Cuby II, G-BVNA

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Aircraft Type and Registration:	Cuby II, G-BVNA
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1994
Date & Time (UTC):	6 June 1999 at 1805 hrs
Location:	North Antrim coast, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 2 - Passengers - Nil
Injuries:	Crew - Fatal - Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	4,050 hours (of which approximately 6 hours were on type) Last 90 days -187 hours Last 28 days - 55 hours
Information Source:	AAIB Field Investigation

History of flight

On the morning of 6 June, a number of friends were at Mullaghmore Airfield, the base for a flying club mainly concerned with microlight aircraft. The weather was initially unsuitable for flying with a surface wind of 25 mph, gusting to 30 mph from the north. Shortly after midday, five of the friends went for lunch while the CFI of the club remained at the airfield. The group returned and stayed at the airfield during the afternoon hoping for a decrease in the wind strength. By approximately around 1700 hrs, the wind was had dropped to approximately 15 mph and some of the group prepared their various aircraft for flying. These comprised a flexwing microlight, registration G-MWIG, an AX-3 conventional microlight, registration G-MYPM and the accident aircraft. G-MWIG was to be piloted by the owner accompanied by the CFI; G-MYPM was to be piloted by the Assistant Flying Instructor (AFI) accompanied by a passenger. G-MWIG would be piloted by the owner and he would be accompanied by the CFI; G-MYPM would be piloted by the Assistant Flying Instructor (AFI) of the club and he would be accompanied by a passenger. The accident owner aircraft, registration G-BVNA would be occupied by the owner of the aircraft together with the holder of an ATPL were to fly in the accident aircraft; the owner was the holder

of a PPL but limited to PIC of microlight aircraft. G-MWIG had no radio but the other two aircraft would intended to be in mutual contact on frequency 122.3 Mhz.

The three aircraft took off at approximately 1730 hrs with the intention of routing to the north and over the Giant's Causeway; a reconstruction of the flight paths is shown at Figure 1. G-MWIG took-off first followed by G-BVNA and then G-MYPM; the first two aircraft flew at 1,200 feet amsl and the third aircraft flew at 2,500 feet amsl. Just south of Portrush, the two aircraft at 1,200 feet turned right and routed towards the Giant's Causeway staying approximately 200 yards off shore; G-BVNA was positioned to the left of the flexwing aircraft. G-MYPM also turned right but maintained a track inland. During this part of the flight, tThe surviving pilots subsequently estimated the wind at their altitude to be approximately 20 to 25 mph from the north. As they approached the Causeway, the CFI in G-MWIG commented to the pilot to his pilot that, although the conditions were good in their present position, they would be much more severe behind just inland from the cliff face. About this time, the AFI in G-MYPM transmitted to the crew in G-BVNA and asked them if they were over the sea. He received a reply in the negative but G-BVNA was then seenby the occupants in from G-MWIG to turn right and descend towards the cliffs behind the Causeway. Nothing more was heard from the occupants of G-BVNA but different parts of the subsequent manoeuvres of the aircraft were subsequently seen by witnesses on the ground and by the occupants of the other two aircraft.

The witnesses saw the aircraft in a descending spiral to the ground; the CFI saw G-BVNA at approximately 800 feet agl with one of its wings 'Folded' Some witnesses also stated that they saw one of the wings folded up about 1/2 to 1/3 along its length. One airborne witness stated that she could see the underside of the left wing as G-BVNA 'Flipped up'. Two witnesses were walking along the cliff top and stated that the wind was strong.

Both G-MYPM and G-MWIG turned towards the area of the crashed aircraft with the intention of landing nearby. However, both experienced extreme turbulence. The flex wing microlight descended to approximately 150 feet agl but the pilot initiated a climb because of the turbulence. The other microlight only descended to 500 feet agl but was also experiencing extreme turbulence; the pilot commented that his aircraft was being affected in all three axes, with indicated airspeed varying between 45 and 75 mph and height varying plus and minus 50 feet. He also initiated a go-around and noted the turbulence only stopped as the aircraft passed through 1,000 feet agl. The pilot of G-MYPM flew back to Mullaghmore, while the flex wing microlight landed further south of the crash site.

While various witnesses to the crash went to the scene, the police recorded the receipt of the first emergency call as 1809 hrs. Fire and ambulance services were alerted and attended the scene.

Pathology report

There were no medical aspects arising from the post mortem examinations of the two pilots which would have had any bearing on the accident. The pathologist concluded that the injuries sustained were consistent with an aircraft collision with the ground following a rapid descent.

Weather information

The club members had checked the weather for the weekend and this indicated strong winds throughout the period. On the day of the accident, a UK Low Level Forecast Chart (METFORM 215) was displayed in the crewroom; the forecast was valid between 1200 hrs and 1800 hrs on 6 June 1999. The general situation was for good visibility but with rain showers and scattered to broken cloud between 2,500 feet and 7,000 feet amsl. The wind at 1,000 feet amsl was forecast to be 360°/25 kt. In addition to this information, the CFI had listened to the BBC weather information during mid-morning.

A forecast issued by The Met Office Belfast (Aldergrove) Airport at 0941 hrs and valid between 1200 hrs and 1800 hrs indicated that a cool and moderately unstable northerly airstream would cover the area. The wind was forecast to be variable between 330° and 040°, but mainly 350°/ 10 to 15 gusts 20 to 25 kt, isolated 20 kt, mainly coastal areas, possible gusts 25 to 30 kt. The forecast for the subsequent period to midnight showed little change.Following the accident, The Meteorological Office at Bracknell was asked to provide an aftercast and to include any available information on recorded surface winds in the area. This indicated that the visibility was good with some isolated cloud at 1,800 feet amsl. The surface wind was 010°/20 kt and the wind at 2,000 feet amsl was 020°/28 kt. A check of local meteorological observations confirmed the surface wind.METAR (Meteorological Aerodrome Report) from Londonderry Airport (Eglinton), timed at 1750 hrs showed a surface wind of 010°/ 16 kt. Wind recordings for 1800 hrs were also received from Coleraine University (010°/ 11 kt gusting 19 kt), Portrush (010°/ 12 kt) and Ballypatrick Forest (330°/ 08 kt).

The Meteorological Office also commented that turbulence, associated with the wind flow over the cliffs, may have been present in the area; research has shown that the turbulent zone can extend to some three times the height of the obstacle and that the turbulence can be felt up to a distance of ten times the height of the obstacle downwind of it. In the vicinity of the accident, the cliffs extended to a height of between 60 and 70 metres (197 200 to 230 feet); therefore, turbulence could have been present up to a height of about 700 feet and, extending 700 metres downwind.

Aircraft history

This Cuby II aircraft had been imported to the UK in the early 1990s as a kit from its Canadian manufacturer. The aircraft did not conform to the UK definition of a microlight and so G-BVNA was registered as a light aircraft in 1994 under the auspices of the PFA (Popular Flying Association). The Cuby II design was 'Accepted' by the PFA, with a number of modifications, using JAR-VLA as the design reference code. The first 'Permit To Fly for Test Purposes' was issued by the CAA in July 1994 and, after development flights, the CAA Permit To Fly was issued in November 1996. G-BVNA was sold to an owner in Northern Ireland in 1998 and to its final owner in 1999. As part of the renewal of the Permit To Fly the aircraft had been inspected by a PFA Inspector in April 1999, with no problems reported The aircraft was last inspected by a PFA inspector in April 1999 as part of the annual renewal of the Permit to Fly.

G-BVNA was the only Cuby II kit imported into the UK. The Canadian kit manufacturer was later dissolved and few examples were completed in North America. Production of a derivative aircraft, the Eurocub, has continued in Hungary, with a number of design changes from the Cuby II. According to the current manufacturer, these include changes to the wing design.

Engineering examination

G-BVNA was examined at the site by the AAIB and a more detailed examination was conducted at Farnborough, in conjunction with engineering staff from the PFA. The PFA noted a number of minor modifications that had not been submitted to them for approval but agreed with the AAIB that none of these were relevant to the accident.

The wreckage was found some 70 metres downwind of the edge of the cliffs and the aircraft had clearly descended at high speed, impacting at a nose-down angle of 20° to 30° and rotating to the right. The rescuers had disrupted the wing and upper cabin structure in order to remove the pilots but the fuselage structure had clearly been intact up to the impact with the ground. Examination of the cabin area showed that the harnesses had remained intact but downward movement of the cabin roof had allowed slack in the shoulder restraints and increased the severity of the impact.

Both wings had been severely damaged in the impact but detailed examination showed that there had been an upward failure of the right-hand outer wing panel in flight (Figure 2). This had resulted from a failure of both the main wing spar and the rear spar just inboard of the attachment point of the wing strut. It appeared to have been the main spar that failed first, twisting into the plane of the wing and then failing in bending.

Figure 3 shows the detail of the failure in the main spar. The initiating event was a crippling failure of the upper cap of the spar, in the area in which compressive loads would be highest from the wing bending and reaction to tensile loads in the lift strut. Following the failure of the main spar, the outer wing panel rotated up and then to the rear, failing the rear spar and resulting in the behaviour of the aircraft observed by the witnesses.

In the corresponding area of the left wing, there was incipient buckling damage to the main spar, indicating that a similar failure was imminent on this side of the aircraft. The This evidence between the two wings showed that, when the right wing suffered its instability failure, the left wing was close to a similar collapse. This shows thatTherefore, the upward loading of the wings was close to symmetrical, probably induced by a combination of upward wind gust from the cliffs and any wing loading resulting from rearward movement of the control stick.

Flight envelope

Part of the paperwork relating to the construction of G-BVNA was a flight envelope manoeuvre diagram (or 'V-N' diagram), showing load factor N against airspeed. The diagram shows the '1g' stall at 43 mph and thus the '4g' limit load factor at 86 mph. Thus 86 mph would normally represent the design manoeuvring speed for the aircraft. G-BVNA's placards referred simply to a Cruise speed of 80 mph and a V_{NE} ('never exceed') of 100 mph; the Operator's Manual for the Cuby II also defined a V_{NO} ('maximum structural cruising speed') of 82 mph.

In accepting the design's structural airworthiness, the PFA had considered three factors:

1) the satisfactory performance of the aircraft in the USA and Canada to date,

2) a computer-based stress analysis conducted for the manufacturer,

3) a static load test, in Hungary, on a specimen airframe to 'ultimate load' factors of +6g and -3g, proving the 'limit load' factors of +4g and -2g. Photographs and diagrams from these tests show loads being applied by placing sandbags on boards laid on the wings.

Analysis

The lack of precise evidence concerning the pilot's intentions and G-BVNA's flight path and speed after it turned inland makes it impossible to define the combination and degree of gust loading and manoeuvre loading which caused the failure of the wing. However, two related aspects may be relevant.

Firstly, although the workmanship in G-BVNA appeared to be of a good standard, a number of experienced aircraft engineers commented on the design of the wing structure. One observation was that, with the main wing spar not occupying the full depth of wing, the leading edge structure would make little contribution to the torsional stiffness of the wing and to the stability of the main spar. Another observation concerned the wing ribs, which were of simple 'trapezoidal' construction and appeared to have low in-plane stiffness. As the AAIB have not been able to contact the original designer, it has not been possible to discuss with him the structural design and whether, the static load test in Hungary was with a wing identical to that in G-BVNA.

Secondly, the role of an organisation, such as the PFA, which may 'Accept' a design for amateur construction is different from that of a national Regulatory Authority (such as the CAA) which may issue a 'Type Certificate' for series production of a particular design. It is important for pilots of 'amateur-built' aircraft to appreciate this difference and to consider it when operating their aircraft. In practical terms, this emphasises the need to understand and observe the limitations of the individual aircraft and to appreciate the significance of flight in turbulence.