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FINAL REPORT

**ON ACCIDENT OF THE AIRCRAFT
CESSNA 172, REGISTRATION HA-SKL**

**28 JUNE 2022,
ISLAND OF BRAČ**



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OCCURRENCE INFORMATION

Type of the occurrence:	Accident
Date:	28 June 2022
Local time:	09:21
Place:	Blaca monastery canyon, island of Brač, Croatia
Type of the aircraft:	Aeroplane
Manufacturer / model:	Cessna/172M
Registration:	HA-SKL
Owner:	Flycoop Legiszolgatato Ltd
Operator:	Aero Murvica j.d.o.o
Number of persons on board:	Three
Injuries:	Serious bodily injuries
Damage to the aircraft:	Destroyed

INVESTIGATION

The Air, Maritime and Railway Traffic Accident Investigation Agency (AIA) received information on the accident from the Operational Communication Center of the Ministry of the Interior (OKC-MUP) and Croatia Control and opened a Safety Investigation.

The Safety Investigation determined the cause of the accident: stalling due to reduced speed and increased climbing angle.

AIA issued general safety recommendations to general aviation pilots.

SUMMARY

On 28 June 2022 around 09:21 LT (LT - Local Time), during a panoramic flight, the aircraft in question crashed into the so-called area of the Blaca monastery on the island of Brač. There were three people on board, the pilot and two passengers. During this event, the three mentioned persons sustained physical injuries, but out of danger.

1. FACTS AND INFORMATION

1.1. FLIGHT INFORMATION

The flight in question was duly announced in the flight plan. It was a VFR circular panoramic flight along the coast of the island of Brač, in which, in addition to the pilot, two passengers also took part.

The pilot arrived at Brač Airport around 08:30 LT that morning and he done the usual preparation and check of the aircraft.

After that, two passengers boarded the aircraft and took off at 09:10 LT for the panoramic flight in question.

The approved altitude was 2,500 ft, and communication with air traffic control took place properly.



After taking off the aircraft flew towards the town of Bol, made a circle near Bol above Zlatni Rat and then headed towards the Blaca monastery.

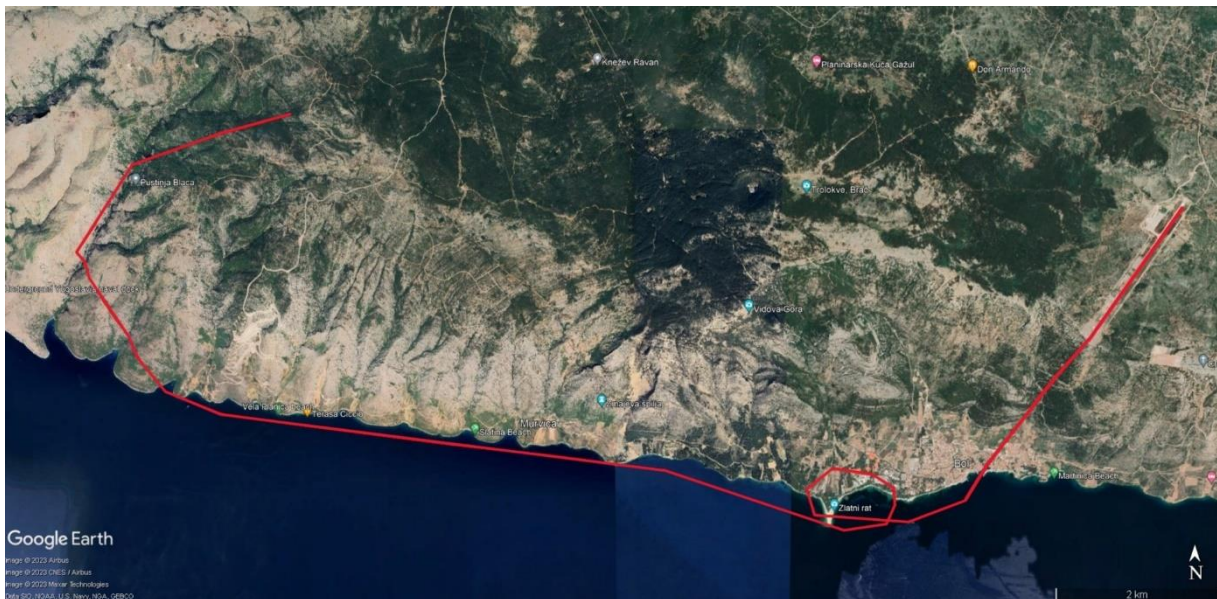
The aircraft entered the gorge where the mentioned monastery is located and flew through the gorge at approximately half the height of the gorge. In the video recorded by the passenger and made available for the purpose of the safety investigation, can be seen that when the aircraft passed by the monastery, it was at an altitude slightly higher than the monastery and that the ridges of the side slopes of the gorge were above the altitude at which the aircraft was flying.

After passing the monastery, the aircraft continued to fly through the gorge towards the interior of the island and in the upper part of the gorge “landed” on the left side slope of the gorge (the left slope viewed in the direction of the flight).

Immediately after the rough landing, the pilot and passengers, injured but mobile, exited the aircraft. The pilot then used his mobile phone to inform control about the situation and requested help.

After the take-off and until the moment of the accident, the pilot did not communicate with the control by radio. According to the controller's instructions, he should have reported when he reached Pučišće, which was one of the points on the planned flight route and was located after the Blaca monastery and the accident site.

The whole flight lasted about ten minutes.



Picture 1 – the flight path of the aircraft in question

1.2. INJURIES

Injuries	Crew	Passengers	Other
fatal	0	0	0
serious	1	2	0
minor / none	0	0	0

1.3. DAMAGE TO THE AIRCRAFT

During the accident in question, significant material damage was caused to the aircraft in the form of complete cracking of the structural elements of the fuselage and wings of the aircraft, their joints and the landing gear.

The left wing was partially torn from the fuselage at the joint of the shoulder blade and was laid parallel to the longitudinal axis of the aircraft. The plating of the left wing was partially torn from the structure of the wing itself, and the fuel tank was visible, which also cracked in several places. Along the entire wing, damage to the plating in the form of bending and cracking was established. The leading edge of the wing along its entire length had damage typical of its passage through trees or vegetation, i.e. longitudinal dents were visible. The left-wing strut was bent backwards and laid down. The left-wing flap was found in the retracted position.



Picture 2 – The aircraft's left wing tank



Picture 3 – Bent left wing along the fuselage

On the right wing, dents are visible on the leading edge, and bending of the plating on the top of the wing near the junction with the fuselage is visible. Damages to the plating of the wing tip and aileron tip are also visible.



Picture 4 – The right wing of the aircraft



Picture 5 – The tip of the right wing of the aircraft

The windshield window frame of the aircraft cabin was completely cracked on the left side, and the pilot door frame was separated from the fuselage. The windshield and rear left window were completely blasted to pieces while the windows on the right side were not. The fuselage from the cabin to the tip of the tail was damaged in the form of bending of the plating, stringers and certain frames.

The front landing gear broke at the area of the upper part of the fork.



Picture 6 - Damage to the front of the aircraft



Picture 7 – Broken front landing gear fork

There are visible damages on both propeller blades caused by hitting an obstacle during its rotation. Bending of the crankshaft from the point of exit from the engine block to the propeller joint, is also visible.



Picture 8 – Bending of propeller arm no. 1



Picture 9 – Bending of propeller arm no. 2

1.4. OTHER DAMAGE

Due to the crash of the aircraft in question, there was minor damage to the vegetation in the immediate vicinity of the crash site in the form of broken branches from the tops of several trees through which the aircraft passed and cut and peeled bark from the tree hit by the rotating propeller of the aircraft.



1.5. PERSONAL INFORMATION

1.5.1. Pilot

Male person, Serbian citizen born in 1987. The pilot possesses a valid CPL(A) pilot's license with authorizations SEP (land)/IR, MEP (land)/IR, issued on 21 December 2018 by the Danish aviation authorities. The pilot also possesses a valid Medical Certificate without restrictions issued on 21 February 2022.

The pilot has a total flight time of 715 hours, the most on Cessna 172 type airplane. In October 2021, he flew on island of Brač in the action of oral vaccination of wild animals from the air and during this he achieved a flight time of 20 hours and 10 minutes, so this island and its orography were already known to him from before.

1.5.2. Passenger

Male person, German citizen. He vacationed and hiked on the island of Brač several times.

1.5.3. Passenger

Female person, German citizen. She vacationed and hiked on the island of Brač several times.

1.6. AIRCRAFT CESSNA 172 N SKYHAWK, HA-SKL INFORMATION

Type of the aircraft:	Aeroplane
Manufacturer / model:	Cessna /172M
Serial number:	17264904
Year of manufacture:	1975
Maximum weight:	1045 kg
Total flight hours (totalizer)	7207

Cessna 172 M is a high wing aircraft of metal construction. The landing gear is non-retractable, type tricycle. The fuselage contains two doors for entry of the pilot and passengers. This model of aircraft has four built-in seats. This aircraft is multi-purpose. Therefore, this aircraft can be used by private users for transport of passengers and baggage, by pilot training centres for training of pilots, as well as for other sports purposes. The aircraft was manufactured in America from 1973 to 1976. Textron Lycoming O-320-E2D engine of 150 hp was installed in this model of the aircraft.

The aircraft in question is registered in the Hungarian Register of Civil Aircrafts. The owner of the aircraft is a Hungarian company "FLY-COOP Aviation Services Ltd". At the time of the accident, the aircraft was leased to a Croatian company "Aero Murvica J.d.o.o."

A valid Certificate of Airworthiness was issued by the Hungarian civil aviation authorities in 2006 and an Airworthiness Review Certificate was issued on 6 January 2022 by the Hungarian CAMO organization Fly-Coop Kft, HU.MG.0056.

No irregularities or inconsistencies were established by the review of the aircraft's technical documentation.



1.7. METEOROLOGICAL INFORMATION

On 28 June 2022, on the route of the aircraft in question, meteorological conditions were favourable for flying. Considering the flight path of the aircraft and the orography of the terrain, an analysis of local meteorological conditions was performed, and their effect on the flight itself was considered.

The numerical model WRF (Weather Research and Forecast Model) ARW (Advanced Research WRF) was used to analyse the meteorological situation.

On the day of the accident, the synoptic map shows a field of high air pressure supporting stable weather. In such conditions, weak winds can be expected. Values of air temperature of 24°C and dew point of 12°C on the aircraft path indicate a low probability of carburettor icing.

Analysis of the prevailing winds and vertical wind speeds indicates that there were updrafts and downdrafts near the crash site, most likely caused by orography. The values of the downward currents are from 0.5 to 1 m/s, and by themselves do not represent danger. However, if the aircraft flies at a very low altitude below the top of the canyon, such downdraft can also threaten flight safety.

1.8. COMMUNICATION

During the flight, the pilot communicated via radio link with the competent air traffic control at the Brač Airport. By listening of the communication, it can be heard that the communication during taxiing, take-off and flight took place as usual. The pilot did not report any difficulties. At the end of the recorded communication, the controller calls the aircraft in question several times, with no response.

Immediately after the crash, the pilot called ARO (Air Traffic Services Reporting Office) Split by mobile phone to inform about the situation and request for help.

1.9. AIRPORT INFORMATION

Brač Airport is located on the island of Brač above Bol, at an altitude of 541 m. It is equipped for the receiving and dispatching of smaller commercial aircrafts with up to 100 seats during daylight and night. Commercial flights mostly take place only during the summer season.

Brač Airport is open all year round, however the flight control is only present at certain periods. During the absence of flight control at Brač Airport, communication takes place with the flight control of Split Airport.

The runway is asphalted, with length of 1760 m and orientation 04/22.

1.10. SEARCH AND RESCUE

After the crash, the pilot and passengers exited the aircraft and the pilot called ARO Split by his mobile phone, informed them about the accident and requested help.

Also, after the aircraft hit the ground, the ELT (Emergency Locator Transmitter) was activated. At 9:21 LT, the MRCC (Maritime Rescue Coordination Centre) received a signal from the ELT device which identified the aircraft and the coordinates of the position from which the ELT was transmitting. After checking with the Croatia Control and confirmation of the crash of the aircraft, a search and rescue operation was commenced.



The fire brigades - DVD Supetar and DVD Bol and Accident & Emergency Medicine Brač participated in the search and rescue.

The aircraft and all persons on board were found at 10:16 LT. Firefighters and Accident & Emergency Medicine members triaged and prepared the injured for transport and secured the aircraft against fire. After that, the injured persons were transported on stretchers through inaccessible terrain to the place where they were picked up by Accident & Emergency Medicine vehicles and taken to Brač Airport. From there, they were transferred by helicopter to Hospital in Split, where they were admitted to hospital treatment at 12:28 LT.

1.11. DESCRIPTION OF THE ACCIDENT SITE

The accident site is located on a slope above a gorge that stretches from the interior of the island to the seacoast. The side slopes on both sides of the gorge descend towards the bottom of the gorge, gently in the upper part, and steeper in the lower part.

The aircraft crashed on the upper part of the side slope of the gorge (the left slope viewed from the direction of arrival of the aircraft). The slope in that part is of a gentle inclination, of stony-grass type and overgrown with typical Mediterranean vegetation - pines, small deciduous trees and bushes.

1.12. CRASH AND WRECKAGE INFORMATION

1.12.1. Inspection of the aircraft at the accident site

AIA investigators performed an inspection of the aircraft and engine at the accident site, during which the following was established:

Instrument panel

The instrument panel was found with damages to the decorative mask that separated on the right side from the instrument panel itself. The markings on the switches are in Hungarian. QNH (Q-Atmospheric Pressure at NH-Nautical height) pressure set on the altimeter is 1018 hPa. The ELT device (Emergency Locator Transmitter) was on and was turned off upon the arrival of the AIA investigators.

It was established that the right rudder was cracked in the part where the shaft enters the instrument panel. The main switch and ignition switch were found in the off position. The fuel injection pump is in the depressed and secured position. The power lever was found in the fully retracted position i.e. the maximum power position, while the fuel mixture lever was also found in the retracted position i.e. the rich mixture position. The carburettor heating lever is in the fully retracted position, i.e. the carburettor heating is turned off. The fuel valve was found in the off position.

The flap control lever was found in the up position (Flap 0°) as was the flap position indicator also showing 0°.



Picture 10 – Instrument panel



Picture 11 – Fuel vent

Right wing

The right wing was found attached to the fuselage, and in the fuel tank of the said wing there was about a third of the fuel, which in colour and smell corresponded to the type of fuel Aviogas 100 LL and which is used as propellant fuel for this type of aircraft. No traces of fuel leakage were found on the right wing of the aircraft, including the filler cap, the drain valve and the fuel tank itself. The right wing flap was found in the retracted position.



Picture 12 – Retracted right wing flap



Picture 13 – The right wing of the aircraft

Left wing

An examination of the left wing revealed that there was no fuel in the tank. The steel cables of the control surfaces of the ailerons and flaps broke due to the separation of the wing from the fuselage.



Picture 14 – Left wing fuel tank

Aircraft fuselage

Due to the rupture of the front landing gear and the slope of the terrain, the aircraft fuselage was laid with the tail up, while the front part was on the ground. An inspection of the steel cables for controlling the depth and direction of the rudder revealed no technical defects that would affect the controllability of the aircraft in terms of depth and direction.



Picture 15 – Aircraft fuselage

Aircraft propulsion system

The engine was thoroughly inspected at the accident site. There were no visible signs of oil leakage on the engine linings. No signs of overheating were found on the engine, such as discoloration on the cylinders or the exhaust system. The crankshaft can be turned by hand. The same was bent from the gasket on the engine block to the propeller bearing, which is an indication that the engine was running at high rpm when it hit the obstacle.

Damage in the form of bending and scratches specific to the impact of the same into an obstacle at high engine revolutions, were found on the propeller. On the top cover of the engine, there were marks caused by the contact of the propeller with the same, most likely after bending of the crankshaft.

An inspection of the engine's oil system established that all associated components such as oil pipes and filters are without external damage, and that there were 7 litres of oil in the engine.

An inspection of the fuel system established that it was in good working order with no signs of leakages on the pipes or the carburettor. Fuel was present in the system itself, i.e. the pipes and the carburettor. The fuel drain valve and handle were found to be in good condition. The fuel valve is correct, i.e. it stops and lets fuel in the corresponding positions. The fuel filter itself is free of visible damage and dirt that could have affected the fuel flow. The fuel drain cup was found ruptured from the impact of the front of the aircraft to the ground, after the front landing gear ruptured.

Upon inspection of the ignition system, it was determined that there was no visible damage to the associated components. System components, magnetos, ignition cables and spark plugs were attached and secured.

Other engine components were found attached with no visible external damage. For a more precise determination of the technical correctness of the engine, individual engine components were sent for testing.

The engine power, fuel mixture, and carburettor heat controls operated correctly and without difficulties to their stops. The connections of the mentioned commands are correct and secured.

1.12.2. Traces at the accident site

Broken branches of the surrounding trees and debris and parts torn from the aircraft are visible at the accident site and in its immediate vicinity.

According to the said damages of the vegetation and the scattered debris, the direction of arrival of the aircraft immediately before hitting the ground is visible. That direction was approximately along the isohypsis of the slope, and the said traces extend for about fifteen meters.

On the line of arrival of the aircraft and its passage through the vegetation, damages to the vegetation on the left side, seen from the aircraft, are visible, while the vegetation on the right side remained undamaged. Also, on the left side of the line of passage of the aircraft, scattered debris torn from the tip of the left wing (the tip of the left wing is significantly damaged, while there is no such damage on the right wing).

The pine tree next to which the aircraft stopped was cut in three places and the bark peeled off.



Picture 16 – A broken branch on a nearby tree



Picture 17 – Traces of the impact of the rotating propeller to the tree



1.13. ADDITIONAL INFORMATION

1.13.1. Information about the installed engine and propeller

An inspection of the aircraft established that the aircraft in question was equipped with a four-stroke gasoline engine type Lycoming O-320-E2D, serial number: RL-42512-27A.

The engine consists of four oppositely placed cylinders of direct power transmission. The engine is air-cooled, and has a built-in so-called "wet sump" and carburettor. It develops power of 150 hp at 2700 rpm.

It was also established that a fixed-pitch propeller McCauley 1C160/CTM7553 type, serial number: 724357, was installed, which was overhauled in August 2020. The propeller is made of aluminium alloy.

1.13.2. Aircraft documents

No aircraft documents were found in the aircraft at the accident site. They were located at Brač Airport. An examination of the aircraft's documents revealed that the POH (Pilot operating handbook) and Check list were written in Hungarian. Among the documents there was also a handwritten aircraft Checklist in English.

1.13.3. Technical correctness of engine components

Considering that at the accident site no technical defects were established on the engine that could have caused its improper operation or stoppage, the technical correctness of the following engine components was checked in an authorized workshop:

Carburettor, MA-4SPA, PN: 10-5217, SN: CC21005

It was established that beside from the wear and tear of the power valve shaft, there was no damage to the carburettor on the outside. The carburettor was tested on the test bench, which included checking for fuel leaks, the correctness of the float, and the correctness of the acceleration pump. The results of the checks show that all components were correct. The said wear and tear of the power valve shaft did not affect the correct operation of the engine.

Ignition magnet (right), PN: 4370, SN: 13121114

The ignition magnet had no visible external damages. During the technical correctness check, a short circuit test, a contact test, and a drive gear check were performed on the test bench. No irregularities were established that would affect the proper operation of the engine.

Ignition magnet (left), PN: 4371, SN: 15030726

The ignition magnet had no visible external damages. During the technical correctness check, a short circuit test, a contact test, and a drive gear check were performed on the test bench. No irregularities were established that would affect the proper operation of the engine.

Magnet cables, PN: M-1795LH, PN: L-2992RH

A visual inspection of the cables established that the external protection (insulation) was damaged in some places. A conductivity test and a high voltage test were performed without negative findings. No irregularities were established that would affect the proper operation of the engine. The mentioned damaged insulation does not affect the normal operation of the engine.



By checking the technical correctness of all the above-mentioned components, it was established that they were correct without any irregularities that could affect the proper operation of the engine.

1.13.4. Pilot's statement

In his statement, the pilot stated that he arrived at Brač Airport at 6:30 UTC that day, made the necessary preparations on the aircraft and performed the pre-flight check according to the "checklist", including checking and draining the fuel. There were 30 gallons of fuel, 15 in each tank. He didn't tank the fuel.

He then met the passengers and took them from the gate to the aircraft and helped them get into the aircraft.

They took off at 09:10 LT. They went around Bol - Zlatni Rat, which was the first point on the planned route, and headed towards the second point, "monastery Blaca", after which they were supposed to fly to Milna.

Furthermore, the pilot stated that, seven minutes after take-off while they were above monastery Blaca, the engine started shaking. The vibrations were so strong that the foot controls of the rudder were shaking, as was the canopy on the nose of the aircraft.

The pilot checked the fuel selector, trim, flaps, fuel and power controls, and the position of the key that was set on both magnets, and the engine instruments.

He stated that he then directed the aircraft towards Brač Airport, which was 8 NM away from the aircraft's current position and began to climb. However, the vibrations continued, and the engine soon began to lose power and the aircraft began to lose altitude.

The pilot realized that the aircraft did not have enough power to fly over the obstacle in front of them (the hill). He stated that he did not want to turn (direct the aircraft towards the sea), because the stall speed in the turn is higher, and landing on water is very dangerous. He began looking for a suitable place to make a "precautionary" landing and informed the passengers to prepare for impact.

Immediately after landing, the pilot closed the fuel valve, turned off the ignition and master switch, and released the fire extinguisher so that he could use it in case of need. He helped the passengers to get off the aircraft and called the ARO at Split Airport on his mobile phone to report the situation and request for help.

After some time, firefighters arrived at the accident site, then he was transported by ambulance to Brač Airport and from there by helicopter to the hospital in Split.

1.13.5. Passengers statement

For the purposes of this investigation, the passengers, a German married couple, gave a statement, that is, answered certain questions posed to them by the investigator. Both of them know the terrain very well, as they have already been to Brač several times, and have also hiked in this area. They described the flight in detail and drew the flight route on the map.

They stated that they decided on the panoramic flight in question at the passenger's birthday.

The flight lasted about 10 minutes. Communication inside the cabin took place via headphones and was difficult.



The passengers stated that during the flight they did not receive any information from the pilot about difficulties with the aircraft propulsion. However, they heard a few words of indignation from the pilot which to them seemed to indicate some kind of difficulties.

Furthermore, the passengers did not recall hearing a warning from the pilot to prepare for an impact. They leave the possibility that it is due to the poor audibility of communication via headphones.

The investigator introduced the passengers to the sound of the stall warning signal. Passengers stated that they did not hear such a sound.

Passengers further stated that during the flight through the gorge in which the “Blaca monastery” is located, they were below the level of the tops of the side slopes of the gorge, while the monastery was below the height at which they were flying.

As they took several photos and several short videos during the flight, the passengers made them available for the purposes of this investigation.

In the end, they state that they believe that the pilot did a good job and thus saved lives.

1.13.6. Communication

The pilot's communication with the flight control took place as expected and in an orderly manner. The pilot did not inform control of any difficulties, including possible problems with the aircraft's propulsion.

1.13.7. Legal framework

SERA.5005(f) provision stipulates the minimum VFR flight altitude. It is 150 m (500 ft) above the terrain, or 150 m (500 ft) above the highest obstacle within a 150 m (500 ft) radius of the aircraft.

2. ANALYSIS

Traces on and around the accident site

Damages to the vegetation around the accident site indicate that, just before the crash, the aircraft passed through bushes and small trees with its left wing, which means that it was tilted to the left side along its longitudinal axis. This is also confirmed by the debris that fell from the top of the left wing, scattered over a length of about fifteen meters.

The pine tree next to which the aircraft remained lying was cut in three places. These damages were caused by a propeller that hit a tree by its left side. Considering that on this aircraft the propeller rotates to the right, the left side of the propeller moves from bottom to top, so the tree was cut in this manner.

The first contact of the propeller with the tree was at a height of about 4 m above the ground. The other cuts are located below the first and are distributed at approximately equal intervals, with gradual shifts to the right.

The described damages to the tree indicate that the aircraft hit the tree with the left part of the propeller. The front end of the aircraft with the propeller was at that moment about 4 m above the ground. After hitting the tree, the aircraft fell towards the ground and rotated around the tree, with the propeller cutting the tree two more times.



Throughout this process, the aircraft's speed gradually decreased enough for the pilot and passengers to survive the crash, even with relatively minor injuries. The aircraft remained lying on the ground so that its longitudinal axis was at an angle of about 90° in relation to the direction of arrival.

Damages to the aircraft

The damages to the aircraft's wing also shows that it scratched the ground with the tip of the left wing, which means that it was tilted to the left just before the crash. Finally, it hit a tree with the propeller and root of the left wing, as a result of which the wing separated from the fuselage, and the aircraft rotated around the tree by 90°.

According to the damages on the power unit (bending of the crankshaft and bending of the propeller), it can be seen that the engine was running at a high number of revolutions and with considerable power. This is confirmed by the damage to the tree described earlier, caused by the rotating propeller.

Apart from the deformations caused by the crash, no technical defects were found on the engine and its components that would affect the correct operation of the engine.

The influence of terrain on the flight of the aircraft

The canyon through which the aircraft flew just before the accident stretches from the sea coast to the northeast towards the interior of the island, is about 4 km long and ends on a plateau with an average altitude of about 600 m.

The Blaca monastery is located on the eastern side of the canyon at an altitude of 230 m. The monastery is a little more than 2 km away from the entrance to the canyon on the coast.

From the video taken from the aircraft, it can be estimated that the altitude of the aircraft (ASL – above the sea level) when passing by the monastery was about 280 m. From there the aircraft should have continued to climb and in the next 2,5 km rise above the plateau where the canyon ends or earlier to rise to a height above the sides of the canyon, i.e. to a height greater than 600 m ASL.

The accident site is approximately 2 km away from the monastery, at an altitude of 470 m ASL. Therefore, in the next 2 kilometres after passing by the monastery, the aircraft climbed from the altitude of 280 m to the altitude of 470 m, i.e. 190 m.

Metrological conditions

Weather conditions were generally favourable for flying. The weather was stable, with good visibility and no dangerous occurrences. However, the characteristics of the terrain locally affect the meteorological parameters and could have adversely affected the flight of the aircraft in the following ways:

- The probability of carburettor icing was minor, but not completely excluded,
- There were weak vertical air currents caused by orography, which could have been somewhat stronger locally. By themselves, such currents should not endanger the flight, but in combination with other elements they can have an unfavourable effect (flight speed, angle of attack, climbing...)

The combination of a low flight speed, a higher angle of attack of the aircraft in climbing, and a descending air current or wind blow from behind, can lead to sinking of the aircraft or even stalling. In



such scenario, low height above the ground reduces the possibility of recovery of the aircraft and return to the normal flight condition.

Critical part of the flight

The pilot, probably wanting to provide the passengers with an interesting flight with attractive sights, flew at a low altitude. The low altitude does not leave much room for reaction in the event of a problem with the aircraft.

A flight through the canyon is certainly attractive for passengers, but from a safety perspective, it does not leave many options for solving the eventual occurrence of technical problems with the aircraft. Due to the small width of the canyon, the possibilities of manoeuvring the aircraft in it are very limited. Also, the terrain of the canyon is such that there is no surface that would allow an emergency landing.

The only way out for an aircraft that has entered the canyon is to climb to an altitude above the sides or end of the canyon. So, the aircraft started to climb at one point, and then it crashed.

There are two possibilities for this development of events:

- the occurrence of some kind of problem with the aircraft's propulsion system, due to which it could not continue climbing,
- stalling of the aircraft during climb

The aircraft approached the crash site on the left slope of the canyon approximately along the isohypse. The terrain rose on the left side of the aircraft and descended on the right. As already mentioned, according to the traces, it can be concluded that the aircraft first touched the ground with the left wing and that this moment it was tilted to the left side along the longitudinal axis. It should be emphasized here that the contact of the left wing with the ground did not occur only because the slope was higher on the left side, but the aircraft was also tilted to the left side.

It seems illogical that the pilot, in case of some problems with the propulsion and the inability to climb, which would result in an emergency landing, would tilt the aircraft to the left side so that the wing scraped the ground. This seems more like an out-of-control situation.

The aircraft's flaps were retracted, which means the aircraft was not prepared for slow flight before landing. In case of controlled landing, the procedure is such that the pilot pulls out the flaps to enable a reduction in flight speed and thereby reduces the force of the impact during an emergency landing. The previously described propeller marks on the tree indicate considerable power and rpm, which also suggests that the aircraft was not configured for an emergency landing.

In case of stalling and simultaneous operation of the engine at considerable power, due to the moment created by the rotation of the propeller and due to the impossibility of countering it because of the cessation of functioning of the control surfaces which, due to too low speed and too steep angle of attack, no longer "take" properly, tilting of the aircraft to the left occurs (on aircrafts on which the propeller rotates to the right).

There is also the possibility that the pilot at the critical moment tried to turn the plane to the right in order to get away from the slope, that is, towards the middle of the canyon where there was more space. For this maneuver, it is necessary to tilt the plane to the right, i.e. lower the aileron on the left wing. Lowering the aileron on the left wing will further increase the angle of attack, which in the flight mode on the edge of the stall, will result in a loss of lift on the left wing. Due to the weight of the left



wing, which no longer has lift, and due to the lift which still exists on the right wing, a moment is created that tilts the plane to the left.

Crash and survival aspects

The aircraft approached the crash site along the isohypsis of the slope, passed through the vegetation, hit a tree with the propeller and wing, and finally rotated and crashed under the tree. All of the above contributed to a gradual reduction in speed, i.e. to softening of the impact. Passing through the vegetation, the impact with the propeller and then the wing that separated from the fuselage and took a significant part of the energy, and finally the rotation, absorbed almost all the energy of the aircraft's movement. The slowdown was gradual enough that survival was possible.

Conclusion of the analysis

In order to get out of the canyon, the aircraft had to climb. The flight speed was obviously too low for the aircraft to perform the necessary climb. Due to the low speed and due to the higher angle of attack in the climb, there was a gradual stalling of the aircraft, loss of lift, lateral tilt to the left and finally a crash.

The gradual stalling of the aircraft during the climb phase and stalling, i.e. loss of lift, could have occurred for two reasons:

- Due to some technical problems, the engine did not have the necessary power for climbing,
- The speed of the flight through the canyon was low, and the aircraft should have gone into climbing at that speed. During the climbing phase, due to the increased angle of attack and insufficient speed, the aircraft stalled.

Although the first of the two just mentioned possibilities cannot be completely ruled out, the knowledge obtained in this investigation points more to the second possibility.

Probably wanting to provide the passengers with an interesting flight, the pilot entered the canyon, which offers almost no possibilities for a safe emergency landing. In addition, the aircraft flew through the canyon at approximately half the altitude of the canyon. The flight speed, judging by the videos, was reduced. When the aircraft had to go into climb, because there was no other option in that situation, it probably entered the climb with a low speed. The flight speed could not have been increased during the climb, on the contrary, apparently it decreased until the aircraft gradually stalled.

Local air currents could affect the behaviour of the aircraft. When flying at low speed and with an increased angle of attack due to climbing, i.e. in a flight regime that is close to the stalling, the wind blow from behind, as well as the appearance of a falling air current, can lead to a drop in lift below the value necessary to maintain a stable flight of the aircraft.



3. CONCLUSION

3.1. FINDINGS

Flight preparation

- The pilot performed the necessary actions related to flight preparation,
- The pilot welcomed the two passengers and accommodated them on board,
- A panoramic flight around the island of Brač, with take-off and landing at Brač Airport, was announced to the control,
- Communication with control was in order, approved altitude was up to 2500 ft.

Terrain

- The terrain of the area where the accident occurred played a significant role in this event,
- The canyon of Blaca monastery does not offer the possibility of at least somewhat safe emergency landing,
- The canyon channels the wind,
- The canyon limits the possibilities of manoeuvring the aircraft,
- The aircraft had to climb in order to get out of the canyon of Blaca monastery.

Meteorological conditions

- They were generally favourable for flying,
- The probability of carburettor icing was minimal, although it cannot be completely ruled out,
- There were weak vertical air currents, which, combined with a certain flight regime of the aircraft, can adversely affect the flight itself.

Pilot

- Possesses all necessary permits and authorizations,
- He has some flying experience,
- Possesses a valid medical certificate.

Flight

- After take-off, the aircraft was directed towards the town of Bol, where it made one circle above the coast, i.e. the Zlatni Rat beach,
- The flight continued over the coast in the west direction to the canyon where the Blaca monastery is located,
- After arriving to the mentioned canyon along the coast, the aircraft enters it and continues its flight through the canyon, flying approximately at half the altitude of the canyon,
- The aircraft had to climb in order to get out of the canyon.



Crash

- At the altitude of 470 m ASL, on the left side slope of the canyon, the aircraft ended up on the ground,
- The aircraft approached the crash site at a small angle, almost on the isohypse,
- Immediately before the crash, the aircraft was in a left lateral tilt, and the tilt along the transverse axis was small,
- Immediately before the crash the aircraft was not configured for slow flight and landing,
- The engine worked with considerable power,
- The vegetation, as well as the rotation of the aircraft around the tree, absorbed a large part of the energy and gradually slowed the aircraft down until it stopped,
- The deceleration was gradual enough for people to survive the crash without life-threatening injuries.

3.2. CAUSE

Immediate cause

Stalling due to reduced speed and increased angle of climb.

Contributing factors

- Low flight altitude,
- Route selection (entering the canyon),
- Possible influence of local air flow,
- The pilot's desire to provide passengers with an attractive panoramic flight, which influenced the choice of altitude, speed and flight route,

4. SAFETY RECOMMENDATIONS

The safety recommendation in no case constitutes a legal presumption of guilt or liability for an accident, serious incident or incident.

Although the manners for avoiding the mentioned contributing factors are well known at flight practice, as well as satisfactorily addressed by legislation, to draw attention to certain elements observed in this investigation, AIA issues the following general safety recommendations to general aviation pilots:

AIN04-SR-04/2023

During the flight, pilots should not choose a path that, due to terrain (canyon) or some other reasons, does not leave alternative options for emergency procedures.

AIN04-SR-05/2023

During the flight, pilots should mind the altitude sufficient to apply emergency procedures in case of difficulties.



AIN04-SR-06/2023

During flight planning and the flight itself, pilots should anticipate and take into account possible local air currents caused by the current meteorological situation and the characteristics of a certain area, and adjust the flight path and regime so that safety is not compromised.

AIN04-SR-07/2023

Pilots who fly panoramic flights and want to provide passengers with interesting flights with attractive sights, should pay attention to ensure that the safety of the flight is not compromised at the expense of the attractiveness of such a flight.

Investigator in charge

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