ACCIDENT

Aircraft Type and Registration:	Skyranger Nynja 912s(1), G-CGWL
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2011 (Serial no: BMAA/HB/601)
Date & Time (UTC):	9 December 2017 at 1233 hrs
Location:	Plaistow Farm Airfield, Hertfordshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Student Pilot
Commander's Age:	58
Commander's Flying Experience:	39 hours (of which 28 were on type) Last 90 days - 10 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

A student pilot had completed a successful dual circuit check with his instructor and was departing for a planned solo flight. After takeoff the aircraft was seen to climb steeply to a height of 100-300 ft agl before the left wing dropped. The aircraft then struck the ground in a steep nose-down attitude. The pilot was fatally injured. It is considered the accident was caused by the aircraft stalling, although a cause for this could not be determined.

History of the flight

The student pilot arrived at Plaistow Farm Airfield on the morning of the accident for a planned flying lesson. He met with his instructor who briefed him for a dual flight conducting circuits to be followed by a short solo general handling flight in the local area if the dual flight was satisfactory. The instructor stated that the brief included discussion of the increased aircraft performance the student would experience when flying solo due to the reduction in aircraft weight.

At approximately 1145 hrs, the student and instructor took off and completed four circuits, one of which included a practice engine failure. The instructor reported that the student's flying was good throughout and that the instructor did not need to make any inputs or corrections.

After the final circuit, the aircraft was taxied clear of the runway and the engine left running whilst the instructor re-briefed the student for the solo flight, as previously planned. The instructor exited the aircraft and at approximately 1230 hrs the student taxied to the threshold of Runway 30 and took off.

Five witnesses watched the aircraft at some stage during its takeoff and initial climb. The instructor reported seeing the aircraft appear to rotate normally before he lost sight of it behind some buildings. Others reported seeing the aircraft climb steeply and that at between 100 - 300 ft agl the left wing dropped and the aircraft turned to the left. The nose then dropped and the aircraft descended towards, and then struck, the ground in a steep nose-down attitude. None of the witnesses remember any unusual engine noises or hearing the engine stop. They quickly arrived at the accident site to provide help, but the student had been fatally injured in the impact.

Accident site

The aircraft had struck the ground within the airfield on Runway 15/33 (Figure 8), approximately 130 m from the threshold of Runway 15. Prior to the arrival of the AAIB, the aircraft had been moved several metres and the wreckage disturbed by the first responders.

A photograph taken by a witness immediately after the accident showed the aircraft nose-down in a near vertical attitude with its Brauniger Multi-Functional Display (MFD) and broken perspex from the canopy on the ground in front of the aircraft. There were no other items from the cockpit on the ground around the aircraft. Other photographs showed that following the accident the pilot's flight bag, headset, fire extinguisher, map and other personal items had been removed from the aircraft. The aircraft battery had also been removed and the fuel tank selector valve had been moved to the OFF position.

From the impact marks, it was established that the aircraft struck the ground on a heading of 140° (M). Both wings were level and there was no evidence of the aircraft rotating or spinning. The aircraft structural tubes supporting the engine mountings had failed during the impact and the floor tubes had been driven into the ground at an angle of 50° to the horizon (Figure1). There was a significant amount of oil in the area of the engine and two of the three propeller blades had broken off and were lying next to the hub. There was also a strong smell of fuel in and around the aircraft.

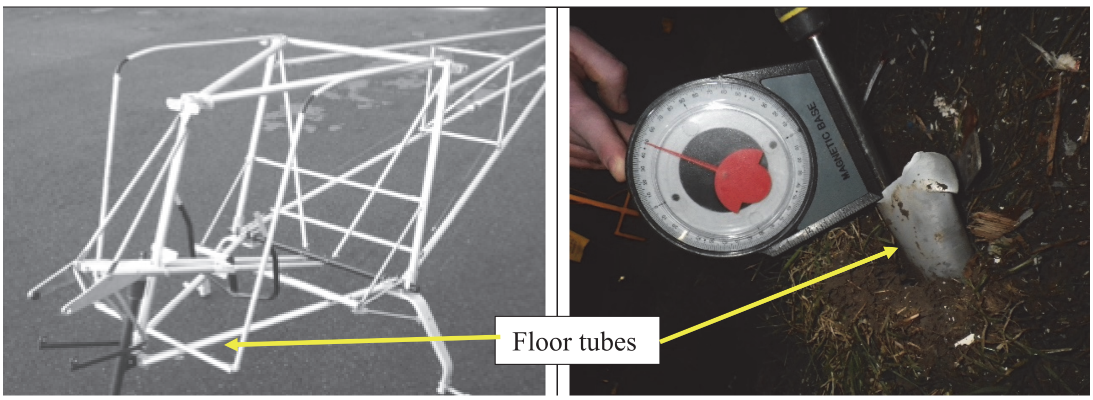


Figure 1

Floor tubes driven into the ground

Aircraft information

General

The Skyranger Nynja (Figure 2) is a high-wing, three-axis microlight aircraft certified in the UK to the requirements of British Civil Airworthiness Requirements (BCAR) Section S. It is fitted with conventional flying controls, three-stage flaps and a fixed landing gear with nosewheel steering. It has two seats with the occupants sitting side-by-side, each secured by a four-point harness. A luggage bag, with a zipped flap access, is fitted above the fuel tanks behind the pilot's seat.

The aircraft is supplied as a prefabricated kit, containing all the required components ready for assembly. It is constructed of straight aluminium tubes that are bolted together and the wings and fuselage are braced with cables (Figure 3). The wings and empennage are covered with Xlam laminate fabric and the fuselage with non-structural glass fibre panels.

Figure 2

Skyranger Nynja G-CGWL

G-CGWL

G-CGWL was registered on 21 February 2011 and operated on a CAA Permit to Fly, administrated by the British Microlight Aircraft Association (BMAA). The last Permit Certificate of Validity was issued on 9 May 2017 and was valid until 7 May 2018. As part of the Permit to Fly Revalidation, a flight test was undertaken on 7 May 2017 during which the following parameters were recorded:

Engine Max Static rpm	*4,900 rpm*
Climb rate @ 445 kg	*1,200 fpm*
Stall speed flaps up	*<32 kt*
Stall speed flaps down	*<32 kt*
Approach and Landing	*Satis*

G-CGWL was initially constructed for use in competition flying and the BMAA had authorised[1] several changes to the standard configuration, a number of which were aimed at saving weight. These modifications included the introduction of a single set of rudder pedals, single throttle, a fuel flow computer, smaller instrument panel and a Pegasus and Mainair fuel leaning modification. On 28 March 2016, at 484 airframe hours, the standard Nynja dual rudder pedals and throttle were installed to allow the aircraft to be used for pilot training.

Figure 3

Aircraft structure (Image from Aircraft Build Manual)

Flying controls

The flying controls were operated by cables and control rods with a single control column mounted on the structure between the seats. The rudder pedals controlled the movement of the rudder, via cables, and the nosewheel steering, by torque tubes connected to the nose landing gear leg. The aircraft was also equipped with three-stage flaps (up, takeoff and landing), which were manually operated and locked in place by a latch mounted on the operating lever. The aircraft could be manually trimmed in pitch by a lever mounted on a tube between the seats. Movement of the trim lever was transmitted through a cable to a trim tab on the right elevator which was reacted by springs attached to the elevator.

Engine and aircraft fuel system

G-CGWL was fitted with a Rotax 912 ULS four stroke piston engine, which powered a Kiev three-blade fixed pitch propeller through a reduction gearbox. The engine was fitted with twin Bing carburettors which, for competition purposes, had been modified to allow the fuel mixture to be leaned in flight.

The aircraft fuel system consisted of two 30 litre polyethylene fuel tanks, one mounted behind each seat. Fuel was fed from each tank through a three-position tank selector valve (OFF, LEFT, RIGHT) and an in-line fuel filter to the engine-driven fuel pump. An anti-vapour lock, fuel return line was fitted between the outlet side of the fuel pump and the carburettors

Footnote

1 Microlight Airworthiness Approval Note (2348) on 15 April 2011.

through a restrictor to the right fuel tank. For competition flying, G-CGWL had been fitted with a fuel computer and an additional fine fuel filter installed in the aircraft fuel system downstream of the inline fuel filter. A bypass valve situated between the seats allowed the fuel to bypass the computer and fine filter. The standard practice at the flying school was to fly with the bypass valve OPEN so that the fuel from the tanks did not flow through the computer or additional fuel filter.

Brauniger Alpha Multi-Function Display (MFD)

G-CGWL was equipped with a digital MFD fitted to the centre of the instrument panel in the cockpit. The MFD used a Liquid Crystal Display (LCD) to provide the pilot with the following information:

- fuel quantity
- aircraft airspeed
- altitude
- vertical speed
- engine rpm
- engine oil temperature
- water coolant temperature
- cylinder head and exhaust gas temperatures
- oil pressure

The airspeed and vertical speed were presented as analogue indicators; the altitude, engine speed, temperatures and pressure were displayed as numerical values; and the fuel quantity as a bar graph.

Figure 4

Brauniger Alpha Multi-Function Display showing vertical speed and airspeed

The MFD provided a visual alert to the pilot if the airspeed or engine parameters exceed set limits. If an engine exceedance was detected, a red warning light located at the top left of the MFD and the associated temperature readout on the LCD, slowly flashed. If the airspeed was either below or above set limits, the red warning light flashed more quickly. The MFD also had the ability to provide an audible alert that accompanied the visual alert. This audio function was not installed on G-CGWL.

The alert thresholds set for G-CGWL were:

- airspeed less than 22 kt
- airspeed greater than 150 kt
- exhaust gas temperature (EGT) greater than 850 °C
- cylinder gas temperature (CHT) greater than 135 °C
- oil temperature greater than 130 °C
- water temperature greater than 120 °C
- engine speed above 5,800 rpm
- oil pressure less than 1.5 bar
- oil pressure greater than 6.0 bar

If external electrical power to the MFD was lost in flight, a back-up battery installed within the MFD automatically provided electrical power that enabled the unit to continue to operate for several hours. The voltage of the integral battery was tested each time the MFD was powered on. If the voltage was detected as being low, a warning was presented on the MFD. The battery from the MFD installed in G-CGWL was removed and tested and found to be within normal parameters.

Stall warner

As typical for this type of aircraft, G-CGWL was not fitted with, nor required to have, an artificial stall warning device.

Aircraft examination

An examination of the aircraft and engine was carried out by the AAIB at the accident site and at their facilities at Farnborough.

General

G-CGWL had been constructed and assembled to a high standard and appeared to have been well maintained.

The forward section of the aircraft and the cockpit area had been badly damaged in the impact. Both seats and the seat harnesses were intact, however, the tube which supported the forward edge of the seats had failed in overload. The student had been sitting in the left seat and the AAIB was advised that his harness had been unbuckled by the first responders. The harness on the right seat had been fastened and the straps fully shortened. The luggage bag was intact and was found by the AAIB with the access flap unzipped.

Due to the damage to the aircraft it was not possible to establish the integrity of the pitot-static system.

Structure

Several of the structural tubes had failed, or were bent, and some of the connecting bolts had sheared. Both forward wing struts had failed and the leading edges of both wings were bent rearwards with distortion around several of the bolt holes. The right wing had sustained slightly more damage than the left wing with its trailing edge tube also being bent rearwards. One bracing wire in the right wing had failed in overload. The right main landing gear had rotated rearwards as a result of the steel torque tube in the fuselage having buckled during the impact.

All the structural damage was consistent with the impact and there was no evidence of any pre-existing failures.

Flying controls

With the exception of the right rudder cables, all the flying control cables were still connected. The rudder pedals had been badly distorted in the accident and the torque tubes that connect the rudder pedals to the nosewheel steering tube had buckled. The head of the bolt that secured the rudder and stop cable to the right rudder pedal had sheared. Damage to the rudder steering torque tube indicated that it was the distortion of the torque tube during the accident that caused the head to shear from the bolt.

All the control cables and rods moved freely and there was no visual damage to indicate that a control restriction had occurred prior to the accident.

The elevator trim control lever and cable were still intact and the lever was found in the forward (nose-down) position. However, the lever may have been inadvertently moved by the first responders.

The flap operating lever had failed in overload as a result of a force having been applied from the left side of the lever. Marks on the front of the lever were consistent with normal operating wear marks. However, there was a fresh scratch in the paint on the right side of the lever, adjacent to the second flap latching position (Figure 5).

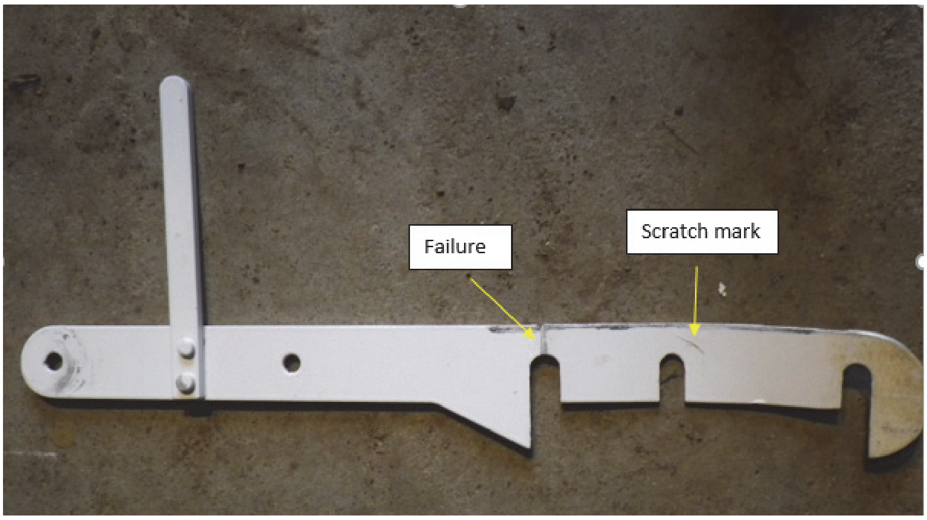


Figure 5

Flap operating and latching lever

The scratch mark on the flap operating lever aligned with the edge of the latching bracket, which corresponded with the flaps being at the takeoff (Flap 15°) position (Figure 6).

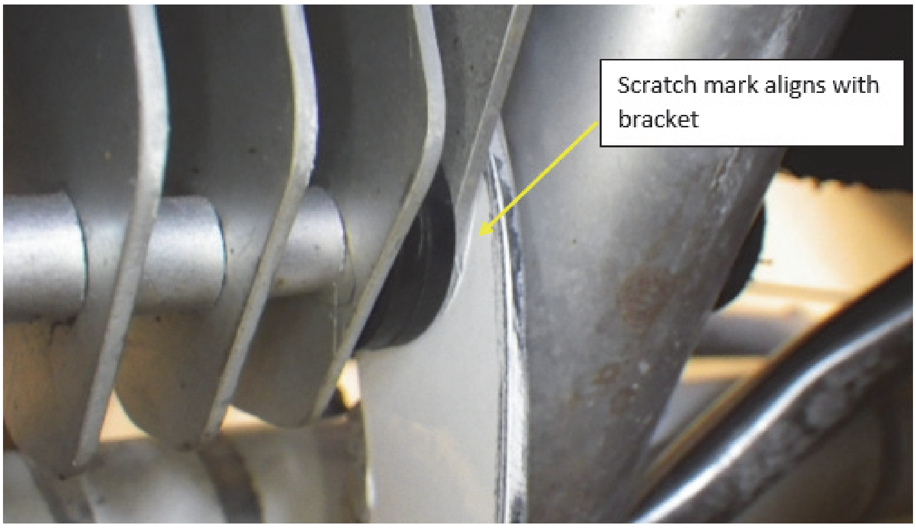


Figure 6

Alignment of the scratch on the flap operating lever with the latching bracket

Fuel system

The AAIB was advised that the fuel tank selector valve was moved to the OFF position following the accident. The fuel computer bypass valve was found in the OPEN position. Both fuel tanks had been punctured during the impact, nevertheless, 2.5 litres of fuel were recovered from the left fuel tank which was tested and found to contain approximately 4.5% ethanol (by volume) which is within the permitted specification for Mogas.

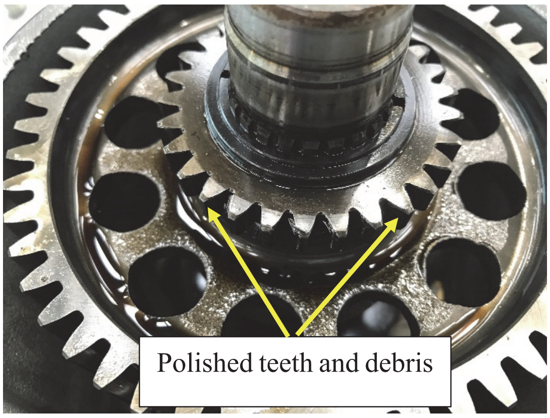
The in-line and fine fuel filters contained a small amount of debris that was considered normal. Fuel was found in all the fuel lines, both carburettor bowls and the fuel pump. The diaphragm in the fuel pump was intact and the pump ejected fuel, under pressure, when manually operated.

Engine

The engine could not be turned by hand and some components and wiring on the outside of the engine had been damaged during the impact.

Following the removal of the reduction gearbox and spark plugs, the engine was free to rotate by hand and the valve assemblies, water and oil pumps all operated normally. The engine was disassembled and clean lubricating oil was found throughout the engine. All the components were in a satisfactory condition and the colour of the cylinder heads and spark plugs indicated that the engine had been operating normally. Both carburettors had been damaged externally, however, the throttle valves and pistons were free to move and the jets were clear of debris. Visually, all the electrical components, harnesses and spark plug leads appeared to have been in a good condition prior to the impact. There was no significant debris in the oil filter and the small amount of debris captured by the magnetic plug in the sump was considered to be normal.

There was a small amount of debris between five of the teeth on the small gear in the reduction gearbox which was used to drive accessories such as a vacuum or hydraulic pump, however, this drive was not used on this engine. The sides of the teeth had a polished appearance which corresponded with a polished area on the engine casing that extended across an arc of approximately 80° (Figure 7). It was assessed that this damage occurred during the impact because of the propeller drive shaft being pushed into the reduction gearbox, causing the sides of the teeth to contact the engine casing. It was this contact, and possible distortion of the reduction gearbox casing, that had prevented the engine from being rotated by hand during the initial inspection.



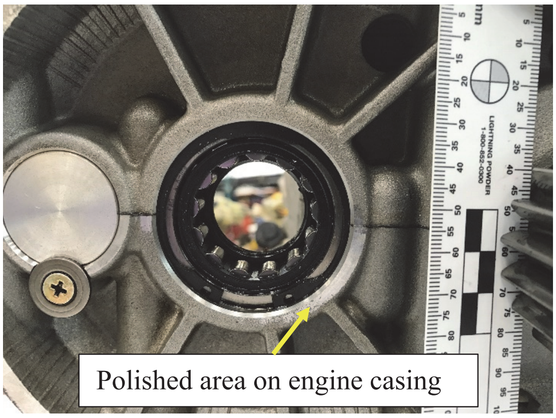


Figure 7

Contact between accessary drive gear and engine casing

Propeller blades

Two of the three propeller blades had failed at the hub and were damaged part way along their span. While the failure of both blades was consistent with the engine contacting the ground at a steep angle, there was no physical evidence of the propeller being driven under power when it struck the ground. This may be explained by the low inertia of the engine.

Recorded information

The MFD had an internal recording function which monitored engine rpm, altitude and airspeed to determine the start and end of a recording period. Each recording started once the engine has been running for one minute and the MFD detected an increase in altitude of about 75 ft, indicating that the aircraft had taken off. The recording ended once the engine had stopped with an airspeed less than about 27 kt and with no change in altitude detected for a subsequent period of approximately 30 seconds.

The MFD recorded flight duration reflected the time that the aircraft had climbed above 75 ft and the airspeed remained above 27 kt.

Recorded information was recovered from the MFD for the accident flight and the 23 previous flights dating back to 3 October 2017. This data provided a peak value of airspeed, altitude, vertical speed and engine parameters (except oil pressure). The recording logic meant that the four previous circuits and the accident flight were combined into one recording period. It was not possible to determine at what point peak values occurred during the recording period.

The data for the previous dual circuit check and accident flight indicates that the engine had been running for a total of 40 minutes, including 17 minutes of flight. The engine was started at approximately 1150 hrs and the first takeoff was logged at 1157 hrs. Table 1 provides the peak values recorded during the period of the four circuit flights and the accident flight.

Rate of climb ft/min	Rate of Sink ft/min	CHT °C	EGT Sensor 1 / 2 °C	Water temperature °C	Oil temperature °C	Engine rpm	IAS kt	Altitude ft
+1,000	-1,000	63	776 / 785	59	65	4,980	72	806

Table 1

Peak parameter values recorded during the circuit flights and accident flight

The maximum recorded altitude of 806 ft and airspeed of 72 kt were consistent with the reported circuit altitude and speed provided by the instructor from the circuit check flight with the student. The maximum recorded rate of climb of 1,000 ft/min was within the climb rate range recorded on previous flights of between 950 -1,950 ft/min.

None of the recorded engine data, including that of accident flight, had exceeded the pre-set alert thresholds.

Personnel

Student pilot

The student had started training for a BMAA National Private Pilot Licence (NPPL) at Plaistow Farm Airfield in April 2017. His logbook recorded that prior to this date he had completed three dual flights, totalling 2.5 hours, in a Skyranger microlight at another airfield. A separate logbook discovered after the accident recorded that the pilot had also previously completed 16 hours of dual instruction on a Cessna 152 between February and September 2016, again at a different airfield.

The student's training was to the BMAA NPPL syllabus and he had completed 40 training flights at Plaistow Farm Airfield totalling 36.5 hours. Nine flights had been completed on a Eurostar EV97 and the remaining 31 flights on G-CGWL, the Skyranger Nynja involved in the accident. He had flown with two instructors during his training at the airfield who both described him as a good student.

The student's training records show normal progress through the syllabus. He first flew solo on 19 November 2017 after completing 33.5 hours of training, which his instructor considered normal for a student pilot of his age. His logbook recorded that on this occasion he flew three circuits, totalling 35 minutes.

The student's only other solo flight was on 2 December 2017, seven days before the accident, when it was recorded that he had flown a 30-minute flight consisting of circuits and general handling.

The student's training records show he completed a stalling lesson in April 2017 on the Eurostar EV97 which was revised in a further lesson in May 2017 on the Skyranger Nynja. The AAIB was informed that other stall revision might have be included as part of subsequent lessons conducted, as for instance would be the case for practice engine failures.

Instructor

The instructor had held a UK NPPL with a microlight rating since November 2013, prior to which he had flown microlights overseas. He had held a UK Flight Instructor Rating (microlight) since April 2014 and had instructed at Plaistow Farm Airfield since that time. His logbook showed he had completed 1,628 hours as pilot in command, including 1,290 hours as an instructor at the time of the accident.

Medical

The student had completed an appropriate medical self-declaration, valid at the time of the accident. The post-mortem did not reveal any medical issues which may be considered to have contributed to the accident.

Meteorology

Witnesses described the weather conditions at the time of the accident as good, with no significant cloud, good visibility and a crosswind on Runway 30 of 3 - 4 kt from the right. None of the witnesses described any significant wind gusts at the time of the accident.

The Met Office provided an aftercast (extract below) of the likely conditions in the area of the airfield at the time of the accident which was consistent with the witness descriptions.

> *'A light to moderate west-northwesterly surface wind, with mean speeds likely to be in the region of 8-10 kt, with the possibility of isolated gusts up to 20 KT at times. Initially, conditions were clear with nil cloud, but cold with a possible grass frost. The visibility associated with these conditions would have been good, potentially as much as 30 KM, but in excess of 10 KM at the very least. Conditions were dry throughout the period of interest, however cloud amounts began to increase by midday, with few amount of cloud with bases most likely to be around 2000 FT AMSL, and occasionally broken bases well above 5000FT.'*

Aircraft handling

Takeoff

The aircraft operator's manual describes the normal takeoff technique as:

> *'When lined up and rolling straight smoothly apply full power. Keep straight with rudder, ailerons neutral and with the elevator slightly up to reduce the weight on the nosewheel. When the airspeed rises to 45 knots CAS rotate and lift off and adopt a shallow climb attitude. Allow the airspeed to rise to 60 knots CAS and adopt a climbing attitude to hold this airspeed.'*

The flying school trained students not to focus solely on the airspeed as a reference during takeoff, but to hold the stick neutral, or slightly aft of neutral (elevator up), during the takeoff roll and that the aircraft would then naturally lift off at approximately 45 kt. Students were further taught that once airborne they should allow the aircraft to accelerate to the climb speed of 60 kt before increasing pitch sufficiently to maintain this speed as they climbed away.

The aircraft required right rudder to be applied during the takeoff roll and initial climb to counter the slipstream and torque effect created at full power.

Pitch trim

For takeoff, pitch trim was required to be set in the mid-range position. During landing, balanced flight normally resulted in a fully aft trim position. If the aircraft takes off with fully aft trim applied this is likely to result in the aircraft lifting off at a lower speed than normal and a tendency to climb at a higher pitch angle, unless the forces are counteracted by the pilot.

Slow flight and stall

An aircraft stalls when one or both wings' angle of attack exceeds a critical angle causing the separation of airflow over the wing and a loss of lift. For a fixed pitch angle, the angle of attack increases as the airspeed reduces. Thus, during slow flight an aircraft is more susceptible to stalling.

The operator's manual described the characteristics of slow flight as:

- Lightening of controls accompanied by reduced effectiveness
- Reduced airflow noise (most noticeable at low power settings)
- High nose attitude (most noticeable at high power settings)
- Rearwards position of control stick and back pressure
- Strong pitch buffet as the incipient stall is entered
- A tendency to roll or wing rock accompanying the buffet

The stall was described as:

> *'Wings Level, Power Off*
>
> *Max pitch attitude is 45^{0}, and stall warning is given about 2 knots above the stall by buffet. Stall is normally marked by a mushing descent in heavy buffet or nose drop.*
>
> *Wings Level, Power On*
>
> *Characteristics are similar to the power off case. An additional warning of the approaching stall is the attitude of the aircraft. With full power set the aircraft stalls at a very high nose attitude.*
>
> *Because of the increased slipstream and torque effect at high power settings considerable rudder deflection may be required to keep in balance as the stall is approached. Stalling out of balance can result in considerable wing drop.'*

Aircraft Checklist

The aircraft was not supplied with a type-specific checklist, although the operator's manual contained information on generic checks.

It is common practise for microlight pilots to memorise mnemonic checklists. The training school produced a printed checklist for students to memorise for this purpose. It was noted during the investigation that there was no reference in this checklist to the flaps under the pre-takeoff checks. The instructor stated that students were taught to incorporate a check of the flap position as part of the trim check that was listed.

There was also no specific after-landing check documented in the operator's manual, or used by the flying school. Due to the nature of the airfield, touch-and-go landings were not performed and, after landing, aircraft were taxied back to the threshold if taking off again. Students were taught to re-configure the aircraft for takeoff during the taxi to the threshold, however this was done without reference to the pre-takeoff check mnemonic.

Airfield information

Plaistow Farm Airfield is an unlicensed airfield used primarily by microlight aircraft. The airfield has two intersecting grass runways: Runway 12/30 (329 m x 20 m) and Runway 15/33 (357 m x 20 m) (Figure 8).

Figure 8

Plaistow Farm Airfield, Runways 12/30 and 15/33 with accident site marked

Circuits are flown to the south of the airfield at 800 ft agl. The prevailing winds are westerly with Runway 30 normally used for takeoff as, although it is the shorter runway, it does not have a significant upslope. Runway 33 has an upslope and, due to this and its longer length, is normally used for landing. After takeoff from Runway 30 aircraft have to make a slight turn to the right to avoid powerlines which run close to the southwest of the airfield to a height of 200 ft agl. There is also a number of trees close to the airfield boundary which can affect the approach.

Aircraft performance

The aircraft operator's manual stated that:

> *'the Nynja can be flown with any permitted fuel, pilot and passenger weights without falling outside of its permitted CG limits.'*

The estimated take-off weight for the accident flight was 360 kg, which was within the permitted MTOW of 450 kg. This was approximately 18% lighter than the take-off weight during the previous flight, significantly enhancing performance. During the initial climb, the aircraft would have been able to climb more rapidly and would have had to adopt a higher nose attitude to maintain the recommended climb speed.

Demonstration flight

A flight conducted by a BMAA test pilot in a Skyranger Nynja similar to G-CGWL demonstrated that if the aircraft was stalled, with Flaps 15 and full power set in balanced flight, it did not have any tendency to drop a wing. However, if the aircraft was stalled in the same configuration but with insufficient right rudder applied, the aircraft would drop the left wing and turn to the left. Typical height loss to recover was approximately 100 ft.

Analysis

The ground marks and damage to the aircraft indicate that the aircraft struck the grass runway in a nose-down attitude at an angle of 50° to the horizon on a heading of 140° (M), the aircraft having turned through approximately 160°. The right wing and main landing gear sustained slightly more damage than the left side of the aircraft, however, there was no physical evidence that the aircraft had been rotating or spinning on impact.

Witness descriptions of the aircraft were consistent with it stalling shortly after takeoff. Take off requires right rudder to be applied and it was demonstrated that if insufficient right rudder is applied, a stall can lead to the left wing dropping and the aircraft turning to the left.

A number of factors were considered in trying to establish the cause of the aircraft stalling or if any other situation might have led to the aircraft behaving as described.

Aircraft engine and structure

The aircraft had been built to a good standard and there had been no reported problems with either the aircraft or engine. The instructor who flew the four circuits with the student prior to the accident flight stated that the aircraft and engine had been operating normally. Witnesses also reported that the engine sounded normal during the accident flight. The data download from the MFD did not identify any unusual engine parameters and an examination by the AAIB could not identify any reasons why there might have been a loss of power. There was sufficient fuel on the aircraft to complete the flight, the fuel filters were clean, the fuel valves were open and the ethanol content of the fuel was within acceptable limits for the engine. The lack of rotational damage to the propeller blades can be explained by the attitude that the engine struck the ground. The damage to the sides of the five teeth in the reduction gearbox accessory gear drive and the engine casing is evidence that the engine had been rotating when the propeller hub struck the ground.

It was assessed that the flying controls were intact prior to the impact and there was no evidence of a control restriction or failure. The wreckage had, however, been disturbed and personal items of equipment removed by the first responders prior to the arrival of the AAIB. It was therefore not possible to exclude the possibility that an item of personal equipment had restricted the movement of the flying controls.

Aircraft configuration

It was considered possible that the student had not re-configured the aircraft appropriately after landing for the subsequent takeoff, which may have caused the aircraft to rotate early at low speed and to have climbed more steeply than normal. This would have made it susceptible to stalling.

Evidence from the aircraft wreckage however indicates the aircraft took off with the correct flap setting and the instructor stated he believed the rotation appeared normal. The position of the trim lever during takeoff could not be determined and it is therefore not known whether this had contributed to the aircraft's subsequent steep climb.

The flying school considered their students were all adequately trained to configure the aircraft properly prior to takeoff. In order to reinforce this they have now updated their printed checklist to specifically include the flaps and have added '*Subsequent Takeoff Checks'* to be completed between landing and the next takeoff.

Medical

The post-mortem revealed no evidence of the student suffering any medical incapacitation and the pilot appeared well during his time at the airfield. It remains possible however that any incapacitation remained undetectable.

Weather

The weather conditions reported at the time of the accident were suitable for the flight and are unlikely to have contributed to the aircraft stalling.

Aircraft handling

The student was considered to fly to a good standard and had just demonstrated to his instructor his ability to fly circuits without the need for any intervention. Whilst this was only his third solo flight, he had previously conducted a number of solo circuits. The last occasion he flew solo was only a week before the accident giving him recent experience of the aircraft's reduced takeoff weight and relative increase in performance. These flights had gone apparently without incident.

Despite this, and whilst there is no objective means of determining how he handled the takeoff, it is possible that the increased aircraft performance created by flying solo led to the student climbing more steeply than normal; sufficiently so to cause the aircraft to stall. Had insufficient rudder been applied at the time to counter the effects of the full power applied at takeoff, this could have then led to the wing drop, as witnessed.

The student had received training in both recognising and recovering from the stall. The last lesson recorded was however some seven months before the accident. It would seem sensible to ensure stall training is revised at appropriate intervals although as this needs to be fitted in alongside other training priorities, defining what is appropriate remains subjective. Had the student received more recent stall training, it is still likely that as the apparent stall occurred so soon after takeoff it would have taken him by surprise. The demonstration flight indicated that even had the stall been recognised, it is probable that there was insufficient height available for recovery.

Conclusion

The investigation did not identify any technical faults with either the aircraft or engine. It is probable the accident was caused by the aircraft climbing sufficiently steeply after takeoff to induce a stall. The cause of the steep climb could not be determined. The possibility of incorrect trim setting, control restriction or incapacitation could not be fully eliminated. It is possible insufficient right rudder had been applied to counteract the effects of the high power set and that this led to the left wing dropping as the aircraft stalled. It is likely the aircraft was too low for a stall recovery to be possible.