Accident

Aircraft Type and Registration:	Piper PA-18-150, G-CUBX
No & Type of Engines:	1 Lycoming O-320-A2B piston engine
Year of Manufacture:	1981 (Serial no: 18-8109006)
Date & Time (UTC):	27 August 2024 at 0932 hrs
Location:	Croft Farm Airstrip (Defford Airfield), Worcester
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:	Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	1,520 hours (of which 3 were on type) Last 90 days - 9 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

G-CUBX tracked to the left on the runway during takeoff and within two seconds of getting airborne it was in a left turn tracking toward obstacles south of the runway. Witnesses reported seeing the aircraft adopt a steep nose-up attitude, but it was not able to climb above a tree which was one of the obstacles in its path. G-CUBX appeared to have struck the tree at the apogee of its flight path before descending steeply, nose-first, into the ground. The pilot suffered fatal injuries at the point of ground collision.

It was not possible to conclusively establish why the aircraft diverged left during and after takeoff. Nonetheless, the investigation considered it likely the relatively low lift off speed of approximately 34 kt contributed to the pilot having insufficient aerodynamic control authority to effectively counter the flight path divergence. Being in a turn rather than wings level would have compromised the aircraft's climb rate resulting in it being unable to climb above the obstacles it was turning toward.

The investigation was unable to find evidence of any pre-accident fault with the aircraft.

History of the flight

The accident occurred on the pilot's second flight in G-CUBX. The first time he flew the aircraft he occupied the rear seat with an instructor in the front. On the accident flight he flew solo from the front seat.

On the morning of the accident, the pilot used a remote-controlled aircraft tug to manoeuvre G-CUBX out of its hangar before completing his pre-flight checks. After initially having trouble starting the engine, he taxied out for departure from Runway 28. As the aircraft entered the runway to backtrack, its wing flaps were retracted (Figure 1).

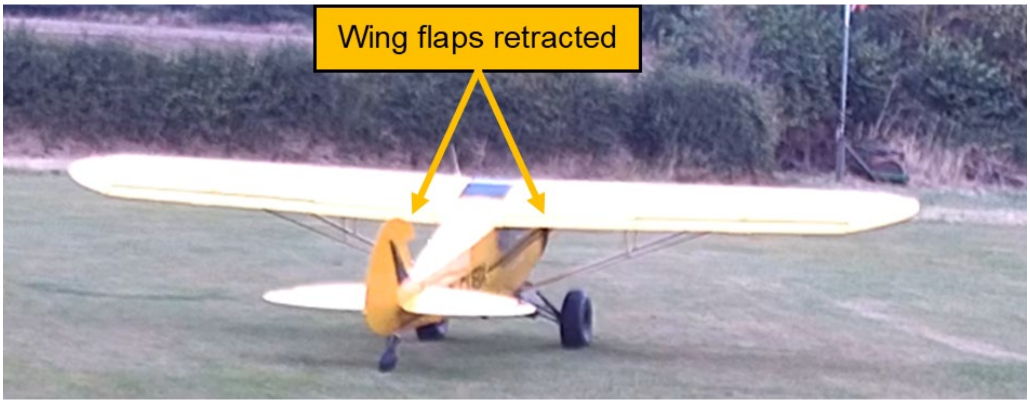

Figure 1

CCTV snapshot showing G-CUBX entering Runway 28 to backtrack for departure

Captured on CCTV, while at low speed during the initial phase of the takeoff roll, the aircraft swung to the left before being re-aligned to the runway by the pilot (Figure 2).

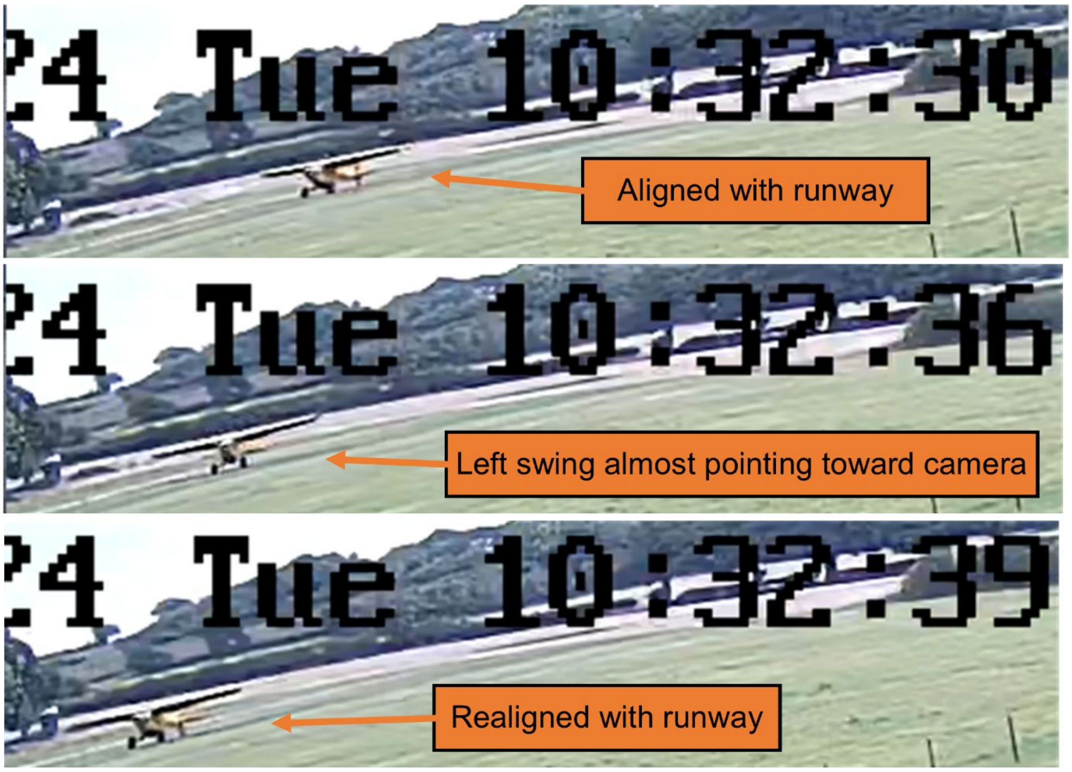

Figure 2

CCTV snapshots of G-CUBX at the start of its takeoff roll
(CCTV shows approximate local time)

After this early yaw divergence, the remainder of the takeoff roll captured on CCTV appeared to progress normally, with the aircraft's tailwheel lifting off just before the aircraft went out of view (Figure 3). Approximately nine seconds later the aircraft reappeared in the CCTV image, close to the camera and in a steep nose down attitude just before it struck the ground. While the CCTV footage was not of a sufficiently high definition to reach a definitive conclusion, it appeared to show G-CUBX's wing flaps in the retracted position before it struck the ground.

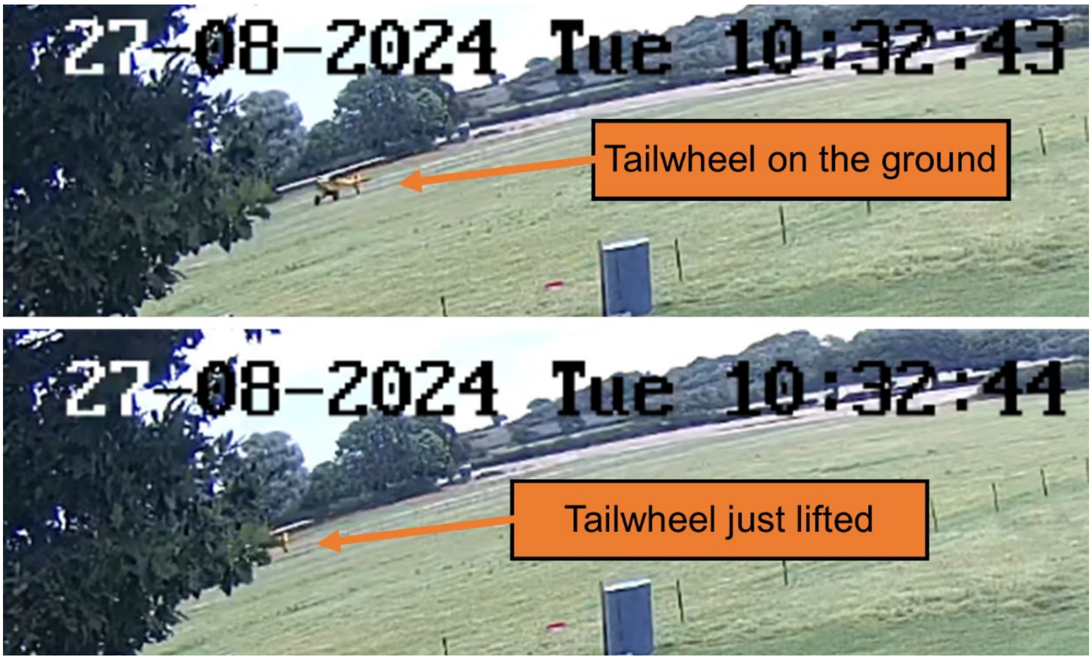

Figure 3

CCTV snapshots of G-CUBX showing its tailwheel being lifted from the runway

Two eyewitnesses described the aircraft's initial climb away from the ground as being steeper than expected. They both reported the engine note sounded normal throughout the short flight. One of the eyewitnesses was inside a hangar, so their view of the aircraft after its initial climb away from the ground was limited by the building structure. The second eyewitness described how, at a low height, G-CUBX's left wing dropped and the aircraft entered a steep left turn. It then descended, striking the ground in front of where he was stood.

CCTV footage revealed that the fire which subsequently consumed the aircraft started near the cockpit area within three seconds of ground impact.

Accident site

While video footage of the accident shows the aircraft initially coming to rest on its nose with the tail almost vertically above it, during the subsequent post-accident fire the tail settled to the ground with the top of the vertical stabilizer resting on the floor. The fuselage was inverted and there was significant damage to the structure (Figure 4).

Figure 4
G-CUBX showing significant post impact fire damage

Ground impact marks show the point where the leading edge of the left wing tip struck the ground before the fuselage pivoted around this initial contact point causing the spinner dome of the propeller to hit the ground. One of the two blades of the propeller was embedded in the ground and, once recovered, showed evidence of twisting consistent with the engine being under power when the aircraft struck the ground.

Twigs from a nearby tree were caught in the tail wheel giving a good indication of the flight path of the aircraft and the height at the point contact was made with the top of the tree. A continuity check revealed that all flight controls remained connected to their respective control surfaces. The exception was the right flap where the bell crank was missing and most of the flap had melted away. The left flap had also partially melted but remained attached to the wing with the control cables still connected between the bell crank and flap control lever in the cockpit.

The left wing and wing struts remained attached to the fuselage, although the right wing was detached at its root. The right wing struts, although bent and showing signs of significant fire damage, also remained attached to the wing and the fuselage.

Nearby, where the aircraft had been parked prior to the flight, there was a small patch of dead grass which was likely to have been caused by fuel dripping onto the ground during attempts to start the engine. CCTV footage showed that the technician who replaced the ignition harness attended the aircraft while the pilot was struggling to start the engine. He stated that when he lifted the cowlings, there was fuel dripping onto the air box. He regarded the dripping fuel as a sign of a potentially flooded engine. According to the O-320 engine operator's manual[1], '*Cranking periods must be limited to ten (10) to twelve (12) seconds with a five (5) minute rest between cranking periods.'* Whilst there were multiple attempts made to start the engine, there was very little time between cranking attempts which was likely to have exacerbated the difficulty the pilot had in starting the engine.

Recorded information

The pilot was using a flight-planning and navigation app on a tablet device which recorded the aircraft's GPS flight path. The ground track is shown in Figure 5. Note that the path stops short of the accident site by about three seconds as the recorded positions during this period were unreliable, probably as a result of the aircraft's banked attitude limiting the tablet's view of the GPS satellites.

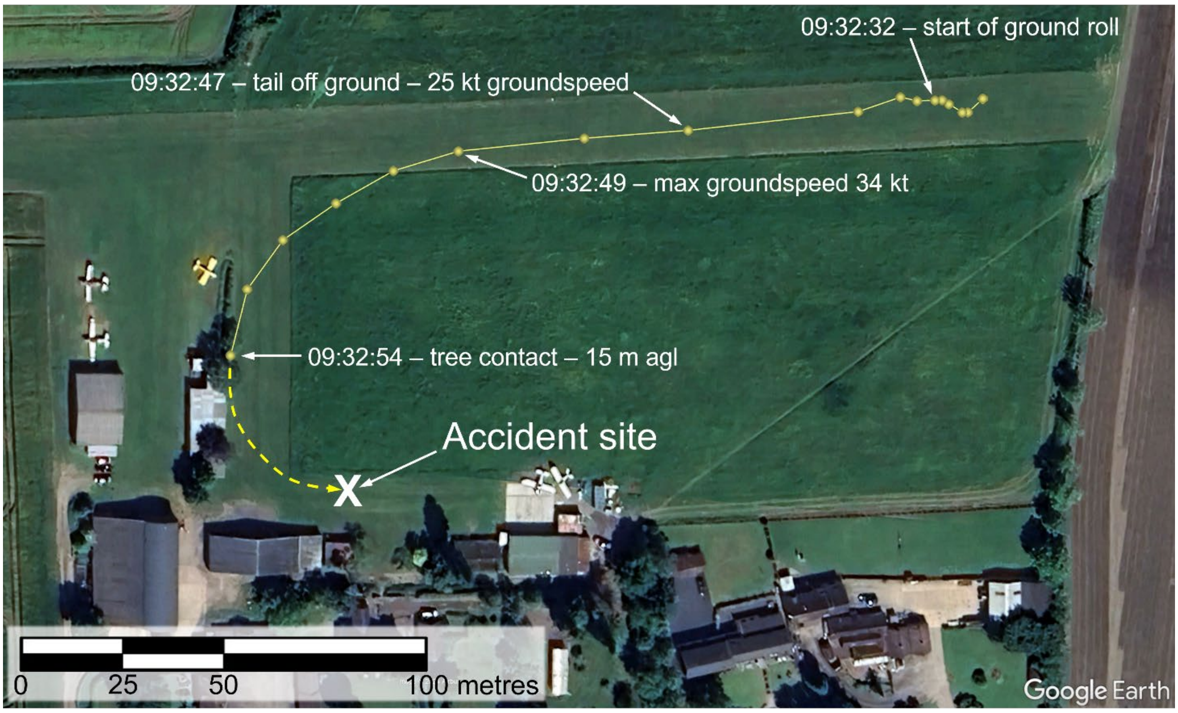

Figure 5

GPS derived ground track of the flight
(© 2025 Google, Image © 2025 Airbus)

Footnote

1 Lycoming Operator's Manual O-320 Series, part number 60297-30, 3rd Edition, October 2006, Section 3, paragraph 3, '*Starting procedures.'*

A side profile of the flight path is presented at Figure 6 together with other GPS derived data. These data show the aircraft initially lining up on the grass strip before beginning the take off at time 09:32:32.

After five seconds of gentle manoeuvring right, left and right again, the aircraft accelerated down the grass strip, veering slightly left, with the tail of the aircraft coming off the ground 10 seconds later (before going out of view of the CCTV). Within two seconds, the aircraft was airborne, after which it climbed at an average flight path angle of 14° and reached the maximum recorded groundspeed of 34 kt. Now turning left, the rate of climb reduced with the aircraft flying over the left edge of the grass strip at just over 10 m height.

The last recorded reliable position was four seconds later when the aircraft contacted a tree, 40 m to the left of the grass strip edge, at a height of about 15 m. Continuing to turn, and roll left, the aircraft came back into CCTV view descending vertically in a nose-down attitude, wings aligned with the grass strip, left wing first.

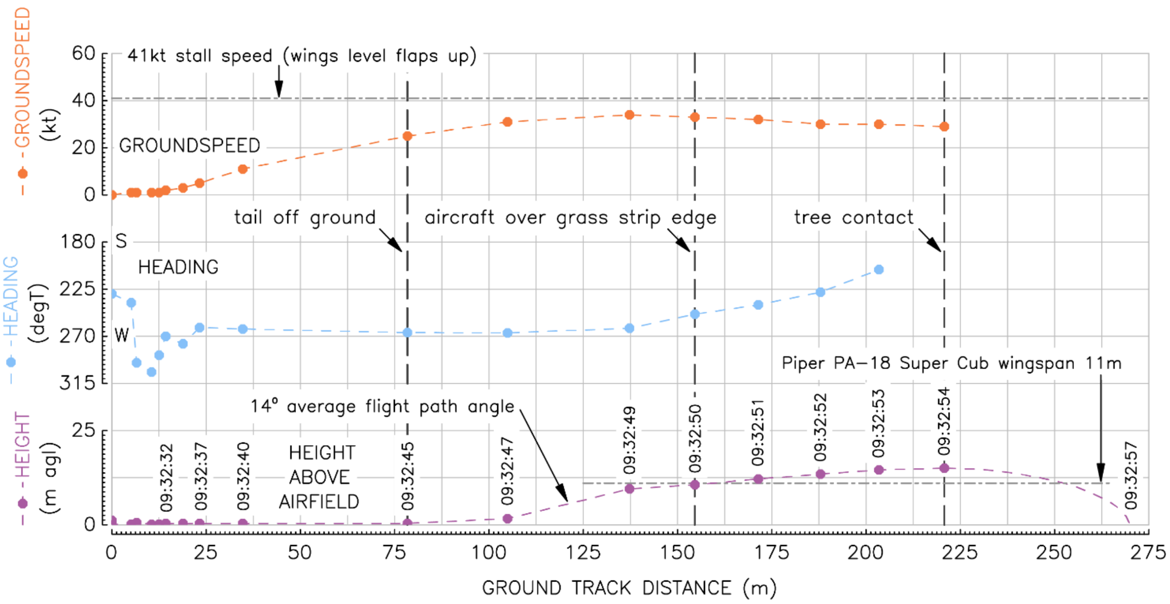

Figure 6

GPS derived data of flight
(PA-18 clean stall speed and wingspan indicated for reference)

Aircraft information and brief history

The aircraft was a Piper PA18-150 Super Cub with a Lycoming O-320 horizontally opposed four-cylinder engine. Built in 1981 and first registered in Greece, it had three previous registrations before being transferred from Germany to the UK and being re-registered as G-CLYI in 2021. It was modified to include an Alaskan Bush fit which included large tundra tyres, Alaskan tail wheel, modified heavy duty landing gear and a 31.5 USG belly fuel tank.

G-CLYI was involved in a landing accident in May 2023[2] where it flipped over onto its back whilst braking shortly after touching down on a grass landing strip. The aircraft spent 13 months undergoing repairs during which it was re-registered as G-CUBX in June 2024 (Figure 7). The engine was shock load tested by an approved engine workshop and refitted during the repairs. To improve stall performance and enhance the short takeoff and landing capability of the aircraft, vortex generators had been fitted just aft of the wings' upper leading edges and on the lower surfaces of the horizontal stabilizer, forward of the elevator hinges. These were also replaced during the repair process. G-CUBX received a CAA UK Airworthiness Review Certificate (ARC) on 11 July 2024.

Figure 7

G-CUBX after repair showing features of the Alaskan Bush fit

After handing over the repaired aircraft to the new owners, the aircraft was returned to the repair workshop on 22 July 2024 because the owner reported '*The aircraft rolls to left in flight*[3].' During the original repairs, the right forward wing strut had been replaced. Subsequent comparison of the left and right wingtip incidence angles, called 'wash-out'[4], showed a 2.5º difference between them. The right wing aft strut was adjusted to remove the incidence difference and the aircraft was flown to confirm that the roll to the left had been eliminated. This was re-confirmed by the owner during the return flight home to Croft Farm Airstrip.

Footnote

2 https://www.gov.uk/aaib-reports/aaib-investigation-to-piper-pa-18-150-g-clyi [Accessed 12 May 2025].
3 G-CUBX Worksheet dated 22 – 30 July 2024.
4 '*Inbuilt wing twist resulting in angle of incidence reducing towards tips',* The Cambridge Aerospace Dictionary, Second Edition, page 768.

On 16 August 2024, multiple problems were found with the ignition system including inoperative spark plugs, poor condition of the ignition harness and timing problems with the right magneto. The ignition harness and spark plugs were replaced and the right magneto removed, reset and refitted. Engine ground runs were carried out to verify the ignition system was functioning correctly and the two magnetos produced the correct reduction in engine rpm when 'mag-drop' checked. During the ground run, the technician believed he had witnessed a slow deployment of the left flap when compared to the right, although both flaps appeared to stop in their correct, fully deployed positions.

Aircraft examination

Engine

The engine was subject to a strip examination. Nothing significant was found with the mechanical and electrical components that could not be attributed to damage sustained when the aircraft struck the ground or the post-impact fire.

Airframe

According to the FAA Supplemental Type Certificate[5], if more than five Vortex Generators are missing or damaged, the aircraft is not airworthy. It was not possible to check the Vortex Generators because they had been glued to the fabric of the wing and the horizontal stabiliser but the fabric had burned away in the fire. Pictures taken shortly after delivery of the restored aircraft show most of the generators fitted to the wings and left horizontal stabiliser. In addition, the pilot could be seen checking the aircraft surfaces as part of his pre-flight inspection of the aircraft, therefore, he would likely have noticed if any were missing or damaged.

Whilst the right flap bell crank was missing (Figure 8), the turnbuckle that should have attached the flap control cable to the bell crank was intact and still attached to the control cable, link and return spring. The bell crank hinge bracket remained in place and attached to the wing. The push pull flap rod, which should have connected the bell crank to the inboard flap hinge bracket, remained attached to the bracket but the bracket had separated from the flap. The left flap control assembly was still connected to the left bell crank and flap although the wing spar section that held bell crank hinge bracket had melted releasing the bracket and bell crank.

Footnote

[5] FAA STC SA00530SE issued 26 June 1998 and emended 29 May 2009.

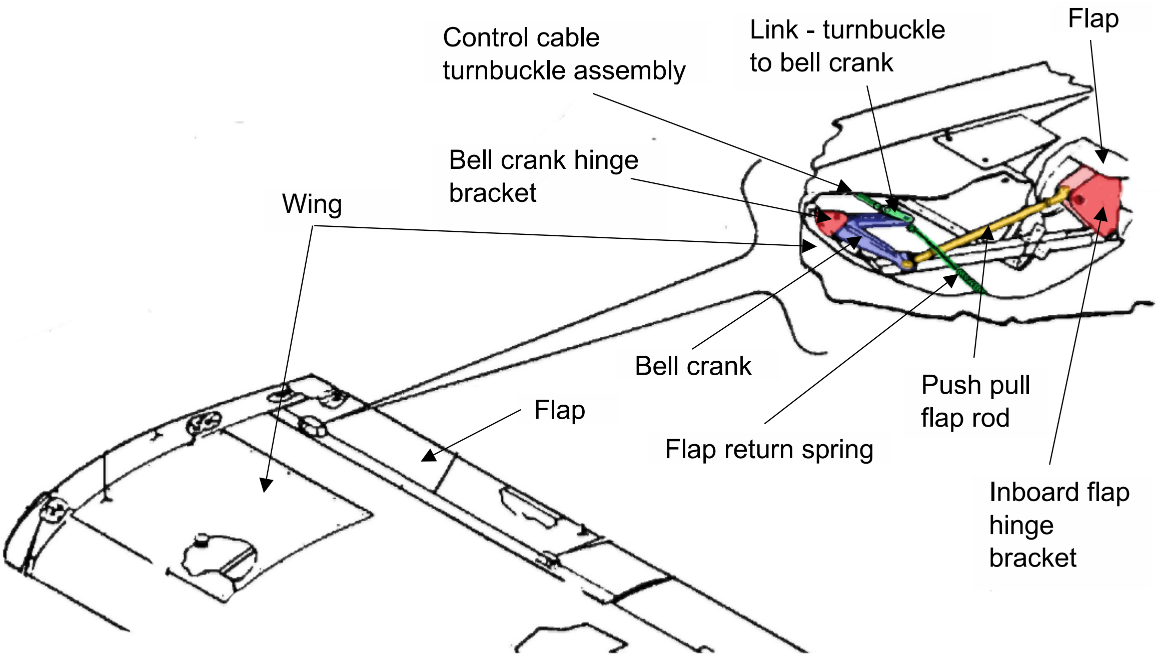

Figure 8
Flap control assembly diagram

It was not possible to examine the seat harnesses or any of the seat fabric because they had all been destroyed in the fire. The front seat had been torn from its mounting and distorted by the impact and the fire. Cockpit instrument panels, switches, control system levers and electrical wiring were also significantly damaged or destroyed.

On examining the various control cables from the cockpit controls to the control surfaces in more detail, no pre-existing restriction or incorrect routing was found. The slow left flap deployment issue reported by the technician who replaced the ignition harness could not be confirmed due to the absence of the left flap bell crank and the significant damage to both left and right flap systems, structure and control surfaces. A comparison of the tension force of the flap control return springs could not be made as both springs were damaged. Whilst most of the airframe and wings were badly damaged, the wings, tail and fuselage structure, including their drag support wires, were still present and no pre-existing faults were found.

The pitch trim, elevator, vertical stabiliser and rudder connections were still functional, and no issues were identified that were not caused by the accident or the fire. Whilst both ailerons had also been damaged by the fire, they remained connected to their respective cockpit controls and control cables.

Survivability

The post-mortem confirmed that, despite the pilot wearing a four-point seat safety harness, at the point of collision he sustained multiple injuries which were not survivable.

Aircraft performance

The Owners' Handbook (OH) for the aircraft states that at maximum gross weight, the '*power off stalling speed with full flaps in the Super Cub "150" is 43 mph* [(37.4 kt)]*: with flaps up the stalling speed increases* [by] *about 4 mph* [(3.5 kt)].'

G-CUBX was fitted with vortex generators to improve its short takeoff and landing performance. The Supplementary Type Certificate documentation for the vortex generator modification indicated that fitting them would reduce the aircraft's stalling speed by 16%.

In 2019 a PA-18-50 fitted with vortex generators like those on G-CUBX was destroyed when it lifted off unexpectedly while stationary on the ground with its engine running[6]. The accident pilot ascribed the unexpected lift off to strong winds and opined that '*a gust of 25 kt would be sufficient to lift the aircraft into the air but that in a pre-take-off scenario there is not the necessary airspeed to the ailerons to counteract a rolling tendency once the wind has lifted the aircraft into the air*.'

Regarding flap deployment for takeoff, the OH is not prescriptive, stating that '*the flaps can be lowered if desired, but should be retracted as soon as climbing airspeed has been reached...*'.

Ground effect may lead to an initial airborne state which cannot be sustained as distance from runway surface increases and the additional lift attributable to ground effect reduces.[7] For fixed wing aircraft, this additional lift reduces to zero at a height above the ground equivalent to the wingspan of the aircraft, which for the PA-18 is 11 m (Figure 6).

Meteorology

At the time of the accident good weather prevailed. There was no low cloud, and visibility was more than 10 km. While generally from a southerly direction, the surface wind was light and variable, giving a maximum estimated crosswind component of 5 kt.

Airfield information

Croft Farm Airstrip (also known as Defford Airfield) is a private unlicensed airfield with a single grass strip 570 m long and 18 m wide, designated Runway 10/28. Extending for approximately 200 m from the threshold, an electrified livestock fence initially delineates the left (south) edge of Runway 28 (Figure 11).

Footnote

6 Accident report available at AAIB investigation to Piper PA-18-150, N162AW - GOV.UK [Accessed 3 February 2025].

7 https://skybrary.aero/articles/ground-effect [Accessed 3 February 2025].

Personnel information

The accident pilot had over 1,500 total flight hours gained in non-commercial flying. His recent flying experience was exclusively on tailwheel aircraft including the Piper J3-65 Cub, Harvard and P51 Mustang types. He had regularly flown from and was familiar with operating at Croft Farm. He did not have any significant underlying medical issues, and the post-mortem did not find evidence of chronic or acute conditions to indicate pilot incapacitation as a causal factor.

Other information

Adverse aileron yaw

When an aileron is deflected downwards the drag it generates increases. This results in a drag differential between the two wing surfaces which generates a yawing moment in the opposite sense to the applied roll. With a right roll input the left aileron is deflected downwards and the resulting yawing moment is to the left.

Swing on takeoff

Due to a combination of factors, propeller-driven aircraft tend to 'swing' to one side on take-off, this requires pilots to compensate with opposite rudder. For nosewheel-equipped aircraft, the two primary factors generating swing on takeoff are slipstream effect and torque reaction. These effects are explained below and assume the aircraft is equipped with a clockwise rotating propeller (the same as G-CUBX). On aircraft with propellers which rotate in an anticlockwise direction, the divergent effects are in the opposite sense ie to the right.

- Slipstream effect: the propeller's rotation produces an asymmetric flow over the fin and rudder, thereby inducing a left yawing moment (Figure 9).

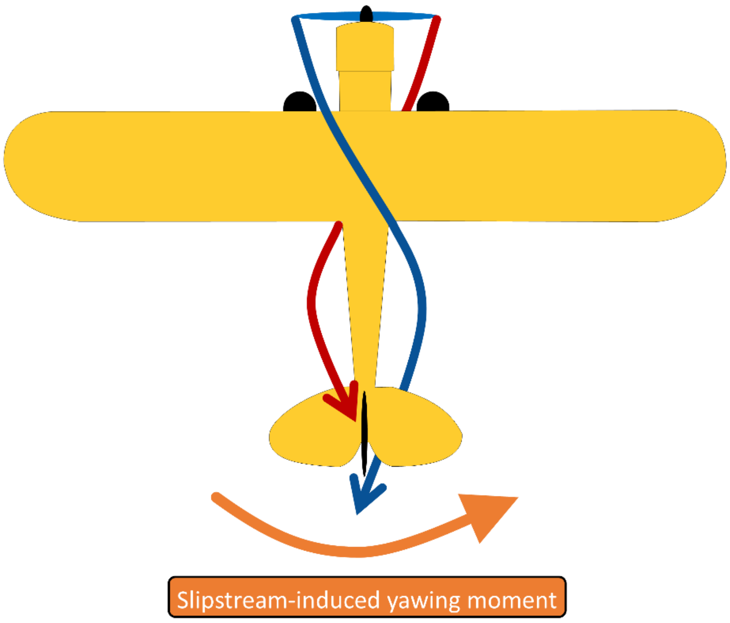

Figure 9

Left yaw due to propeller slipstream (viewed from above the aircraft)

- Torque reaction: torque reaction from driving the propeller imparts a left rolling moment on the aircraft (Figure 10). During the takeoff roll this results in more weight being supported by the left wheel thereby increasing its rolling resistance and giving rise to a tendency to swing left until the aircraft is airborne.

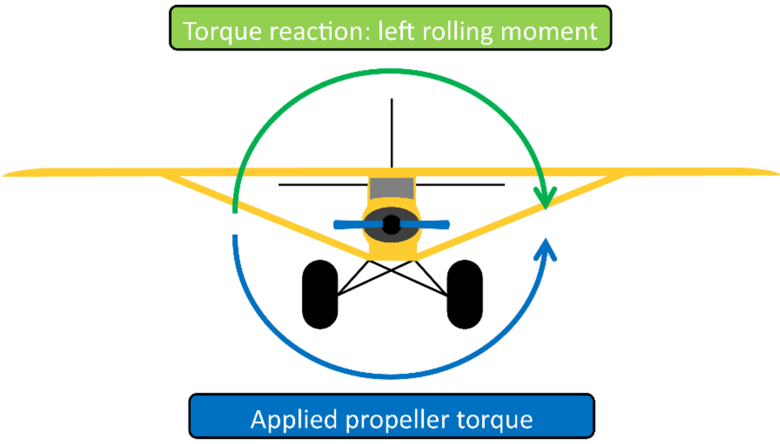

Figure 10
Torque reaction producing rolling moment

For tailwheel aircraft there are two additional factors that can affect swing during the takeoff roll:

- Asymmetric blade effect: while the aircraft's tail is down, the plane of rotation of the propeller is not at right angles to the direction of forward motion. This means the down-going propeller blade has a higher speed relative to the airflow than the upgoing blade, this produces more thrust for given angle of attack and leads to an asymmetric left yawing moment. As the tail is raised and the propeller's plane of rotation becomes more perpendicular to the relative airflow the asymmetric blade effect reduces towards zero.

- Gyroscopic precession: as the tail is raised, a force is applied to the top of the propeller disc in a nose-down sense. The resulting gyroscopic precession force induces yaw/swing to the left.

Analysis

Despite the difficulty experienced by the pilot when initially starting the engine, eyewitness reports indicated it was operating normally throughout the brief flight. CCTV evidence was inconclusive, but the aircraft did not appear to have its wing flaps selected down for takeoff. The Owners' Handbook stated that the power off stalling speed with flaps retracted would have been approximately 41 kt at maximum takeoff weight, but did not contain a means for interpolating stalling speeds based on gross weight, or intermediate flap settings. Applying the 16% stall speed reduction stated in the vortex generator Supplemental Type Certificate documentation to the OH figures, would give a power off stalling speed of 34.5 kt in the clean configuration.

The investigation did not find conclusive evidence to explain why the pilot lifted off at 34 kt groundspeed or for the steep climb and apparent loss of effective control. The investigation considered the aircraft's ground roll track converging with the electrified fence bordering the southern edge of the runway (Figure 11) could have been a contributory factor if the pilot decided to lift off earlier than perhaps he originally intended.

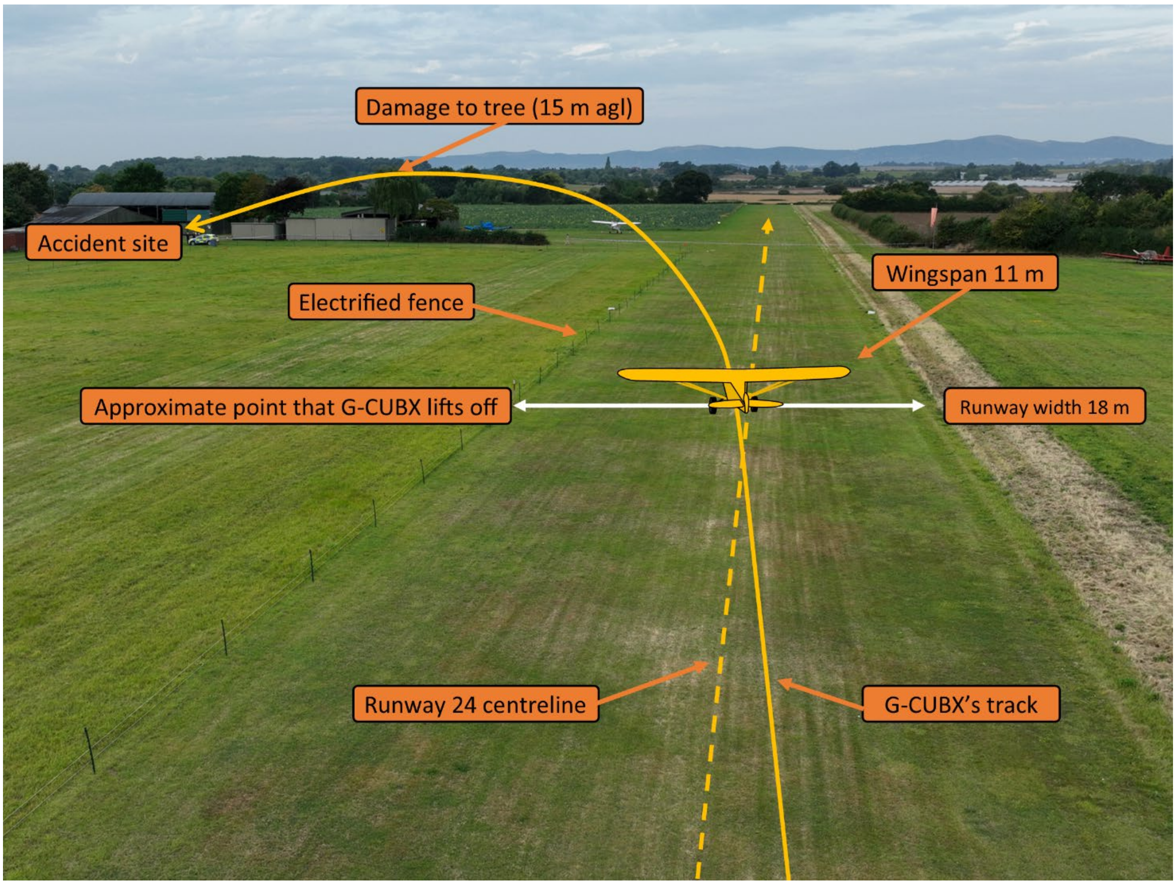

Figure 11

G-CUBX's approximate ground track and flightpath (aircraft drawn to scale)

Getting airborne at relatively low speed, potentially without wing flaps deployed and in a semi-stalled condition, would likely have generated only limited aerodynamic control authority for the pilot to correct the heading divergence which appears to have occurred almost immediately after lift-off. Applying right aileron to level the wings could have led to adverse aileron yaw exacerbating any tendency for the aircraft to swing and roll left. Using right rudder, rather than aileron, to correct the heading divergence would have been an appropriate action, although limited aerodynamic directional control authority would have made such a correction more difficult. The investigation considered it likely some of the adverse factors pre-disposing the aircraft to swing left on takeoff were contributory factors in the pilot not being able to re-establish a safe longitudinal trajectory. However, lacking evidence to support detailed analysis, it was not possible to reach a definitive conclusion in this regard.

Once the aircraft had started turning left towards the trees and buildings the pilot needed to reverse the turn or climb to avoid a collision. As the aircraft climbed through approximately 11 m any lift benefit from ground effect would have been lost and being in a turn would have further compromised the aircraft's achievable rate of climb.

At very low height and heading toward obstructions, pulling up to try and clear the obstacles would have been an instinctive pilot reaction. Given that twigs were found in the tail wheel landing gear it is very likely that the aircraft was not able to avoid the trees.

There were no pre-existing mechanical issues identified with the aircraft during detailed examination after the accident that would explain the deviation from the runway centreline or the subsequent circumstances leading to the accident. Evidence from eyewitnesses, CCTV footage and ground marks, plus the damage caused to the engine and propeller, indicate that the engine was under power when the ground collision occurred.

Conclusion

G-CUBX tracked to the left on the runway during takeoff and within two seconds of getting airborne it was in a left turn tracking toward obstacles south of the runway; one of these obstacles was the tree which G-CUBX appears to have struck at the apogee of its flight path. It was not possible to conclusively establish why the aircraft diverged left during and after takeoff. Nonetheless, the investigation considered it likely the relatively low lift off speed contributed to the pilot having insufficient aerodynamic control authority to effectively counter the flight path divergence. Being in a turn rather than wings level would have compromised the aircraft's climb rate resulting in it being unable to climb above the obstacles in its flight path.

The investigation was unable to find evidence of any pre-accident fault with the aircraft.

Published: 29 May 2025.