepilot was removed from the aircraft. To do this the forward instrumentconsole was broken and pulled clear and he was lifted out throughthe remains of the front windscreen. He died shortly afterwardswithout regaining consciousness. The rear seat passenger wasthen removed in turn. To achieve this the owner stood in therear section of the helicopter, having first removed a flightbag, and provided support as he was lifted clear. It is believedthat this passenger died at about this time.

The crash occurred at approximately 1920 hrs and the telephonecall to the emergency services was made almost immediately afterwards. The police were notified by the ambulance service at 1923 hrs. Two fire engines arrived at 1945 hrs followed by the first offour ambulances about 10 minutes later.

Meteorological Information

The Meteorological Office produced the following aftercasts;

At 1700 hrs the synoptic situation showed a light, southerly airstreamestablished over the area. Weather was probably nil althoughthe airstream was producing occasional light rain and drizzlein places. Visibility was about 6 km, QNH 1010 mb, cloud wasone to two octas with a base of 1,000 feet, three to seven octaswith a base of 1,500 to 2,000 feet, and five to seven octas witha base of 3,500 feet. The surface wind was 160_/5 kt or lessand the temperature was 7_C and the dewpoint 5_C.

By 1900 hrs the weather had changed slightly. Cloud had increasedto become scattered to broken cover at 1,000 feet (three to sevenoctas) and the surface wind had backed slightly to 140_ at 5 kt.

Pilot's experience

The pilot operated in a self-employed freelance capacity and theflight was conducted as a private flight. He was well known andrespected for his experience and ability. He had operated intothis particular landing site for a number of years and had designedand constructed a visual landing aid which he used to assist himduring his approach. This was set up on the lawn close to thenorth western corner.

His most recent medical examination by a CAA authorised medicalexaminer had taken place on 1 July 1996 and had included an electrocardiogramand an audiogram. He was found fit at that time and the onlyrestriction to his Class One medical certificate was the mandatoryuse of correcting spectacles which he was wearing at the timeof the accident. The audiogram confirmed a condition of markedhigh tone deafness in both ears which had been observed some yearspreviously. This hearing loss was at the limit allowable underthe International Standards and Recommended Practices which aredetailed in Annex 1 (Personnel Licensing) to the Convention onInternational Civil Aviation for the issue of a class one medicalcertificate.

Although it has not been possible to locate the pilot's flyinglog book which would confirm the exact detail of the flying carriedout by him immediately prior to the accident, it has been possibleto ascertain that his workload was not high and that he appearedto be fit and was well rested.

Examination of the wreckage

Both main rotor blades struck the trunk of a fir tree locatedapproximately 35 metres behind and 8 metres to the rightof the take off point, at a height approximately 22 metres aboveground level. These strikes produced two successive parallelcuts through the full thickness of the trunk, causing separationof the outermost parts of both blades at positions approximately1.0 and 1.5 metres respectively from the tip. The residual energyof these separated parts was sufficient to throw them distancesin excess of 300 metres. The rotor mast was wrenched heavilyforward during the blade strikes, breaking out the main gearboxlower attachment and rotating the mast and gearbox casing forwardand downward in its mounting, through approximately 40°;the mast then fractured, and the rotor fell to the ground adjacentto the tree. The direction of main gearbox/mast wrenching wasconsistent with the blade strikes having occurred in the leftrear quarter of the rotor disc, with the aircraft travelling rearwardand to the right, in a substantially level attitude, when theblade strikes occurred. Severe in-plane bending deformation wasevident on both outer blades which, together with the damage sustainedby the tree and the residual energy left in the separated tipsections, was consistent with a high degree of main rotor energyat the time of the strikes.

In light of the significant rotor energy evident at the time ofthe tree strikes, and having regard to the overall circumstancesof the accident (which was not consistent with of a loss of

power),examination of the engine was limited to a visual examinationtogether with a specific check for possible loosening of the "B"nuts in the air signal lines to the fuel control unit, all ofwhich proved negative.

The flying control operating systems were examined very closelyfor evidence of a possible control restriction or malfunction. Each of the linkages between the main rotor blade pitch hornsand the swash plate had fractured in overload, consistent withthe forces of the tree strikes and the subsequent ground impact. No evidence of obstruction or disconnection was found in themechanical circuits between the pilot's controls and the mainrotor hydraulic actuators, nor in the yaw control circuit or theinterconnecting circuits between the pilot's and co-pilot's controls. No pre-impact defects or disconnections were evident in the tailrotor drive shafts and couplings. The tail rotor gearbox wasundamaged and turned freely, and the tail rotor blade bearingsand pitch links were all undamaged and serviceable.

All of the three hydraulic power actuators were intact but theirmountings had fractured in the accident, and the output linksto the swash plate were broken. The actuators themselves, however,suffered no significant damage and were function tested by theAAIB at an approved overhaul agency. These tests confirmed thateach power actuator was serviceable. With the exception of minorrigging errors attributable to slight impact distortion of theinput linkages, each unit operated within the manufacturer's tolerances.

The hydraulic system filter was unobstructed and contained nosignificant debris. The combined hydraulic reservoir andpump, which is mounted on the forward face of the main gearbox,had been driven downward when the gearbox moved during the treestrikes, partially breaking through the cabin roof and fracturingthe pump drive shaft and casing. The reservoir itself was foundto be empty, but the aircraft had fallen onto its left side andthe reservoir contents would have been expected to drain downonto the ground and to have become mixed with fuel from the rupturedmain fuel tank. In addition, several of the flexible hydrauliclines from the reservoir and pump had become trapped between thecabin roof and parts of the main gearbox when the latter was wrenchedforward in the accident, severing these lines and providing furtherpotential for fluid loss. A strip examination of the hydraulicpump revealed no evidence of any pre-impact failure or malfunction.

Possible disturbance during the rescue attempts rendered the postaccident positions of switches and controls in the cockpit unreliable. No clear evidence of filament stretching (indicating an illuminatedcondition), was found on any of the warning caption bulbs on theinstrument panel. The panel had not been subject to severe impactforces and consequently the absence of stretching does not, initself, rule out totally the possibility that one or more warningcaptions may have been illuminated at the time of impact. Theinstrument panel lighting filaments also showed no evidence ofhot stretching, but similar comments apply. Examination of thetwo landing light filaments did reveal some evidence of stretchingon the filament from the forward lamp, raising a possibility thatthis filament may have been illuminated at impact; however, theamount of stretching was very slight, and no reliable conclusioncould be drawn. The filament from the rear lamp displayed noevidence of stretching, and it is probable that this lamp wasnot illuminated at impact.

All four doors were examined in detail for evidence of latch engagementand door position at impact. From the pattern of deformationto the doors and frames, and to the internal components of thelatch mechanisms, it was possible to confirm that each of thedoors had been closed fully, with the latch engaged, at the timeof impact.

Analysis

Correlation of the statements by the two eyewitness indicate thatthe helicopter was flown in a controlled manner up to the timeof the accident and that the pilot had commenced a transitionto forward flight by tilting the rotor disc forwards. Apparently,this was not done sufficiently to prevent the helicopter driftingbackwards until it hit the trees. This failure to tilt the rotordisc sufficiently to complete the transition could be interpretedas a simple misjudgement on the part of the pilot, however hisexperience and ability would suggest that this was unlikely. Two other possibilities are either that the pilot was subjectedto a distraction at the time of transition to forward flight suchthat he was unaware of the rearwards movement of the aircraftor that he was unable to visually assess that movement.

Examination of the wreckage has failed to provide any evidenceto support the theory of distraction. The pilot and his passengerswere all correctly strapped in. The only baggage within the passengercompartment was a large briefcase which was secure and the aircraftdoors showed no evidence of being unfastened prior to the accident. No technical defect was found with the helicopter. Post-mortemexamination of the pilot showed that he was fit and well. Anylesser distraction should have been well within the competenceof this pilot to cope with while completing a safe departure.

The towering transition technique for take-off from a restrictedarea at night is a difficult manoeuvre which requires experienceand skill. It is the recommended technique in these conditions. The pilot was aware of the difficulties presented by the siteto the extent that he had spent some of his spare time designingand building an approach aid in the form of a pair of metal indicatorboards. These were placed at the back of the site and were routinelyused by him to assist in his judgement of his descent during theapproach. Visual assessment of the descent was made more difficultby the slope of the ground up towards the landing site.

The helicopter landing light was switched 'ON' for the take-offand was found to be unbroken and not lit after the accident. It was customary for the pilot to switch 'OFF' the landing lightshortly after take off. The landing area was not directly litor marked. The only illumination was provided indirectly by thelighting within the rooms of the house. The effect of switching'OFF' the landing light at about the time of transition to forwardflight might have been to cause the pilot to lose some visualacuity until his eyes became accustomed to the dark. It was adark night with considerable cloud cover and the lights of thehouse would at that time have been positioned below the helicopterand on the side away from the pilot and therefore out of his fieldof view. The effect of such a lack of visual clues would be toexacerbate the difficulty the pilot would have had in appreciatingthe rearward drift of the helicopter, possibly caused by the wind,in what was a very confined area.

Safety Recommendation

Article 90 paragraph 4 of the Air Navigation (No 2) Order statesthat "the person in charge of any area in the United Kingdomintended to be used for the taking off or landing of helicoptersat night"...."shall cause to be in operation"...."suchlighting as will enable the pilot of the helicopter:

(i) in the case of landing, to identify the landing area in flight,to determine the landing direction and to make a safe approachand landing; and

(ii) in the case of taking off, to make a safe take off."

Article 90 does not apply in the case of this accident solelybecause the flight was not being conducted for the purpose ofthe public transport of passengers. Nonetheless, the standardof safety referred to is desirable in all circumstances, especiallyas in the case of a corporate transport flight such as this, theonly reason it is not defined as a public transport flight isbecause the passengers were not fare-paying but were present onboard by virtue of their employment.

In the circumstances pertaining to this accident, it is possiblethat the provision of touchdown and lift-off area marking andlighting, to the standard described in ICAO Document 9261 andwhich in turn would have met the requirements of Article 90 ofthe Air Navigation (No 2) Order, might have provided the pilotwith sufficient outside reference to assess the rearward movementof his helicopter and therefore might have prevented the accident.

As a result of the investigation into an accident involving aprivately operated Agusta A109 helicopter which occurred on 27June 1990, (AAIB reference EW/C1168 published in Bulletin 11/90),the AAIB recommended to the CAA that 'consideration be givento a suitable form of safety audit which would monitor privateoperators. It is suggested that the British Helicopter AdvisoryBoard (BHAB) might be invited to produce a Code of Conduct forCorporate helicopter operators with the intention that corporatemanagements would monitor their flight operations more closelyin future.' In its closure of the recommendation, in April 1991,the CAA responded: 'The regulation of corporate operations hadbeen under consideration by the Authority prior to this accident;its proposals, one of which was the need for an operations manual,were subsequently endorsed by the Operations Advisory Committee. However, the advent of JAA regulations which override nationallegislation has made further work on this subject nugatory. TheAuthority however will represent these views in the appropriateJAA working group tasked with devising rules for regulation ofCorporate Transport Operations'.

JAR OPS 4, not yet in draft and for which no promulgation dateis currently forecast, intend to deal with General Aviation operationsby helicopters, which includes the corporate sector. In the meantimesome safety oversight by the national aviation authority (CAA),withoutprejudice to the JAA's intentions, is considered essential. Thefollowing recommendation has therefore been made to the CAA:

Recommendation 97-22

The CAA should re-examine the recommendation made as a resultof the accident to Agusta A109 helicopter, which occurred on 27June 1990 with a view to producing guidance material, such asa Code of Conduct, for Corporate helicopter operators which shouldtake into account all those aspects of public transport operationsreferred to in the Air Navigation (No 2) Order which are appropriateto a minimum safety standard for corporate operators.