ACCIDENT

Aircraft Type and Registration:	Zenair CH 601HD Zodiac, G-CBDT
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2002
Date & Time (UTC):	5 May 2011 at about 1600 hrs
Location:	A private airstrip 19 nm southeast of Penrith, Cumbria
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	591 hours (of which 93 were on type) Last 90 days - 11 hours Last 28 days - 6 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft crashed after it struck trees, following an approach to a private landing strip situated in a small valley. There was no evidence that a technical malfunction played a part in the accident. The cause of the accident was not positively determined but adverse wind conditions and pilot medical factors were possible contributory factors.

History of the flight

The pilot owned G-CBDT and operated it from a private airstrip at his residence on the western edge of the Pennines, in Cumbria. The day before the accident, he had taken off from the airstrip at about 0800 hrs and flown to Caernarfon Airfield in Gwynedd, where he met other members of a flying association for an organised visit to RAF Valley, on Anglesey. He telephoned his wife at home to say that he had arrived safely.

After arrival at Caernarfon, the pilot refuelled the aircraft with 35 litres of Avgas before departing on the visit and a local sightseeing trip. He stayed overnight in Caernarfon with other group members and continued with the visit programme the next day until after lunch, when he prepared to return home. The pilot was reportedly in good health during the time of the visit, and had normal social interaction with others in the group. The details of his preparation for the return flight are not known; the pilot's wife had checked the local weather conditions for passing to her husband if he should telephone ahead but he did not.

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G-CBDT took off from Caernarfon at 1419 hrs. There was no record of the pilot's return route, but flight time by the most likely route would have been about 1 hr 40 mins, giving an arrival time back at the airstrip of about 1600 hrs.

When the pilot had not returned home by early evening, his wife walked to the adjacent airstrip, only part of which was visible from the house. She found the wreckage of G-CBDT to one side of the airstrip, with the pilot still secured by his seat harness within the wreckage. Emergency services attended but the pilot had received fatal injuries.

Accident site

The aircraft came to rest 58 m to the east of the airstrip, on a heading of 165ºM. It was approximately 28 m from a wooded area that was immediately to the east of the airstrip (Figure 1). Wreckage from the aircraft, together with ground impact scars, formed a trail 67 m in length, running between the western end of the wooded area and the aircraft's final position.

Fresh damage to trees in the wooded area adjacent to the landing strip indicated that the aircraft had struck the trees before impacting the ground beyond. Five individual tree strikes were observed, varying in height between 4 and 6 m above ground level, along a line inclined approximately 14º to the horizontal, in the direction of landing. Damage to the trees indicated that the outer 2 m of the aircraft's left wing had been in contact with the trees. The red lens from the aircraft's left wingtip navigation light was recovered on the ground between the wooded area and the runway, close to broken branches from the tree strikes (Figure 1).

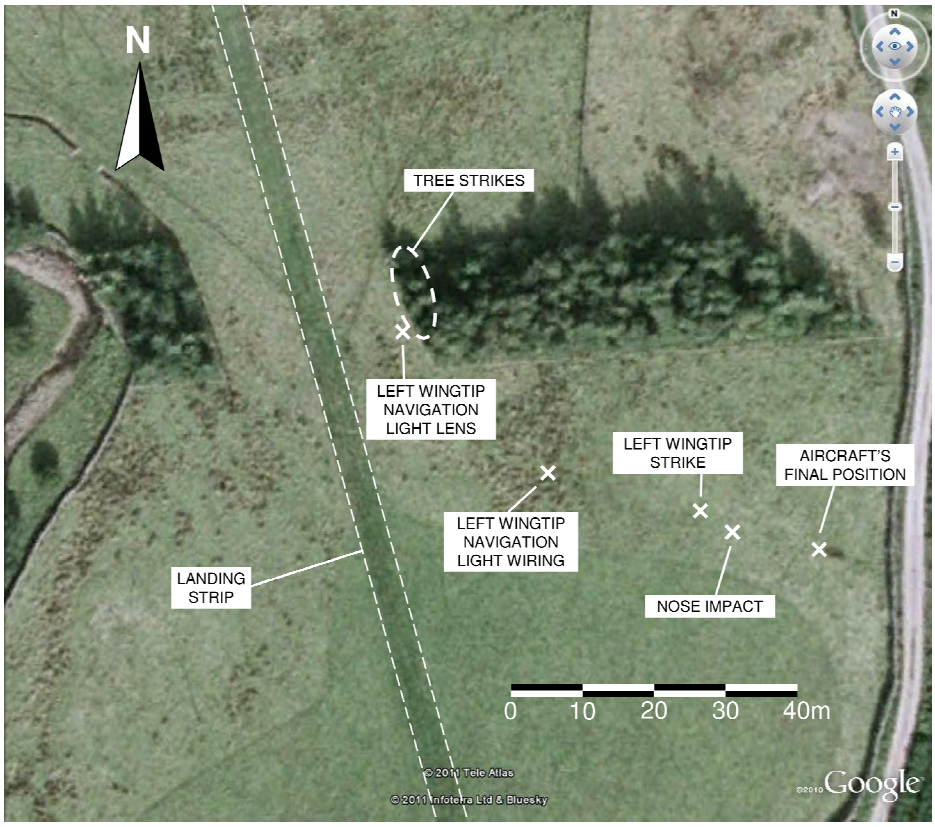

Figure 1

Wreckage plot

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A ground impact mark, made by the left wingtip, was evident in the wreckage trail 21 m from the aircraft. This was followed by a 17 cm deep nose impact crater, 13 m from the aircraft. Another ground scar, adjacent to the nose impact crater but laterally offset from it by 75 cm, had been made by the nose undercarriage leg, following detachment of the nosewheel fork assembly from the bottom of the leg. Two sheared bolts of the type used to secure the nosewheel fork to the leg were found in this ground scar.

Two parallel propeller slash marks were evident in the soil immediately before the nose impact crater. Both slash marks were approximately 30 cm in length, and were laterally spaced 33 cm apart. A small quantity of engine oil had leaked onto the ground from the engine oil cooler and the oil tank. No significant fuel spillage was apparent, no fire had occurred and a total of 27 litres of fuel was recovered from the fuselage tank. An auxiliary fuel tank mounted in the right wing was inspected but this did not contain any additional fuel.

Wreckage examination

The leading edge of the left wingtip had sustained impact damage over the outer 1.5 m, with traces of soil and grass found trapped in the folds of the metal structure. The inboard trailing edge of the left wing was buckled, consistent with an impact load sustained at the left wingtip. The outer 2.8 m of the left wing had bent forwards by 70º and the left wing's rear spar had failed in tension, 42 cm outboard of the rear spar bolted joint. The nature of this damage indicated that the forward failure of the wing had occurred after the left wingtip ground strike, probably due to inertial loading of the wing as the aircraft came to rest.

The right wing was largely intact, apart from a 1.1 m length of leading edge impact damage at the wingtip. The left side of the fuselage, behind the cockpit, had partially collapsed in buckling, consistent with the fuselage experiencing compressive loading during a nose-down ground impact. All three propeller blades had broken off at the hub, indicating that the engine was rotating at impact. Fragments of propeller blades were scattered up to 33 m from the nose impact point.

The engine had been pushed rearwards during the nose impact, forcing the left rearmost cylinder's exhaust pipe into the engine's external oil tank. The oil tank filler cap had detached, allowing oil to escape and coat the forward fuselage. The oil tank itself had been pushed into the firewall, causing the firewall to displace rearwards by about 11 cm.

The aircraft's flying controls were examined at the accident site and determined to be continuous, with no evidence of pre-existing control restrictions or any reduction in the range of control movement. The elevator trim tab, which was controlled by an electrical servo, was in a neutral position in line with the right elevator. The engine throttle control was of the 'plunger' type and this was found in the fully forward (throttle fully open) position. However, the rearward migration of the engine oil tank had bent the throttle control torque tube where it was mounted on the firewall, drawing the throttle control fully forward. The throttle position was therefore considered to be unreliable.

Photographs taken by the local police force showed that, prior to recovery of the pilot from the aircraft, the pilot's lap belt and shoulder harness had been fastened. The points at which the harness attached to the aircraft's structure were examined and found to be in good condition, with no evidence of mechanical overload. The single piece canopy transparency had a broken section measuring approximately 60 cm in

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height by 30 cm in width, adjacent to the pilot's left shoulder.

The aircraft was recovered to the AAIB's facility at Farnborough for further detailed examination. The engine was removed from the aircraft and dismantled. It was free to rotate, was in good mechanical condition and all the engine damage observed could be related to the ground impact sustained during the accident. Both carburettors were disassembled and fuel was present in both carburettor bowls. A single GPS unit had been fitted to the instrument panel but was later found to contain no recorded data pertinent to either the outbound or return flight. No other sources of onboard recorded information were found during inspection of the aircraft.

Aircraft description

The Zenair CH 601D is a two-seat aircraft, fitted with a Rotax 912ULS piston engine, rated at 100 HP, and a fixed-pitch three-bladed composite propeller. The propeller is driven by the engine via a reduction gearbox and its operational range lies between approximately 620 rpm at idle, and 2,390 rpm at the maximum engine limit. The aircraft has a fixed tricycle undercarriage. Both occupants are provided with a three-point harness consisting of a lap belt and a single shoulder belt. In the case of the pilot, sitting in the left seat, the shoulder belt routed over his left shoulder to a buckle release by his right hip.

Aircraft records

The aircraft's airframe and engine logbooks were reviewed. They showed that the aircraft's last annual LAA Permit to Fly maintenance inspection had taken place on 29 July 2010 and that the aircraft had a current LAA Permit to Fly. A weight and balance calculation was performed after the accident, based on the quantity of fuel recovered from the aircraft, baggage found in the aircraft and the pilot's mass. This analysis showed that, when the accident occurred, the aircraft was operating within its maximum authorised total mass and that the centre of gravity was within permitted limits.

Pilot information

The pilot gained a Private Pilot's Licence (Aeroplanes) in 1998. Soon afterwards, he finished construction of a Rans S6 aircraft, which he first flew in June 1999. In 2001 he acquired G-CBDT as a part-built project and, following completion, first flew the aircraft in August 2004. From then until the date of the accident, the pilot owned and flew both aircraft, which were kept at a small hangar at the airstrip. The majority of the pilot's flying was in the Rans S6; in the year immediately prior to the accident, only one quarter of his logged 42.4 flying hours were in G-CBDT. The pilot's last flights in G-CBDT (prior to the flight to Caernarfon) were made on 22 March 2011. Apart from one other day in March 2011, the pilot had not flown the aircraft since August the previous year.

The pilot had applied for, and been granted, a National Private Pilot's Licence (NPPL) in 2004, and had surrendered his original PPL(A). The pilot's flying licence was found to contain medical certificates dating back to 1997, when he started flying training. Since 2003, the pilot had been flying on a medical declaration[1], which held a validity period of five years. The latest medical declaration found was dated 16 May 2003, which therefore expired in May 2008.

Footnote

[1] The medical requirements for a NPPL are less onerous than for a JAR-FCL licence, being equivalent to the DVLA group 2 standard, which is applicable to drivers of heavy goods vehicles and buses. A declaration of fitness must be endorsed by an applicant's General Practitioner, who must have access to their medical records.

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In information published by the CAA, a pilot's GP should retain on file a copy of the medical declaration. However, the pilot's GP had no later copy on file, nor record of a consultation or examination around the time of expected renewal. Holders of NPPLs are required to forward a copy of completed medical declarations to the appropriate National PPL administrative body (in this case, the National Pilots' Licensing Group Limited (NPLG Ltd)). Enquires with NPLG Ltd revealed that the most recent declaration on their file for the pilot was that dated 16 May 2003. It was concluded that the pilot most probably did not have a valid medical declaration at the time of the accident.

Airstrip information

The grass airstrip was orientated 17/35, with the landing QDM being measured at 172°M. With an elevation averaging 980 ft amsl, the airstrip was about 460 m long with a prepared central strip 5 m wide. It was surrounded on all sides by higher ground, which reached about 1,100 ft amsl immediately to the north and about 1,400 ft amsl within 0.5 nm in the sector from the north-east, through south, to the west. Thus, the airstrip sat in a small valley (Figure 2). The highest ground in the vicinity was at 2,170 ft amsl, 1.7 nm to the south-east.

A line of trees straddled the strip about 125 m from its start, with a gap in the trees of about 30 m through which the strip passed. The portion of strip before the trees was of softer ground than the remainder, and was generally only used for takeoff. Therefore, the touchdown point for landing was effectively in line with the trees. There were two windsocks, one close to the northern end of the strip and a second about 160 m from the southern end.

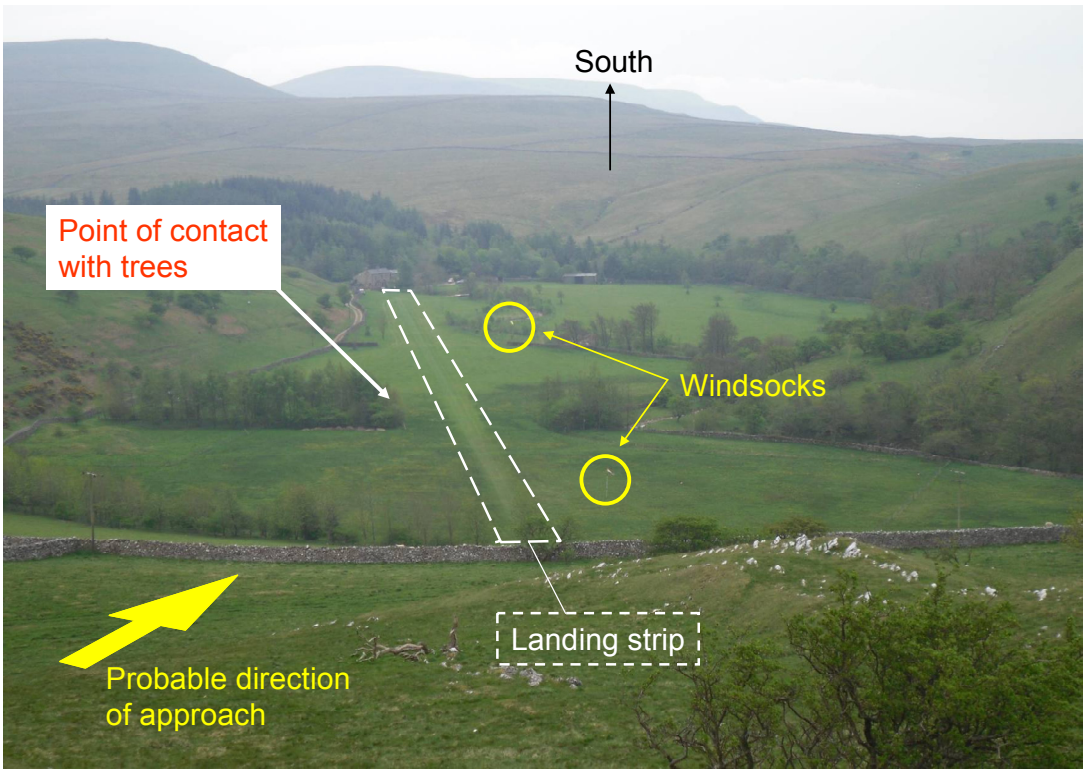

Figure 2

View of the airstrip from high ground to the north

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The pilot had been flying from the airstrip since 1999. His family reported that he would approach the strip from the north, using one of two approach paths. Each was through a col in higher ground, such that the strip could be approach either 'straight in' or from a left base position, the former requiring a steeper approach and the latter requiring a relatively late left turn to align with the landing direction.

The pilot was reported to have been cautious with regard to adverse wind conditions. It was not unusual for him to discontinue an approach and divert to a more favourable airfield if conditions were not suitable for landing. It was felt that, on the accident flight, the pilot would most probably have made an approach to the airstrip from the left base position, since the steeper straight in approach was more suited to the Rans S6 which was equipped with wing flaps, unlike G-CBDT.

Meteorological information

Four days before the accident, the pilot contacted the Met Office by e-mail to enquire whether strong winds which were affecting the area would persist until his departure for Caernarfon on 4 May. In his reply, the Regional Advisor said that the winds would moderate and that the pilot could expect south or south-easterly surface winds of about 5 to 10 kt for departure, although they may be expected to increase a little over the following 24 hours. With no significant weather expected, the Advisor said he was reasonably confident that the outbound and return flights could be made under Visual Flight Rules.

The pilot's wife had thought it possible he may telephone home for a weather update before departing from Caernarfon, although as it transpired he did not. Using the internet, she obtained a report of conditions at Kirkby Stephen[2], timed at 1309 hrs (about one hour before G-CBDT took off from Caernarfon). The report gave a surface wind of south to south-east at 15 mph, gusting to 20 mph (13 to 17 kt). Increasing amounts of rain were forecast, with a cloudbase of 1,800 m (about 6,000 ft). The pilot's wife recalled that some rain fell during the afternoon, but had cleared before evening.

Personnel from the emergency services who attended the scene soon after 1900 hrs that evening reported that quite a gusty wind was blowing. It was noted that the two windsocks were indicating markedly different directions: the upwind windsock indicated a headwind approximately aligned with the landing direction, while that closer to the threshold indicated a brisk crosswind, blowing from right to left across the direction of approach. There were no reports or estimates of actual wind conditions in the late afternoon, when G-CBDT was most likely to have been making its approach.

The Met Office provided a report on the likely conditions at the airstrip on the afternoon of the accident, which would have been heavily influenced by the local topography. The gradient wind (at 2,000 ft amsl) was estimated to have been from 170° at 15 to 20 kt, with a theoretical wind at airstrip level (about 1,000 ft amsl) of 160° at 15 kt. However, the surface wind at airstrip level would have been subject to much greater variation, due to topography, than the 2,000 ft wind, giving the potential for significant windshear between the airstrip and about 2,000 ft, with variations likely in wind speed and direction. The topography and wind direction would suggest that the surface wind and 2,000 ft wind would have been relatively closely aligned at the upwind (southerly) end of the airstrip, while blocking

Footnote

[2] Kirkby Stephen was about 1.5 nm north-west of the airstrip, at an elevation of about 600 ft amsl.

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and funnelling effects of the topography would be likely to have produced a marked variation in wind direction at the approach and touchdown (northerly) end of the strip.

Pathology and survivability

A post-mortem examination was conducted by a specialist Consultant Aviation Pathologist. In his report, the pathologist concluded that the pilot had died as a result of head and neck injuries sustained in the accident. Although these may not have been immediately fatal, the pilot would most likely have been rendered unconscious in the accident, and immediate medical attention would have been unlikely to have altered the fatal outcome.

Evidence from the accident site and the presence of a preserved survivable cockpit space within the aircraft, together with the general pattern of the pilot's injuries, suggested a relatively low energy impact. While a four-point harness would have provided better restraint to the pilot's upper body, his head would still have been free to flail and similar injuries may still have resulted. The pilot was not wearing a safety helmet but as there was no evidence of a significant direct impact to the pilot's head, the use of one was thought unlikely to have had a beneficial effect in this accident. However, an air bag system may have had the potential to alter the survivability of the accident.

The pilot had a recent history of transient episodes of an irregular heart rhythm. His condition precluded the pilot from meeting DVLA group 2 medical standards, although he met the group 1 standards, which meant that he could only fly solo or with another qualified pilot. This fact was bought to the pilot's attention by his cardiologist and was acknowledged by the pilot. Although the possibility of the pilot being incapacitated by his heart condition could not be entirely discounted, his previous episodes had not been incapacitating. Autopsy evidence suggested that the pilot's left hand had been on one of the controls (most likely the throttle, being on the pilot's left side) at the time of the accident. While this suggested the pilot was physically flying the aircraft, the possibility of a subtle incapacitation could not be ruled out.

Toxicological examination revealed no evidence of alcohol or exposure to carbon monoxide. However, O-desmethyltramadol was present at a blood concentration of less than 50 µg/litre. This is a metabolite[3] of tramadol, a prescription-only opiate-like drug used for the treatment of moderate to severe pain. No tramadol was detected on toxicology but O-desmethyltramadol can produce some of the effects and side effects of tramadol, which include dizziness, somnolence and nausea.

The toxicology results indicated that the pilot had taken either tramadol or O-desmethyltramadol at some point before the accident, most likely within the preceding 24 hours. However, the results did not allow reliable conclusions to be drawn about whether the pilot would have been experiencing any of the effects of the drug at the time of the accident.

The reasons for the pilot having taken tramadol or O-desmethyltramadol are unknown. His GP did not prescribe it and was unaware of any reason why he should have taken it. Similarly, the pilot's family had no knowledge of the pilot ever taking the drug or of any reason why he might have done so. Under the terms of the medical declaration for the NPPL, the pilot would have been required to discuss any conditions which

Footnote

[3] A substance formed through metabolic processes.

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would necessitate use of the drug and the drug itself. It is unlikely that any condition for which the use of tramadol would be required would be compatible with piloting an aircraft.

Analysis

A detailed inspection of the aircraft did not reveal any technical defects that may have contributed to the aircraft striking the trees adjacent to the airstrip. There was strong evidence that the propeller was rotating under power when the aircraft struck the ground, and a subsequent strip inspection of the engine did not reveal any internal mechanical defects.

The distance between the nose impact crater and the ground mark made by the nose undercarriage leg was compared against the manufacturer's three-view drawing of the aircraft. This analysis indicates that aircraft attitude was approximately 45º nose-down at the point of nose impact.

The distribution of ground impact marks at the accident site indicated that the aircraft had initially struck the ground with the left wingtip whilst the aircraft was in a left-wing low attitude, before impacting heavily on its nose at an angle of approximately 45º nose-down. It then bounced, whilst continuing to rotate, causing a light ground impact with the right wingtip before the aircraft came to rest in a level pitch attitude whilst yawing to the left, causing both main landing gear legs to collapse to the right, but remaining attached to the airframe.

The spacing of the parallel propeller slash marks at the accident side, in combination with the propeller operational rpm range, indicated that the aircraft's impact speed was within a range between 20 kt and 74 kt. However, in the absence of any recorded information, it was not possible to refine this estimate any further.

The pilot had not flown G-CBDT a great deal since the previous summer, and the majority of his flying had been in the Rans S6 he owned. However, his overall flying currency was good and it is unlikely that the relative lack of currency on G-CBDT was a significant factor in the accident. Similarly, the pilot was very familiar with the airstrip and would be expected to be equally familiar with unusual local wind effects due to its unusual topography.

The pilot was reported to be cautious about using the strip in adverse conditions and had proved willing to divert to an alternative landing site if necessary. His enquiry to the Met Office prior to his trip supports this; it seems most likely that his main concern about wind was in the effect it would have in the immediate vicinity of the airstrip. Nevertheless, it is quite possible, based upon known wind conditions and observations later in the day, that the pilot was faced with demanding wind conditions for his landing, which could have included significant horizontal and vertical wind shear.

The aircraft struck trees some way to the left of the strip centreline, approximately level with the probable point of intended touchdown. The overall angle of the line of damage through the trees indicated a climbing flight path, although it could also have been produced, at least to some extent, by the aircraft rolling to the right. Combined with the height of the damage above ground and the final position of the wreckage, it was considered most likely that the pilot was attempting to execute a late go-around[4] when the aircraft struck the trees.

Footnote

[4] A manoeuvre in which the approach and landing is discontinued and the aircraft is climbed to a safe height.

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It could not be determined how the pilot came to have O-desmethyltramadol in his system, but it appears that he took either tramadol or O-desmethyltramadol at some time during his stay in North Wales. Although it is not possible to say whether the pilot would have been experiencing any of the effects of the drug at the time of the accident, the possibility exists that his performance may have been impaired because of it.

Conclusion

The cause of the accident was not positively determined. There appeared to have been no fault with the aircraft at the time of the accident. The evidence suggested that the pilot was flying a late go-around when the aircraft's left wing struck trees adjacent to the landing strip. Three factors were identified which, either singly or together, may have contributed to the accident. These were the weather conditions at the airstrip at the time of landing, a potentially distracting or incapacitating heart condition, and the possible adverse effects on the pilot's performance caused by the presence in his system of the drug O-desmethyltramadol.

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