ACCIDENT

Aircraft Type and Registration:	Europa XS, G-GBXS	
No & Type of Engines:	1 Rotax 914-UL piston engine	
Year of Manufacture:	1998 (Serial no: PFA 247-13196)	
Date & Time (UTC):	21 August 2013 at 1317 hrs	
Location:	Airstrip at Common Farm, Wymeswold, Leicestershire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Fatal)	Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Light Aircraft Pilot's Licence	
Commander's Age:	56 years	
Commander's Flying Experience:	About 460 hours (of which 104 were on type) Last 90 days - 20 hours Last 28 days - 1 hour	
Information Source:	AAIB Field Investigation	

Synopsis

The evidence suggested that the pilot was performing a low-level circuit to land back at the farm strip from which he had just departed, most likely in response to an engine problem. Control was lost during the base turn and the aircraft struck the ground in a steep nose-down attitude, fatally injuring the pilot and passenger.

History of the flight

The pilot and passenger arrived at the airstrip, where the aircraft was based, on the morning of the accident. At about 1230 hrs another locally-based pilot (Witness A) arrived and had a short discussion with them. The accident pilot told him he intended to land away at an airfield in East Anglia. The relative merits of various airfields were then discussed, but no definite destination was established.

G-GBXS was approved to use Mogas and the pilot was seen refuelling the aircraft from jerrycans using an electric pump. It is not known how much fuel was added, but the pilot was heard commenting to his passenger that they would add all the available fuel so that they would not have to refuel again that day.

The pilot then conducted a pre-flight inspection on the aircraft. While Witness A closed and locked the hangar, the pilot and passenger boarded the aircraft and the engine was started. The engine was running when Witness A came outside and he watched the pilot conduct the power checks outside the hangar. The aircraft then taxied to the south-east end of the runway to take off in a north-westerly direction[1].

Having seen the aircraft taxi away from the hangar, Witness A then drove to the airfield gate, about 150 m down a short slope beyond the departure end of the runway, and watched the takeoff. He considered that the takeoff and initial climb looked and sounded normal but as the aircraft made a left turn crosswind, it rolled abruptly to the left by about 70º. The witness believes he saw large elevator and aileron inputs as the aircraft recovered to an approximately wings-level attitude. It then proceeded on a downwind heading. He continued to watch the aircraft, which now appeared to be operating normally, until it passed from his view on the downwind leg. He then left the airstrip.

At about 1900 hrs, the wreckage of the aircraft was found in a field adjacent to the south-eastern end of the airstrip.

Wreckage site

The wreckage was located in a field of stubble adjacent to the airstrip.

The propeller and most of the reduction drive unit had detached from the engine. There were two almost parallel ground marks, each 4 m long either side of the propeller, consistent with the leading edges of both wings striking the ground. The majority of the wreckage, comprising the fuselage, engine, both wings and empennage, was located approximately 7 m from the propeller.

The tip of the propeller spinner was buried 35 cm below the surface of the ground. The orientation of the propeller hub plate indicated that the aircraft's impact attitude was 25º left-wing-low and 80º nose-down. There was a small cut mark in the ground under one of the propeller blades, possibly indicative of engine rotation but there was no significant evidence of rotation on the fracture surfaces of the reduction drive unit. It was concluded that the engine was probably turning, but it was not possible to assess the engine power at impact.

Both wings were largely intact but had significant leading edge damage. The left wing leading edge was more damaged than the right. The fuselage was severed just aft of the wing trailing edge and just ahead of the horizontal tailplane. There was no evidence of fire.

The fuel tank was intact, but the fuel lines were broken, allowing fuel to drain onto the ground. There was a smell of fuel on the ground around the wreckage. It was not possible to determine how much fuel had been on board the aircraft.

The engine coolant and oil systems, both of which had a radiator and reservoir, were damaged so it was not possible to determine the coolant and oil quantities before the accident. There was evidence of staining on the lower fuselage; this included a thin streak of brown fluid that extended to halfway between the wing trailing edge and the tailplane leading edge.

Footnote

[1] Common Farm has a single grass runway oriented SE-NW.

Pilot information

The pilot held an EASA Light Aircraft Pilot's Licence (LAPL) with a Single Engine Piston Rating. His medical certificate was not located, but CAA records show that he held a valid EASA LAPL medical, issued on 15 July 2013.

The pilot's last flight with an instructor was in October 2011, within the 24 months required by the LAPL recency requirements. He also routinely flew a Renegade microlight aircraft and his flying logbook contained 323 hours of microlight flying.

The pilot was familiar with the airstrip at Common Farm, having operated from there on numerous occasions.

Aircraft information

The aircraft was a Europa XS with a retractable monowheel undercarriage. The flaps and undercarriage were activated simultaneously by a mechanical lever, such that the flaps and gear were either both up or both down. G-GBXS was built in 1998 and had flown 1,328 hrs at the time of the accident. The aircraft was issued with a Permit to Fly on 12 August 2012.

The aircraft was equipped with a stall warner, consisting of a tube mounted in the wing leading edge, a pressure switch and an electric buzzer.

Results of flight tests conducted on G-GBXS for the purpose of renewal of its Permit to Fly gave a clean stall speed of 54 kt and a flaps-down stall speed of about 46 kt. The stall warner activated approximately 7 kt above the clean stall speed and 11 kt above the flaps-down stall speed.

The aircraft was fitted with a four-cylinder, turbocharged Rotax 914 UL engine. The fuel air mixture was fed from a manifold to the twin carburettors. A balance pipe between the two carburettors ensured they were fed with a similar mixture. The balance pipe had a tapping for the manifold pressure gauge. An Airmaster propeller was fitted, along with a constant speed controller. In normal operations the propeller operated at a constant speed, depending on which of the four settings (TAKEOFF, CLIMB, CRUISE and HOLD) was selected on the controller unit in the cockpit. A manifold pressure gauge in the cockpit provided indication of engine power.

The aircraft was equipped with a FLYdat engine monitoring system, which measures eight engine parameters including: engine speed, Cylinder Head Temperature (CHT), oil pressure and oil temperature. All eight parameters are output to a LCD display in the cockpit. Each parameter has warning and alarm thresholds. If the warning threshold for a parameter is exceeded, the corresponding parameter on the LCD display flashes and a red warning light on the instrument panel next to the FLYdat unit flashes. If the alarm threshold for a parameter is exceeded, the corresponding parameter on the LCD display flashes and the red warning light next to the FLYdat illuminates continuously. The FLYdat records, in non-volatile memory, the highest value measured for each parameter for each six-minute period of engine operation. However, for the last period of each flight, the highest value for each parameter measured is recorded for an unspecified period of between 1 second and 5 minutes and 59 seconds.

The FLYdat unit was configured so that the engine speed thresholds were 5,800 rpm for a warning and 6,000 rpm for an alarm, and the CHT thresholds were 135ºC for a warning and 150ºC for an alarm.

Recorded information

GPS

Recorded information was available from a GPS[2] recovered from the aircraft, the FLYdat recovered from the aircraft and a wind turbine located about 1 km north of the accident site. The GPS contained a track log of the accident flight, with GPS-derived aircraft position, track, altitude and groundspeed. The record commenced at 1309 hrs with the aircraft parked near the hangar and ended at 1317:53 hrs. Information from the GPS is shown in Figures 1 and 2. Wind data recovered, with the assistance of the operator of the wind turbine, included wind direction as well as minimum, maximum and average wind speed for ten-minute periods. The data was acquired by an anemometer located on the turbine hub, 180 ft agl.

At 1314 hrs, G-GBXS taxied from the hangar area to the threshold of the north-westerly runway, where it remained for about a minute. At 1316 hrs the aircraft commenced the takeoff roll. As it passed the departure end of the runway, its groundspeed was 62 kt and it had climbed to an altitude of about 430 ft (120 ft agl). The aircraft continued climbing along the runway track to about 200 ft agl (Figures 1 and 2, Point A). It then made a 180º left turn[3], during which it descended at an average rate of 384 ft/min over 12 seconds, to approximately 140 ft agl (Point B).

Having completed the left turn, the aircraft was established on a downwind track parallel to, and 210 m laterally displaced from, the runway. As it flew downwind, it climbed slowly at an average rate of about 70 ft/min, whilst its groundspeed remained at about 53 kt (based on a wind from 166º at 12 kt, the aircraft's airspeed would have been about 63 kt). The rate of climb was such that the aircraft maintained a relatively constant height of about 160 ft. When the aircraft was almost abeam the threshold of the north-westerly runway, it turned left towards the runway. At this point the aircraft's lateral distance from the runway was about 240 m. The final data point (Point C) was recorded with the aircraft at a height of about 100 ft (470 ft amsl) and a groundspeed of 58 kt. The corresponding airspeed would have been approximately 54 kt. The position of the final data point was 89 m from the wreckage site and 170 m from the threshold of the north-westerly runway.

Previous flights

The GPS record contained eight of the pilot's previous flights dating back to 30 April 2013. Six of the flights had departed from the north-westerly runway at Common Farm. Comparison of the accident flight and these previous takeoffs indicates that the acceleration profiles of the aircraft whilst on the runway were similar, with the accident flight having the third highest

Footnote

2 Garmin manufactured unit, model 296.

3 The average rate of turn during the 180° turn was 15°/sec and the average groundspeed was 55 kt. In a level turn, this would equate to an average bank angle of approximately 38°.

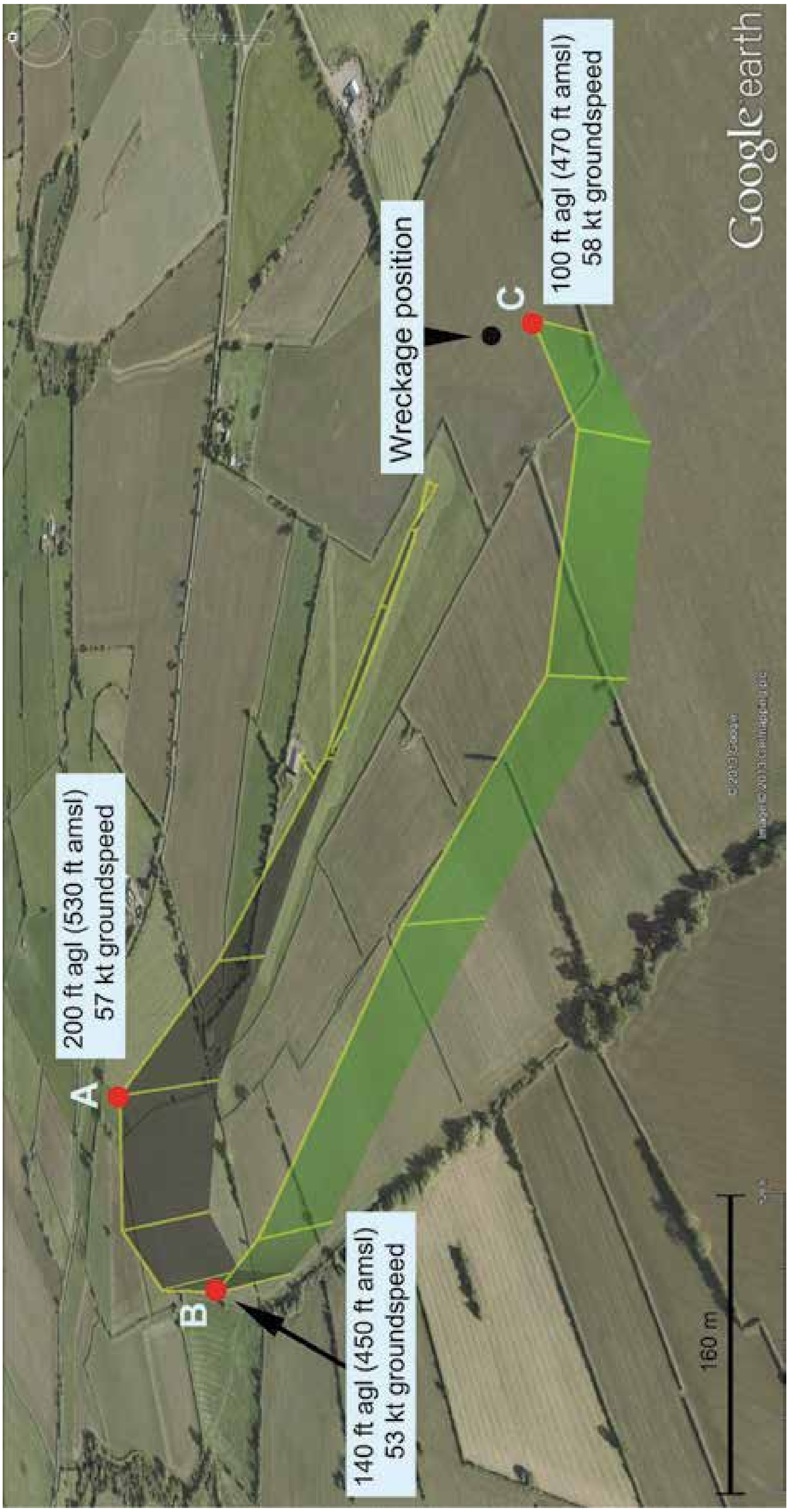

Figure 1

Overview of G-GBXS GPS track

acceleration. Factors affecting aircraft acceleration such as weight, air temperature and condition of the grass runway during each of the previous flights could not be established. However, the data is indicative that the aircraft's performance during the accident flight takeoff was not unusual.

The downwind positions and heights recorded were somewhat variable, but were in the order of 1,000 to 1,500 m lateral spacing from the runway and 600 to 1,000 ft agl.

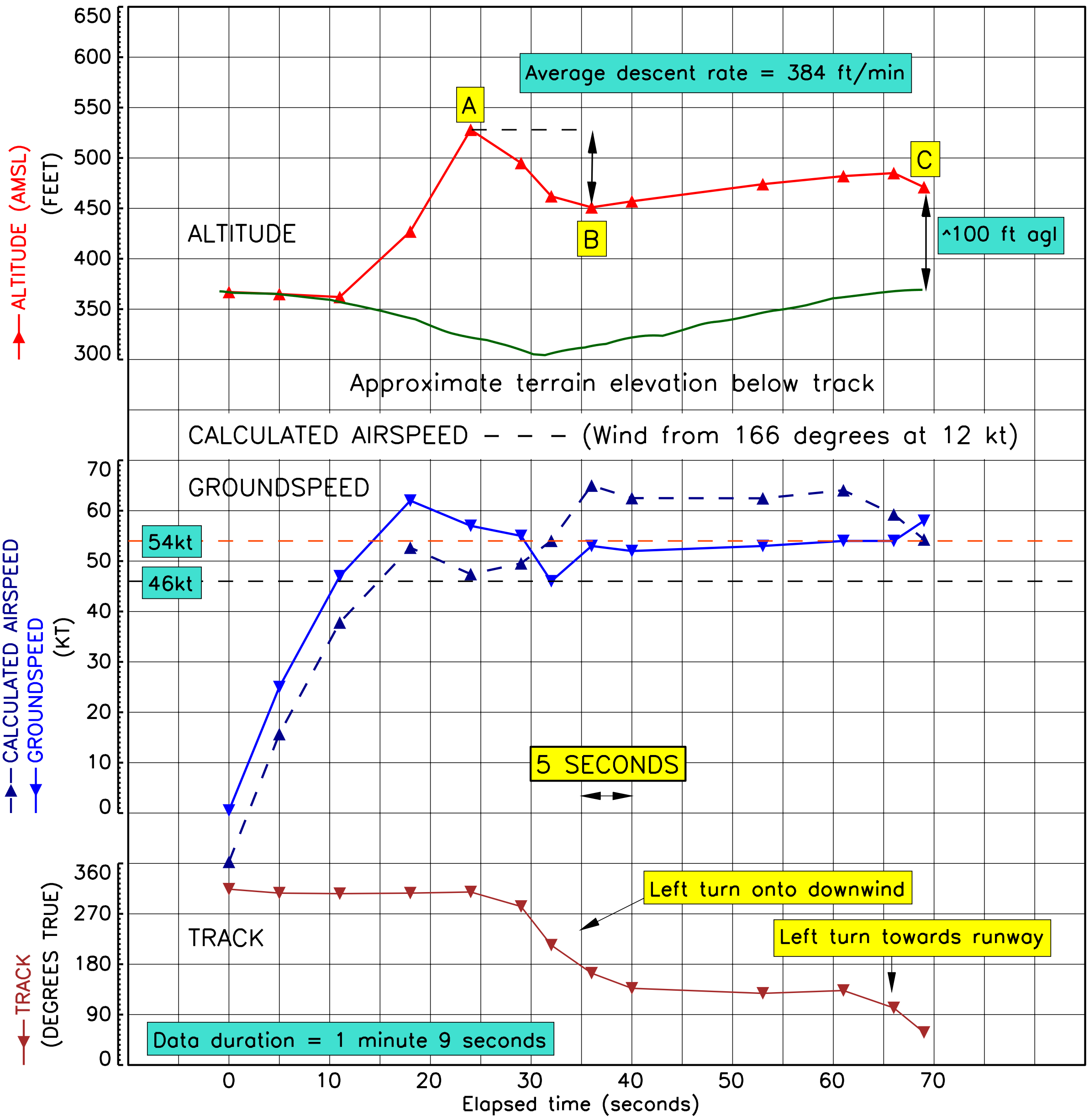

Figure 2

Time series plot of GPS data

FLYdat

The FLYdat unit was successfully downloaded. The engine speed and CHT for all three recorded periods for the accident flight were as follows:

Time after engine start	Engine rpm	CHT (°C)
0 to 5 min 59 s	2,660	84
6 min to 11 min 59 s	4,130	143 (warning)
12 min to end of recording	5,830 (warning)	198 (alarm)

The six-minute time intervals make precise assessment of the data difficult. The parameters for the first time interval are consistent with engine start up, and power checks at around 4,000 rpm appear to have been made during the second time interval. It was not possible to determine the duration of the final time interval which very probably contained most, if not all, of the 69 seconds from the start of the takeoff run to last recorded GPS position.

Information from earlier flights was also recorded on the FLYdat. The previous three flights had maximum recorded engine speeds of 5,960, 5,950 and 5,930 rpm, all of which had registered a warning on the FLYdat. However, for the accident flight a CHT warning was triggered before the engine speed warning was reached, possibly whilst the aircraft was still on the ground. Some time after the CHT warning occurred, an engine speed warning and a CHT alarm were recorded by the FLYdat, although it was not possible to determine which had occurred first.

The CHT sensor for the FLYdat has an operating range of -20ºC to 204ºC. The sensor was tested with another similar sensor and found to read the correct temperature over a range of temperatures from room temperature up to 200ºC. The red FLYdat warning light was tested and illuminated satisfactorily.

Maintenance activity

The pilot had carried out maintenance on the aircraft the day before the accident. The entry in the engine logbook was as follows:

'Oil leak traced to hose into radiator
Tightened hose clip after lowering both radiators. Tested O.K.'

The propeller was fitted with new blades in June 2011.

Detailed examination of the wreckage

The engine was stripped with the assistance of the UK distributor. There was no evidence of any thermal distress or mechanical failure. The damage to the engine and engine area was such that it was possible to recover only a small quantity of fluid from the coolant system. This was subsequently chemically analysed. Whilst not definitive, it was concluded that the fluid in the coolant system was most likely a 50:50 glycol/water mix.

The filler cap for the coolant system was found detached from the expansion tank and the pressure relief valve had detached from the cap. There were no compelling marks on the cap to suggest that it had been forced off when the aircraft struck the ground so the filler cap becoming detached during the flight could not be ruled out.

Swabs of the brown streak along the lower fuselage were taken and chemically analysed. It was concluded that the brown streak was engine oil and not engine coolant. This streak could have been made some time before the accident.

The tube linking the manifold balance pipe to the manifold pressure gauge in the cockpit was examined. There were two pieces of tubing of different diameters, joined by a length of metal tubing. According to the engine installation manual, a condensate trap should be installed in the balance pipe. The manifold pressure gauge was badly damaged and it was not possible to carry out a functional test. The absence of the condensate trap exposed the pressure gauge to possible damage from fuel vapour.

The mainwheel was found in the retracted position. Although there were some witness marks around the landing gear/flap lever 'DOWN' detent, these could have been produced during the complex impact sequence. The level of damage was such that it was not possible to determine the gear and flap position when the aircraft struck the ground.

The flying controls were examined and no evidence of a control problem was found.

An inspection of the propeller revealed significant damage to the hub unit. The propeller blades appeared to be towards the fine pitch end of the range; this was consistent with the selector knob in the cockpit which was in the TAKEOFF position.

The buzzer and the pressure switch in the stall warner were tested and operated satisfactorily. The airspeed indicator calibration was tested and was found to be within 3 to 4 kt in the speed range from 40 to 70 kt.

Pathology

Post-mortem and toxicological examinations were conducted on both the occupants on behalf of the Coroner. The reports were reviewed by a specialist aviation pathologist. He reported that there was no evidence of natural disease which could have had any bearing on the cause of the accident. The toxicology tests on the pilot detected an over-the-counter drug which '*had the rare potential to cause drowsiness*'; however, it was thought '*unlikely to have played a role in this accident*'.

Regarding injury the pathologist reported that:

> *'The pilot exhibited injuries to the palm of his left hand, suggestive of having grasped something at the time of the crash; the most likely thing would be the control column. This finding strongly suggests that the pilot was conscious at the time of the crash.'*

and:

> *'Overall the pattern of injury between the two occupants was similar and consistent with a nose-down impact with the ground. The crash forces were beyond the range of human tolerance.'*

Increase in stalling speed during turns

The stalling speed of an aircraft increases in a turn due to the increase in the load factor.

In order to make a final approach from the downwind leg an aircraft has to be turned though about 180º. From its position on the downwind leg, for G-GBXS to avoid significantly overshooting the runway centreline, this turn would have to be accomplished in a lateral distance of around 240 m. Assuming an entry airspeed of 59 kt, this would have required an average angle of bank of 38º. The result of applying this bank angle would be a load factor of 1.14, resulting in an increase in the aircraft's clean stalling speed from 54 kt to 61.6 kt, and an increase in the flaps-down stalling speed from 46 kt to 52 kt.

Forced landing options

The fields surrounding the airstrip were generally level or gently sloping with, in a majority of cases, short stubble on a hard soil base. Available ground runs ranged from 300 m to over 1,000 m, depending on approach direction.

Analysis

The evidence shows that, after becoming airborne, the pilot decided to abandon the flight and return to the airstrip.

It is impossible to be certain why the flight was abandoned, but, if the FLYdat system was generating a CHT alarm, it would have been prudent to land as soon as possible. Whilst some anomalies were identified during the wreckage examination, these should not have prevented the engine from producing sufficient power to complete a circuit successfully. The fact that the aircraft was able to maintain height and airspeed supports this.

The aircraft's position on the downwind leg was closer to the runway and at a lower height than on other flights recorded on the GPS. It was not possible to determine why the aircraft did not accelerate or climb to a greater height, but this may be indicative that, either by choice or circumstance, the pilot did not or could not use all of the available engine power.

The sudden roll excursion observed by Witness A was consistent with a low-speed stall during the crosswind turn, from which the pilot was able to recover.

The GPS data show that the airspeed was approximately 10 kt above the clean stall speed during the downwind leg but during the base turn the airspeed decreased significantly. Given the increased stalling speed in the turn due to the load factor, it is likely that the reducing airspeed caused the aircraft to stall during the turn, leading to a loss of control from which the pilot was unable to recover.

The Europa's landing performance and the condition of the fields surrounding the accident site were such that the prospects of a successful off-airfield landing were good. On the other hand, given that the aircraft was able to maintain height and speed on the downwind leg, the pilot may have considered that a landing back on the strip was an achievable and preferable option. However, the aircraft's low height and positioning close in to the runway would have made successful completion of the circuit highly challenging.

It is likely that the pilot would have been looking out during the base turn and concentrating on aligning the aircraft with the runway. The aircraft's proximity to the runway meant that there was less distance and hence less time available than usual to complete the manoeuvre. In addition, the wind, although light, was from a direction that would have pushed the aircraft through the turn, increasing the possibility of it overshooting the runway centreline. If the pilot's attention was focussed on looking out and successfully completing the turn, he may not have been aware of the decreasing airspeed and the risk that this posed.

This, and previous similar accidents, show that a loss of control at low level has a very high probability of serious or fatal injury.

The increased load factor and resultant increase in the stalling speed in a turn mean that it is critical to maintain a sufficient margin of airspeed above the stall, particularly when manoeuvring at low altitudes where there may be insufficient height available to recover.

Conclusion

The evidence suggests that the pilot had abandoned the planned flight and was flying a low-level circuit to land back on the airstrip, probably as a result of an engine problem. The aircraft was at a low height and close to the runway during the downwind leg.

The airspeed decreased during the turn onto the base leg, probably resulting in a stall and subsequent loss of control. There was insufficient height to effect a recovery and the aircraft impacted the ground in a steep nose-down attitude, causing fatal injuries to both occupants.