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Report A-043/2019

Accident involving a mid-air collision between a Bell 206 L3 aircraft operated by Roterflug, registration D-HOTT, and an Aeroprakt A22L aircraft, registration EC-GU1, on 25 August 2019 in the vicinity of Inca (Mallorca)



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COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Tel.: +34 91 597 89 63
Fax: +34 91 463 55 35

E-mail: ciaiac@mitma.es
<http://www.ciaiac.es>

C/ Fruela, 6
28011 Madrid (España)

Notice

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.6 of Regulation (UE) n° 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1 and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

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Abbreviations

00° 00' 00"	Degrees, minutes and seconds
°	Sexagesimal degree
°C	Degrees Celsius
%	Per cent
ACC	Air Control Centre
AGL	Above Ground Level
ATC	Air Traffic Control
CPL-H	Commercial Pilot Licence (Helicopter)
CTR	Controlled Traffic Region
CV	Metric horsepower
E	East
FI (H)	Flight Instructor (Helicopter)
ft	Feet(s)
h	Hour(s)
hPa	Hectopascal
kg	Kilogramme(s)
km	Kilometre(s)
km/h	Kilometre(s) per hour
kt	Knot(s)
LBA	Luftfahrt-Bundesamt (Germany's National Civil Aviation Authority)
LECP	Palma TACC
m	Metre(s)
MAF	Multi-axis fixed-wing
METAR	Meteorological Aerodrome Report
MHz	Megahertz(s)
N	North
QNH	Altimeter setting to obtain elevation above sea level when on the ground
S	South
SW	Southwest
TACC	Terminal Area Control Centre
TMA	Terminal Manoeuvring Area
TULM	Ultralight Aircraft Pilot License
TWR	Control tower
ULM	Ultralight motorised aircraft
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
W	Watts

Synopsis

Aircraft no. 1:

Operator:	Rotorflug
Aircraft:	Bell 206 L3, registration D-HOTT
Date and time of accident:	25 August 2019, 11:35 UTC ¹
Site of accident:	Vicinity of Inca (Mallorca)
Persons on board:	Five deceased
Type of flight:	Commercial air transport - Non-scheduled - Domestic- With passengers
Flight rules:	VFR
Phase of flight:	En route - cruising

Aircraft no. 2:

Operator:	Private
Aircraft:	Aeroprakt A22L, registration EC-GU1
Date and time of accident:	25 August 2019, 11:35 UTC
Site of accident:	Vicinity of Inca (Mallorca)
Persons on board:	Two deceased
Type of flight:	General Aviation-private
Flight rules:	VFR
Phase of flight:	En route - cruising
Date of approval:	24/02/21

Summary of incident

On Sunday 25 August 2019, a Bell 206 L3 aircraft, registration D-HOTT, and an Aeroprakt A22L aircraft, registration EC-GU1, were involved in a mid-air collision in the vicinity of Inca (Mallorca).

¹ Unless specified otherwise, all times in this report are UTC. On the day of the incident, local time was UTC+2 hours.

The helicopter had taken off from a private estate near Manacor, with the pilot and four passengers on board, intending to transfer the passengers to Camp de Mar in the Andratx area of the island.

The Aeroprakt aircraft had taken off from Binissalem Aerodrome with the pilot and a passenger on board to make a local flight and return to the same airfield.

At the time of impact, both aircraft were in the cruise phase of their respective flights, with convergent trajectories. The ultralight was located to the helicopter's left (according to the latter's direction of travel).

Both aircraft were destroyed, and all the occupants were killed.

The investigation has concluded that the most likely cause of the accident was insufficient airspace surveillance.

1. FACTUAL INFORMATION

1.1. History of the flight

On Sunday, 25 August 2019, the Aeroprakt ultralight aircraft, registration EC-GU1, took off from Binissalem Aerodrome with the pilot and a passenger on board to make a local round-trip flight. Prior to the accident flight, the aircraft was used by the same pilot and a different passenger for a flight within the Binissalem Aerodrome traffic pattern.

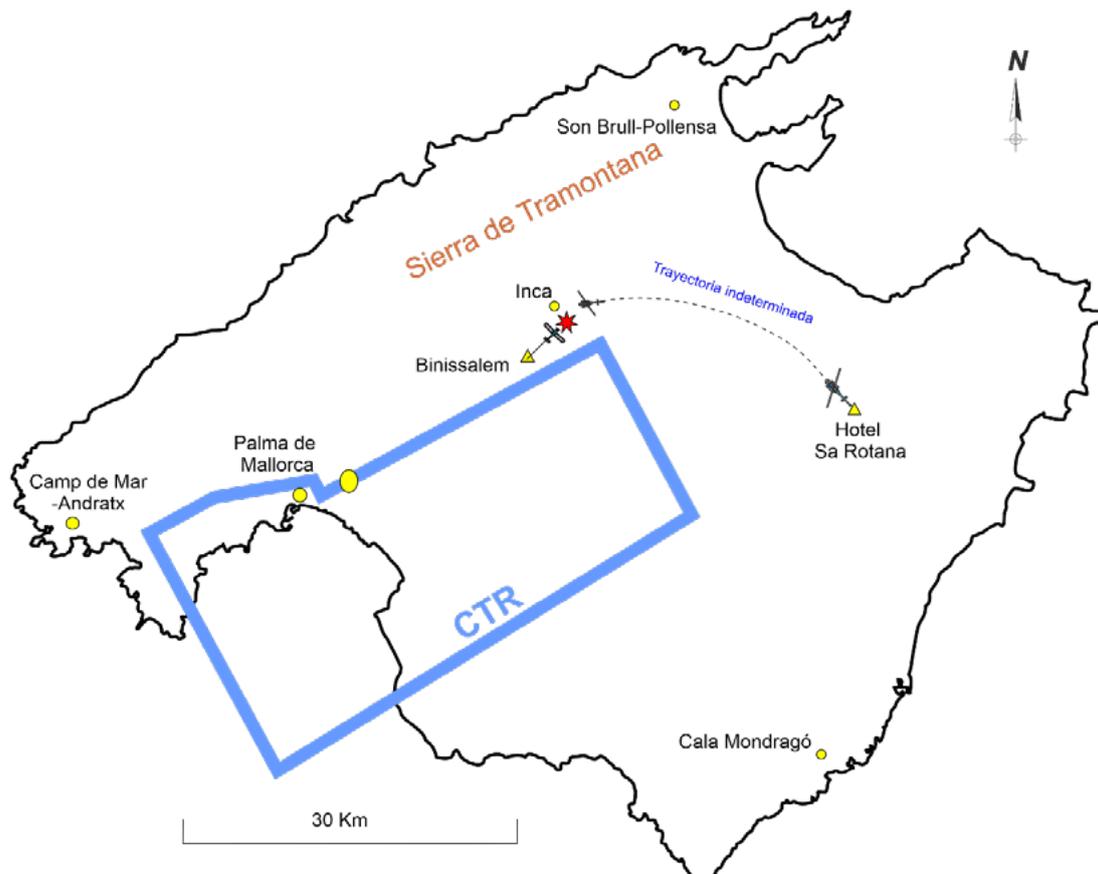


Fig. N°1.- Map of locations and aircraft positions.

For its part, the Bell 206 L3 helicopter, registration D-HOTT, was following a two-hour flight plan departing and returning to the Son Bonet Aerodrome.

First, it flew from Son Bonet to Son Brull in Pollensa to pick up two passengers and transfer them to the "La Martina" farmhouse in Cala Mondragó.

Subsequently, it flew to the Hotel Reserva Rotana in Manacor, landing at 10:38 h to pick up, along with another Robinson 44 helicopter from the same company, eight more passengers belonging to two different families of four, and transfer them to Camp de Mar in the Andratx area of the island. In addition to the transfer itself, the flight was also to serve as a scenic leisure tour.

As the helicopters didn't have the capacity to fly four family members in each one (the Bell 206 seats five passengers, and the Robinson 44 only seats three), one of the families decided to travel by car.

The Bell 206 L3 helicopter eventually took off at 11:25 h from the temporary heliport of the Reserva Rotana, bound for Camp de Mar in Andratx with the pilot and four passengers on board. The plan was to tour the north of the island, skirting around Palma CTR so that the passengers could appreciate the landscape of the Sierra de Tramuntana.

A few minutes later, with both aircraft in the cruise phase of their flights and the ultralight to the left of the helicopter (according to the helicopter's direction of travel), their converging trajectories caused them to collide in mid-air.

Following the collision, both aircraft fell, almost in line with the direction they were travelling, until they impacted the ground at two different locations.

Both aircraft were destroyed and burned, and all the occupants were fatally injured.

1.2. Injuries to persons

Aircraft D-HOTT:

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	1	4	5	
Serious				
Minor				
None				
Total	1	4	5	

Aircraft EC-GU1:

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	1	1	2	
Serious				
Minor				
None				
Total	1	1	2	

1.3. Damage to the aircraft

Aircraft D-HOTT:

The aircraft was completely destroyed as a consequence of the impact and subsequent fire.

Aircraft EC-GU1:

The aircraft was completely destroyed as a consequence of the impact and subsequent fire.

1.4. Other damage

To the exterior area of private properties.

The D-HOTT aircraft crashed into the grounds of a house, hitting the wire fence that separated it from the adjoining property. The fire damaged part of the fence and nearby vegetation.

Aircraft EC-GU1 fell onto the side of a road bordering the grounds of a house at a lower level. After the impact, the nose and front part of the aircraft landed on the plot. The tail remained on the edge of the road. As a result, part of the metal fence, nearby vegetation, and various belongings in the vicinity were damaged in the fire.

1.5. Personnel information

1.5.1. Information about the crew of aircraft D-HOTT

The 49-year-old pilot had a commercial pilot license (CPL-H) issued by the National Civil Aviation Authority of the Federal Republic of Germany (LBA), with Bell 206 and R22 ratings valid until 28 February 2020 and FI (H) VFR Night valid until 30 November 2019.

He also had a class 1 medical certificate, valid until 12 November 2019.

He had 2965 hours of flying experience, of which 690 were in the type of aircraft involved in the accident and 151 were as an instructor.

According to the information provided by the company, the pilot's activity was compliant with the relevant activity and rest requirements.

1.5.2. Information about the crew of aircraft EC-GU1

The 43-year-old pilot had a multi-axis fixed-wing (MAF) ultralight pilot license issued by Spain's National Aviation Safety Agency, valid until 30 June 2020.

He also had a class 2 medical certificate, valid until 08 May 2020.

As of 11 August 2019, which was the day his flight log was last updated, he had 672:19 hours of flying experience, of which 567 hours were in the type of aircraft involved in the accident.

1.6. Aircraft information

1.6.1. Information about aircraft D-HOTT

The helicopter was a BELL aircraft, model 206 L3, with a maximum take-off weight of 1882 kg. It was built in 1992, registered on 11 March 2013, and its serial number was 51587.

Its Airworthiness Certificate was issued on 4 August 1992 by the National Civil Aviation Authority of the Federal Republic of Germany (LBA). On 28 August 2018, when it had 3036:08 flight hours, it was issued an Airworthiness Review Certificate by the approved organisation Rotorflug GmbH (reference DE.MG.313AOC). It was valid until 27 August 2019.

Both the aircraft and its Allison 250-C30 P engine had undergone a scheduled 600 h / 12-month maintenance overhaul at 3112:11 h, obtaining the corresponding commissioning certificate on 19 March 2019.

The work included engine, transmission and gear oil changes, filter changes, structural and corrosion inspections and inspections of the batteries, temperature sensors, pitot tube, avionics, components, lubrication, hydraulic system, tail rotor, floats, skids, crossbeams, load hook, weight and balance...

According to the aircraft station license, it was equipped with a 10 W Bendix King KX 165A communications device and a 10 to 16 W power output Garmin GTR 225 A, which allowed the crew to listen to two stations simultaneously. It also had a 240 W transponder manufactured by TRIG, model TT31.

1.6.2. Information about aircraft EC-GU1

The second aircraft was an AEROPRAKT motorised ultralight, model A22L, with a maximum take-off weight of 450 kg. It was built in 2017, registered on 23 June 2017, and its serial number was A22L-17-0075.

It had a Restricted Certificate of Airworthiness issued on 24 April 2017 by Spain's National Aviation Safety Agency.

As of 11 August 2019, which was the day the aircraft's logbook was last updated, it had 567:04 flight hours.

The aircraft was equipped with a ROTAX 912 ULS 100 CV engine. According to the engine logbook, last updated on 11 August 2019, it had 567:04 hours of operation and had undergone a scheduled 500 h maintenance overhaul on 29 May 2019 with 500:09 hours of flight. In addition, the carburettor floats were changed on 11 July 2019.

According to the aircraft station license, it was equipped with a VHF communications device manufactured by FUNKE (model ATR-833) with 4 W of power in the 118.000 to 136.975 MHz frequency band. The equipment could be tuned in to two stations simultaneously. The aircraft also had a FUNKE Transponder (model TRT 800 H) with 10 W of power, a reception frequency of 1030 MHz and a transmission frequency of 1090 MHz.

1.7. Meteorological information

According to the information provided by the State Meteorological Agency (AEMET), the meteorological conditions in the area at the time of the accident were light cloud, light winds and good visibility.

The closest meteorological stations to the accident site available to AEMET are Binissalem (6 km to the southeast), Lluc (12 km to the north-northwest), and Sa Pobla (12 km to the northeast).

The data recorded were as follows:

Binissalem: Temperature 33°C, relative humidity 39%, average wind 3 km/h from the southeast and maximum wind speed 23 km/h from the northeast.

Lluc: Temperature 28°C, relative humidity 38%, average wind 5 km/h from the west and maximum wind speed 18 km/h from the east.

Sa Pobla: Temperature 32°C relative humidity 37%, average wind 13 km/h from the northeast and maximum wind speed 24 km/h from the northeast. Pressure 1013.6 hPa.

The METAR from Palma airport (located 23 km to the southwest) at 11:30 h and 12:00 h indicated 11-12 kt wind from 240°-230°, good visibility, light cloud at 2000 ft, scattered cloud at 3500 ft, temperature 29°C, dew point 22° and a QNH of 1,017 hPa. No significant changes.

METAR LEPA 251130Z 24011KT 9999 FEW020 SCT035 29/22 Q1017 NOSIG=

METAR LEPA 251200Z 23012KT 9999 FEW020 SCT035 29/22 Q1017 NOSIG=

The aerodrome forecast at the time was:

Between 12 h on 25 and 26 August, wind speed of 12 kt from 230°, good visibility, a few clouds at 2000 ft, maximum temperature of 32°C at 13h on the 25th, minimum of 20°C at 05 h on the 26th. 40% chance of the formation of tower cumulonimbus at 4000 ft between 13h and 17 h. Variable winds changing from a 050° direction with a 05 kt speed between 18 h and 20 h to a 230° direction with a 12 kt speed between 11 h and 12 h on the 26th.

TAF LEPA 251100Z 2512/2612 23012KT 9999 FEW020 TX32/2513Z TN20/2605Z PROB40 TEMPO2513/2517 FEW040TCU BECMG 2518/2520 05005KT BECMG 2611/2612 23012KT=

1.8. Aids to navigation

1.8.1. Radar information

The airspace immediately above the scene of the accident is on the final approach path to Palma airport. The aircraft involved in the accident were flying under VFR with VMC.

The radar screen only shows one primary signal positioned in the vicinity of the NAKOP point near Manacor, moving towards the CTR. This trajectory is consistent with that of the helicopter, appearing intermittently at 11:13:00 h and apparently heading towards Inca and the VFR traffic notification point 'E'. The signal disappears at 11:28:02 h. There's no information about its altitude, and we cannot be sure it corresponds to the helicopter.

1.9. Communications

Given the airspace in which they are permitted to fly, ULM aircraft are not required to carry radio equipment.

Aircraft in the area use the 123.500 MHz Son Bonet Aerodrome frequency to communicate with each other.

In the vicinity of the Binissalem Aerodrome, the frequency used is 130.15 MHz.

It's common practice to notify and request traffic information for the area.

The frequency used in the terminal area of Palma (TACC) is 118.005 MHz, and any user of the uncontrolled airspace can request flight information.

We checked the ACC and TWR frequencies but were unable to identify any communications with the aircraft involved.

1.10. Aerodrome information

N/A.

1.11. Flight recorders

Neither the helicopter nor the ULM were equipped with flight data or cockpit voice recorders, as they are not a legal requirement for either type of aircraft.

1.12. Aircraft wreckage and impact information

The wreckages of the helicopter and the ULM were primarily located at two points approximately 340 m apart. In addition, separate pieces of both aircraft were found scattered throughout the area.

1.12.1. Helicopter

This aircraft impacted within the grounds of a residential property located approximately 600 m southeast of Inca. The GPS coordinates for the site are 39° 42' 27" N – 02° 54' 58" E.

There were no marks on the ground to indicate it impacted previously or that it dragged along the ground.

The bulk of the aircraft wreckage was concentrated at the crash site. However, the main rotor, vertical stabiliser, tail rotor (which had lost its transmission and a blade), passenger and luggage compartment doors, engine fairings, and other miscellaneous debris were found separated from the main aircraft wreckage.

With the exception of part of the rear horizontal stabiliser, the tail cone and the other components that broke off, the aircraft was completely burnt out. Among the charred remains, we were able to distinguish the side engine fairings, the landing gear strut and skids, and a few other isolated parts of the aircraft.

The following components were found in the area immediately to the east of the main wreckage: at about 50 m, two doors; at 64 m, the tail rotor's transmission, and at about 90 m, the main rotor head (whose mast showed signs of torsion damage), with part of its blades still attached and two other separate pieces nearby, spaced 12 m, 15 m and 6 m apart.



Fig. no. 2 - Detail of the rotor head and damage to parts of the blades.

Two more pieces of the same blade were found 150 m to the west of the main wreckage area, which, together with two more small pieces located 64 m to the south-southeast of the main wreckage (one of them the blade tip), accounted for the entire surface of the blades.

The tail rotor lay further away, 185 m to the southeast, between the two main wreckage sites. One of its blades was still attached, and the other had broken off and was found a further 110 m to the south.



Fig. no. 3 - Detail of the tail rotor.

The vertical stabiliser was found 37 m to the west of the tail rotor. About a quarter of its upper half had broken off. Both the main body of the stabiliser and the severed part showed significant deformations and signs of having been crushed on their front side.



Fig. no. 4 - Helicopter's stabiliser: main body and detached upper part

The pieces of the main and tail rotor blades all displayed creases, scratches, breakages and deformations consistent with impacting both the aircraft and the ground. Furthermore, white paint marks were observed on the helicopter's vertical stabiliser and the blades and shaft of the tail rotor.

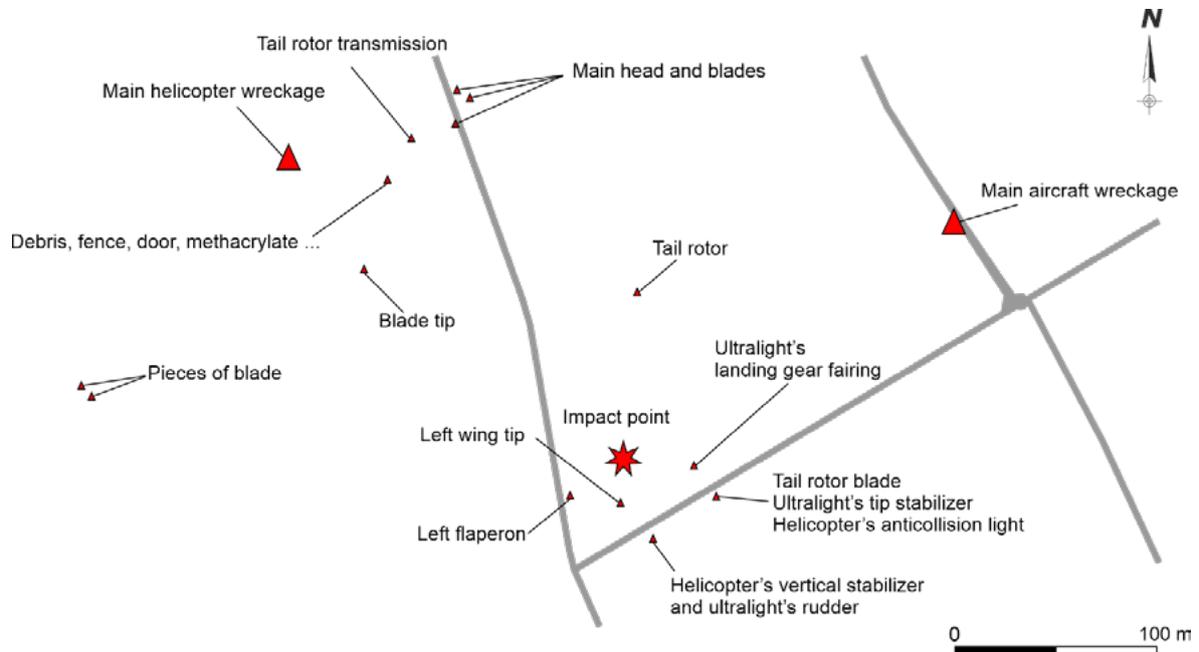


Fig. no. 5 - Sketch of the distribution of the wreckage.

1.12.2. ULM

This aircraft impacted within the grounds of a residential property to the east of where the D-HOTT aircraft hit. The GPS coordinates for the site are 39°42'25,77" N, 02°55'12,93" E.

It was located next to a tree, bordering a dividing retaining wall (made of concrete up to a height slightly higher than ground level with wire fencing on top) that separated the property from a minor local dirt road at a higher level.

The aircraft had impacted the ground in an almost vertical inverted position, with its front part, fuselage and left wing landing inside the plot, and the right wing and tail assembly on top of the wall itself and extending onto the road.

There were no marks on the ground to suggest a previous impact, but on its descent the aircraft damaged the tree, leaving part of its wing stuck in the branches.

Although the debris was mainly concentrated at the crash site, the left wingtip, left flaperon, part of the landing gear fairing, the upper part of the stabiliser and the rudder broke off before the impact.

The left flaperon and wingtip were found on farmland located between the main aircraft and helicopter wreckage sites, 238 m west of the aircraft's main structure, with a separation of 25 m between them.

Part of the landing gear fairing was found 40 m from the left wingtip (heading towards the main wreckage), and 18 m to the south of that were the ultralight's rudder, the tip of its stabiliser and the helicopter's anti-collision light.

With the exception of the tail assembly and aforementioned detached parts, the aircraft was completely destroyed by the fire.

The propeller hub and blades didn't catch fire, and the hub and one of the two visible propeller blades were intact with no damage or deformation. The other visible blade was damaged at its root and had a laminar incision along its trailing edge.

Some of the aircraft's structure and components could be distinguished among the burned debris, particularly the landing gear legs, struts and wing profiles.

The right wing ended up in an inverted position on the concrete wall. The part furthest from the fuselage maintained its structure with the spars and ribs intact, but the part that made direct contact with the wall was completely destroyed. The section closest to where the wing attaches to the airframe, although burned, retained some of its cladding.

The left wing (minus the parts that had broken off) was found on the ground within the property boundary. It was completely charred and only identifiable by part of its spar and a few ribs.

The tail assembly was separated from the main body of the aircraft, resting on the road and the retaining wall in an inverted position. Both the horizontal stabilisers were creased and deformed and the left one had splashes of lubricating oil from the main rotor yoke (reddish in colour) on its underside.



Fig. no. 6 - Detail of the tail assembly.

The upper section of the vertical stabiliser was incomplete, with a left to right laceration running almost parallel to its upper edge (according to the aircraft's direction of travel). The detached upper section was found with its corresponding riser 180 m away. The rudder was found in the same place and also had a laceration at the same height going in the same direction, starting from the part closest to the stabiliser and extending almost to the furthest edge (going from left to right according to the aircraft's direction of travel).





Fig. no. 7 - Detail of the rudder, stabiliser end and the two components together

The separated part of the left wing accounted for approximately one-third of the whole wing. Its underside was split open in the direction of the chord, one metre from the tip. It was torn and lacerated throughout.

Part of its flaperon had broken off and was found 25 m away. It was also was torn and lacerated.

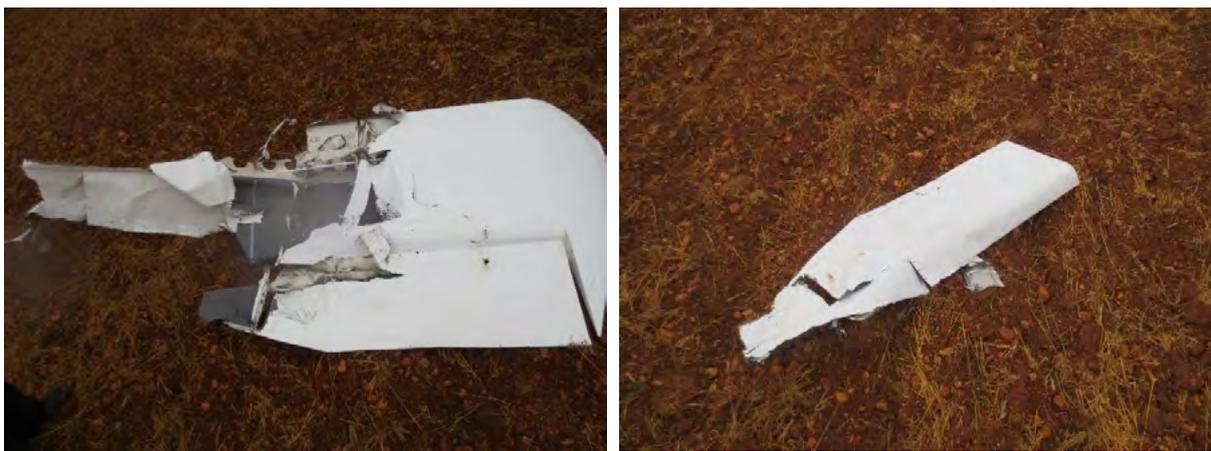


Fig. no. 8 - Detail of the left wingtip and flaperon.

1.13. Medical and pathological information

We have found no evidence to suggest the flight crew were affected by any physiological or disabling factors.

1.14. Fire

With the exception of the detached parts, the remains of both aircraft were almost completely incinerated.

1.15. Survival aspects

The force of the impact against the ground was such that the aircraft cabins could not maintain their shape, and the harnesses would have been unable to improve the occupants' chances of survival.

1.16. Tests and research

1.16.1. Witness statements.

Several witnesses in the area at the time of the accident provided a statement:

Witness 1.- Located to the north of the accident site, on a property in front of the plot where the helicopter landed. The witness heard an engine noise, although he couldn't tell if it was a helicopter or an aircraft and, on looking up at the sky, *saw a light aircraft and a helicopter getting closer and closer to each other, until, eventually they collided.* The witness said the light aircraft was coming from the direction of Palma and the helicopter from Alcudia. *The collision happened side-on, with the helicopter's main rotor blades hitting the light aircraft's wing and flying off, along with a dark-coloured piece of fuselage. Immediately after the collision, the helicopter went into a spin and the light aircraft dived in the opposite direction.* After they hit the ground, the witness heard two explosions coming from the area of the helicopter and one from the area of the aircraft.

Witness 2.- Was on a plot between the two primary wreckage sites. He said he heard *a helicopter flying right over where I was sitting with some family members. I lifted my head to see it and, at that moment, I saw a light aircraft approaching underneath the helicopter.* Before he could finish saying, *what are they doing so close to each other?* they had collided.

Next, debris began to fall on his land, while *the helicopter became completely destabilised, lurching and losing altitude until it fell on a property some 700 m from his.*

When asked about the direction of travel of each of the aircraft, he said the helicopter was heading towards Palma and the aircraft towards Alcudia (the directions in which they fell), and although he couldn't specify the height, he thought they were flying low.

He added that, given his position, for a moment he even thought that both aircraft were going to land on top of them.

Lastly, he said he heard the sounds of the initial impact and the light aircraft hitting the ground. Then, after about five minutes, two explosions which came from the light aircraft. With regard to the helicopter, after it fell he saw a cloud of black smoke and about ten minutes later, he heard an explosion.

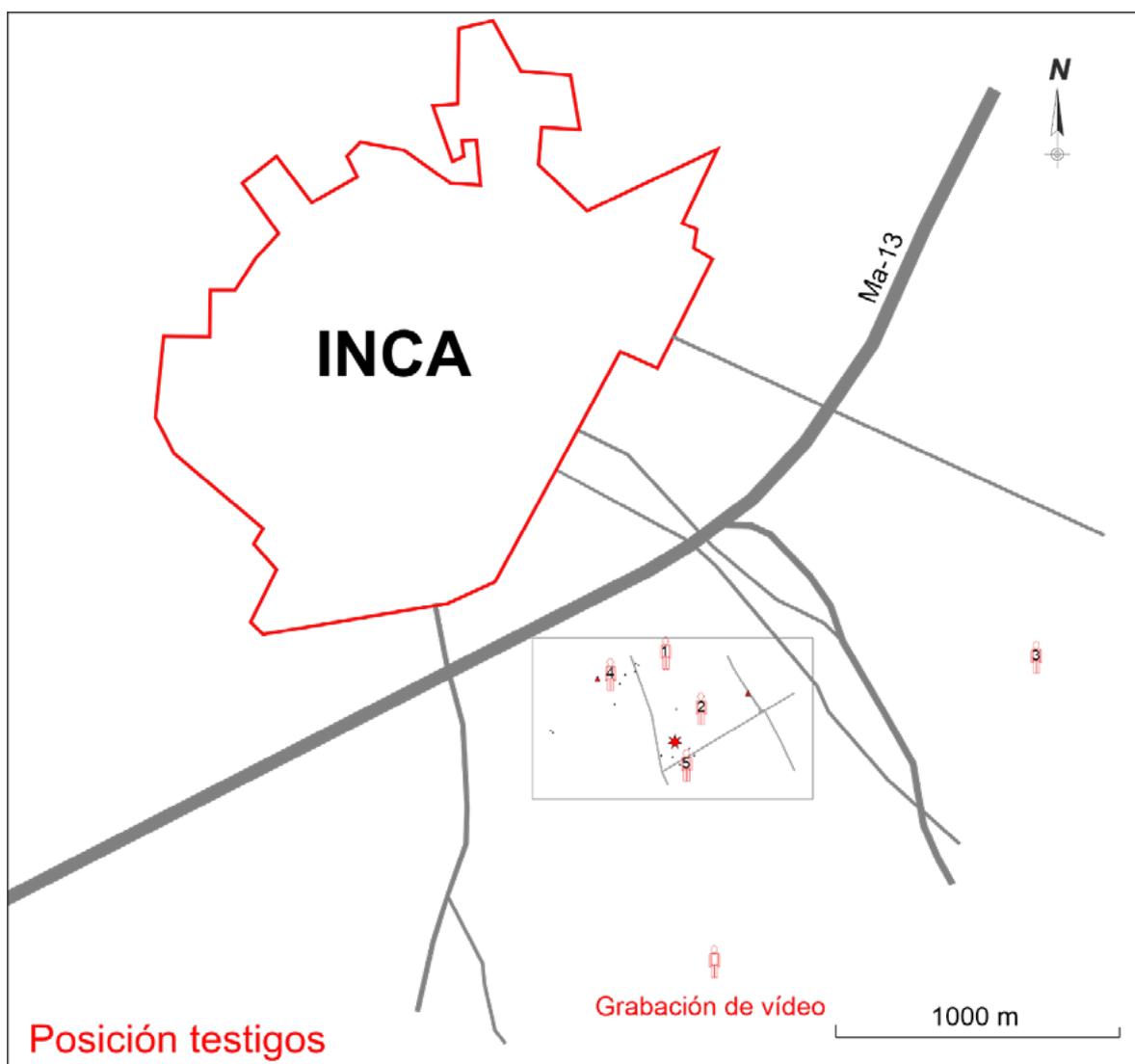


Fig. no. 9 - Map showing the location of the witnesses in relation to the wreckage sites.

Witness 3.- Was located to the east, on a property 1,300 m away from the accident scene. First, he saw a helicopter pass by coming from Costitx and heading towards Inca. After about five minutes, he saw *another helicopter heading in the same direction and a light aircraft, which flew towards the helicopter until they collided in mid-air. Rather than being a head-on collision the helicopter was going across and the light aircraft was heading straight, and it was the helicopter's propellers that hit the light aircraft.*

As soon as they collided, debris began falling everywhere and the helicopter started to lurch and spiral. The light aircraft dropped first and then the helicopter, with both falling in their respective directions of travel.

The witness added that the rotor blades were on top and hit the front of the aircraft. He believes the two aircraft were flying low compared to other aircraft he'd seen in the area.

He didn't hear any explosions after the accident, just the noise of the impact.

Witness 4.- Was outside her house on a property adjacent to where the helicopter landed. She stated that she was looking up at the sky when she saw a small, dark-coloured helicopter flying over her property towards the Sierra de Tramuntana. Less than a minute later, she saw another similar helicopter of the same colour following the same route and, although she couldn't actually see the markings, she assumed they were from the same company.

As the second helicopter flew towards my home and was about 300 m away, I spotted a white light aircraft flying towards Alcudia. The light aircraft was coming from my right, and the helicopter was straight ahead. Watching them, I don't think either of the two pilots saw the other aircraft until they were just a few metres away from each other and suddenly become aware of the situation. The helicopter was flying higher and turned to its right and down. The plane was lower, but it picked up speed and lifted its nose as it passed beneath the helicopter. At that moment, with the helicopter tilted slightly to its right and its nose pitched slightly downwards, the light aircraft overtook and, on lifting its nose, the main rotor of the helicopter cut into the rear rudder of the light aircraft. That bit of the rear rudder fell straight down below the place of impact, or just a few meters away, onto a property called Can Blai.

She went on to say that she also saw *the helicopter's propeller break off at the moment of impact* and fall onto the property adjacent to hers, which is separated by the old road to Costitx. She thinks the collision occurred about 150 m from her position.

She later added that, after the impact, the light aircraft plummeted out of sight. She then watched the helicopter as it hurtled towards the ground, first with its right side facing towards her while at the same time turning on itself, until it hit the ground with its tail end first.

As she watched the helicopter falling, she moved from where she had been standing to take refuge under her porch because pieces of it were falling on her property. She couldn't see the helicopter impact the ground.

Two other witnesses inside the house came out when they heard it impact the ground. The three of them headed towards the helicopter but retreated when they noticed the strong smell of fuel, just before it exploded twice. The first explosion was more intense than the second.

They went to fetch hoses to put out the fire as more neighbours appeared to try and extinguish the fire and help the victims.

They tried to call 112 without success and, after a while, the firefighters and emergency services arrived.

With regard to the light aircraft, she believed the neighbours living in the property it fell on managed to put out the fire with a hose.

She stressed that there were no explosions in the air, only on the ground, specifically two that came from the area of the helicopter. She didn't hear any explosions coming from the area of the aircraft.

The helicopter's main rotor was missing when it fell; it had already completely detached.

She stated that *the helicopter's nose was hit during the mid-air collision, and several pieces fell onto her property, such as a window, a door, etc...*

Lastly, she remarked that, after the mid-air impact, the light aircraft was intact apart from its tail rudder and that both aircraft performed an evasive manoeuvre at the same time. Furthermore, she said it was common to see aircraft flying over her home.

Witness 5.- Was on a property further along the road where the aircraft landed. First, he saw a helicopter flying over the area. Then, after about five minutes, he heard the noise of helicopter blades turning continuously in the air, as if it was hovering.

He looked up and saw *the helicopter's propellers hit the tail of the aircraft, making a loud noise and forming a tremendous cloud. Pieces fell to the ground and then the aircraft plummeted out of sight.*

He immediately left his property and watched as, to his left, the helicopter *spun around on itself then turned with its blades down and dropped, its nose closer to the ground than the tail.* He confirmed the helicopter was heading towards Palma and the light aircraft towards Alcudia.

He made his way to where the light aircraft had landed, and he and the owner of the property put out the fire. After a few minutes, the firefighters arrived.

He said parts of the aircraft fell on his property but could only identify the *white rear directional fin of the light aircraft*, which was at the entrance to his land. He believes they were flying lower than normal, and he didn't hear any explosions.

Witness 6.- Pilot of the Robinson R-44 helicopter.

He started his testimony by saying that he is a self-employed pilot who, on the day of the incident, had been hired by Rotorflug, as on previous occasions, to transport three passengers and accompany the helicopter involved in the accident on the same flight route.

He had been in Son Bonet with the deceased helicopter pilot at around ten² in the morning and had arrived at the La Reserva Rotana farmhouse in Manacor at one³ in the afternoon. When he arrived, the aforementioned pilot was already there with another helicopter.

Later, two families arrived. They took photos, and the Bell pilot held a safety briefing in German with the families.

Subsequently, on realising they couldn't fit four people in each helicopter (it had to be five and three), one of the families decided to travel by car, and the four members of the other family boarded the Bell 206 L3 helicopter.

The Bell 206 L3 took off first and he then followed with his helicopter, bound for the Son Bonet Aerodrome. As his helicopter was lighter, he overtook them and continued on his route.

During the flight, he notified his position several times on the Son Bonet Aerodrome frequency to make his presence known to any other traffic. He also listened as the other helicopter pilot announced his position on the same frequency, not mentioning any problem with the flight or the aircraft.

When asked how the deceased pilot seemed to him that day, he stated that his impression, as usual, was that he was perfectly capable of carrying out the flight.

Trying to find an explanation for what happened, he suggested a factor to take into account is the *issue of having to fly in a narrow strip of air between 500 ft and 1000 ft, which is saturated with light aircraft and has little room for manoeuvre. In addition, ultralights aren't obliged to carry a radio and, if they do have one, in the vicinity of Binissalem Aerodrome, they use the Binissalem frequency and not Son Bonet.*

² Local time

³ Local time

1.16.2 Video documentation

A witness located 900 m south of the accident site supplied us with a video recorded on a mobile phone.

The video lasts fourteen seconds, and although the image quality is poor, it shows parts of the trajectories of the helicopter and the ULM moments before the mid-air collision. The actual moment of impact is not recorded because a pergola in the area blocks the view of the aircraft.

A photogrammetric study of the video has made it possible to estimate the aircraft were flying at a height of between 500 ft and 1000 ft, therefore ruling out the possibility they were flying at an altitude of less than 500 ft.

1.17. Organisational and management information

Aircraft flying in the uncontrolled airspace use the 123.50 MHz Son Bonet Aerodrome frequency.

As indicated by the operator, Rotorflug, by default, their aircraft always fly with the VFR 7000 standard code when no other transponder code has been previously assigned to them.

Furthermore, when its aircraft fly in the vicinity of Binissalem Aerodrome and other restricted-use aerodromes in Mallorca, they communicate on the 130.15 MHz frequency (except for the Es Cruce aerodrome, which operates on the 130.20 MHz frequency).

Similarly, according to the Binissalem Aerodrome flight manager, and as stated in point 7 of the aerodrome flight regulations, *radio-equipped aircraft flying in the specialised restricted aerodrome traffic pattern must use the ULM frequency of 130.15 MHz. On leaving the traffic pattern, they must transfer to the area's 123.5 MHz air-to-air information frequency called Son Bonet radio.*

1.18. Additional information

1.18.1. Air space information

The flights operating from the Binissalem airfield are mostly ultralight aircraft and, as such, are not required to use radio equipment, a transponder code, or submit a flight plan.

The aircraft with registration D-HOTT had submitted a local visual flight plan with the origin and destination specified as Son Bonet Airport, an intermediate stop at a private estate in Manacor (Rotana), scheduled departure at 08:15 UTC, a flight time of 4:30 h and five hours of autonomy. The flight plan says there would be two people on board.

The collision occurred to the SW of the Mallorcan town of Inca, in uncontrolled "G" classified airspace.

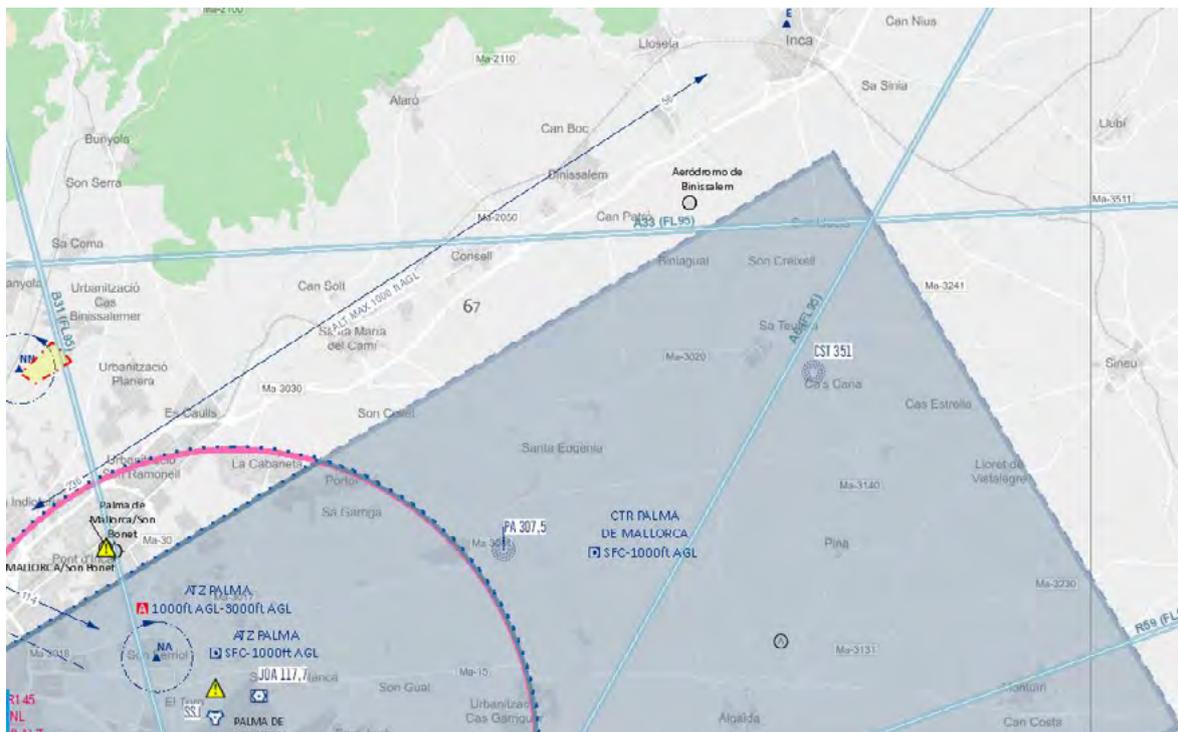


Fig. no. 10 - Palma CTR (grey zone) and location of Binissalem Aerodrome

As established by European Regulation SERA.6001, in a class "G" airspace, aircraft are not subject to ATC clearance, separation is not provided between any type of flight and a flight information service is only provided on request.

Both aircraft were flying in the Palma sector for VFR flights, where traffic must maintain a maximum of 1000 ft AGL because the class "A" Palma TMA is directly above it.

The pilots-in-command did not request any information from the Palma ACC (LECP) flight information service as no such communication was recorded by said unit. Any possible communications on either the Binissalem or Son Bonet frequencies were not capable of being recorded and, therefore, we have been unable to confirm whether the aircraft notified their positions and intentions.

Furthermore, although there were no radar traces, we can't be sure they weren't using their respective transponders because coverage problems are common at the height they were flying.

We have been unable to locate any pilot who was in the area at the time and can confirm hearing notifications from the aircraft.

1.19. Useful or effective investigation techniques

N/A.

2. ANALYSIS

2.1. General aspects

According to the documentation provided, the aircraft's pilots were in possession of the relevant licenses and medical certificates required for the flight. They also had extensive experience in the activity they were carrying out.

The aircraft had the correct documentation for their respective flights.

Both aircraft had made flights immediately prior to the accident flight with complete normality and no incidents reported. We, therefore, believe they were in good condition for the flight.

The take-off weights of both aircraft were within the operational limits of their respective flight manuals.

2.2. Of the weather conditions

According to the information provided by the State Meteorological Agency (AEMET), the meteorological conditions in the area at the time of the accident were light cloud, light winds and good visibility.

Therefore, the operation was carried out within the admissible meteorological conditions for this type of activity.

2.3. Of the operation

After checking the ACC and TWR frequencies, no communication with the aircraft involved could be identified, indicating that the pilots-in-command did not request the flight information service.

As there are no radar traces, we cannot confirm whether both aircraft used their respective transponder equipment.

Furthermore, although the pilot of the R-44 helicopter claimed the Bell 206 notified its position on the 123.5 MHz frequency at the beginning of the flight, we have been unable to confirm whether either aircraft reported their position and intentions through corroboration with any other listening user in the area of the accident.

Therefore, whether the pilots were aware of each other's presence in the area remains unknown.

With regard to the location of the accident, it occurred to the SW of the Mallorcan town of Inca, in uncontrolled airspace classified as "G". Specifically, both aircraft were flying in the Palma sector for VFR flights, where traffic must maintain a maximum of 1000 ft AGL because the class "A" Palma TMA is directly above it. Thus, flights in the area of the accident must stay within the narrow margin of 500 ft and 1000 ft above ground level.

Additionally, and as established by European Regulation SERA.6001, in a class "G" airspace, aircraft are not subject to ATC clearance, separation is not provided between any type of flight and the flight information service is only provided on request. The pilots themselves are responsible for maintaining adequate separation from the other aircraft according to the general standards outlined in the Air Traffic Regulations.

2.4. Of the aircraft wreckage and impact

Based on the different witness statements and the video recording, we can confirm that, just before the mid-air collision, the aircraft were on convergent trajectories coming from opposite directions, with the ultralight slightly below and to the left of the helicopter, according to the latter's direction of travel. Although we have concluded that the impact was side-on, we have been unable to determine the exact angle between both trajectories.

A study of the images in the aforementioned video has also confirmed that the aircraft were not flying below 500 ft, which is consistent with the main wreckage being found in two distinct and distant groups and the detached parts being dispersed throughout the area.

Helicopter

The helicopter wreckage was mostly concentrated at the impact site. However, the main rotor, vertical stabiliser and tail rotor detached from the main structure and were found scattered over a considerable distance.

The pieces of the main and tail rotor blades all displayed creases, scratches, breakages and deformations consistent with impact, both against the aircraft and the ground.

The fact that the main rotor head and different pieces of the blades were found more than 90 m from the main wreckage and more than 240 m away from each other is consistent with the blades impacting powerfully against the ultralight aircraft and the uncontrolled trajectory of the helicopter on its descent.

Specifically, the torsional shear evident on the main rotor mast is congruent with it bumping against the static stops of the rotor head due to the excess flapping of the main rotor blades, possibly after destabilising and going into a spin as a consequence of losing its tail rotor.

As for the main rotor blades, after the impact, one of the blade tips flew off and hit the ultralight. The others, which were already deformed, came loose and were ejected when the helicopter went into a spin after losing its tail rotor.

Additionally, the detachment of the vertical stabiliser and tail rotor, and their distance from the two main groups of debris, is consistent with the aircraft colliding in mid-air. The white paint transferred from the aircraft to those parts also corroborates the contact between the aircraft.

Of particular note is that the helicopter's vertical stabiliser came off in two parts (the upper part completely separating) and displayed significant deformities and evidence of crushing on its front, confirming that it was involved in a powerful collision with the main body of the aircraft.

As no evidence corroborating the mid-air collision (deformations or dark paint marks from the helicopter) was found on the debris of the ULM, it's highly probable the impact affected the front part of the aircraft, which was completely destroyed by the fire.

Ultralight

The aircraft had impacted the ground in an almost vertical inverted position, with its front part, fuselage and left wing landing within the plot, and the right wing and tail assembly on top of the wall itself and extending onto the road.

The absence of markings beyond the impact site, and the broken branches in the tree next to it, show that its trajectory in the moments before impact was practically vertical.

Although most of the ultralight debris was concentrated at the impact site, the fact that various pieces of it (rudder, the upper part of the rear vertical stabiliser, left wingtip, left flaperon and part of the landing gear fairing) were found some 250 m away suggests they broke off in mid-air as a result of the collision.

The severed part of the left wing accounted for approximately one-third of the whole wing. Its underside was split open in the direction of the chord, one metre from the tip. It was torn and lacerated throughout. The flaperon belonging to said wingtip, which was found about 25 m away, was also torn and lacerated.

Having studied the lacerations and deformations observed on both parts, we have concluded that they could have been caused by the helicopter's main rotor blade. Given the relative proximity of the two pieces on the ground, they were probably both damaged by the same action.

The tail assembly, which was separated from the rest of the aircraft in an inverted position, had splashes of lubricating oil from the main rotor yoke (reddish in colour) on the underside of its left horizontal stabiliser. This would suggest that the two parts made contact at some point in the collision or, at the very least, that they came very close to each other.

The upper section of the vertical stabiliser was incomplete, with a left to right laceration running almost parallel to its upper edge (according to the aircraft's direction of travel). The detached upper section was found with its corresponding riser 180 m away. The rudder was found in the same place and also had a laceration at the same height going in the same direction, starting from the part closest to the stabiliser and extending almost to the furthest edge (going from left to right according to the aircraft's direction of travel).

The findings above are consistent with an impact from the end of one of the helicopter blades. Because of their anti-clockwise rotation and the relative positions of the two aircraft, the blade would have struck from the left and reached the entire horizontal length of the stabiliser (severing the upper part) and most of the horizontal length of the rudder, tearing it without completely severing its top, which remained attached to the main body.

Considering the evident grouping of most of the significant amount of debris that broke off in mid-air (the helicopter's vertical stabiliser (both parts), tail rotor (two pieces), the aircraft's rudder, stabiliser end, left wingtip and flaperon), we can establish that the collision happened somewhere within the vertical area above the debris distribution zone.

Possible impact scenario:

Based on the testimonies of the witnesses and the analysis of the wreckage, we have attempted to determine the positions of the aircraft during the impact, concluding that the most likely situation at the time of the collision was the following:

The aircraft were on converging trajectories travelling in opposite directions, with the ultralight slightly below and to the left of the helicopter, according to the latter's direction of travel.

Up until the instant before the collision, the pilots were unaware of the presence of another aircraft in their surroundings. At the last moment, the pilots became aware of the imminent collision and performed an evasive manoeuvre: the helicopter lowering its nose and turning to the right, causing the main rotor blades' plane of rotation to be practically vertical, and the ultralight applying power to rise slightly above the helicopter.

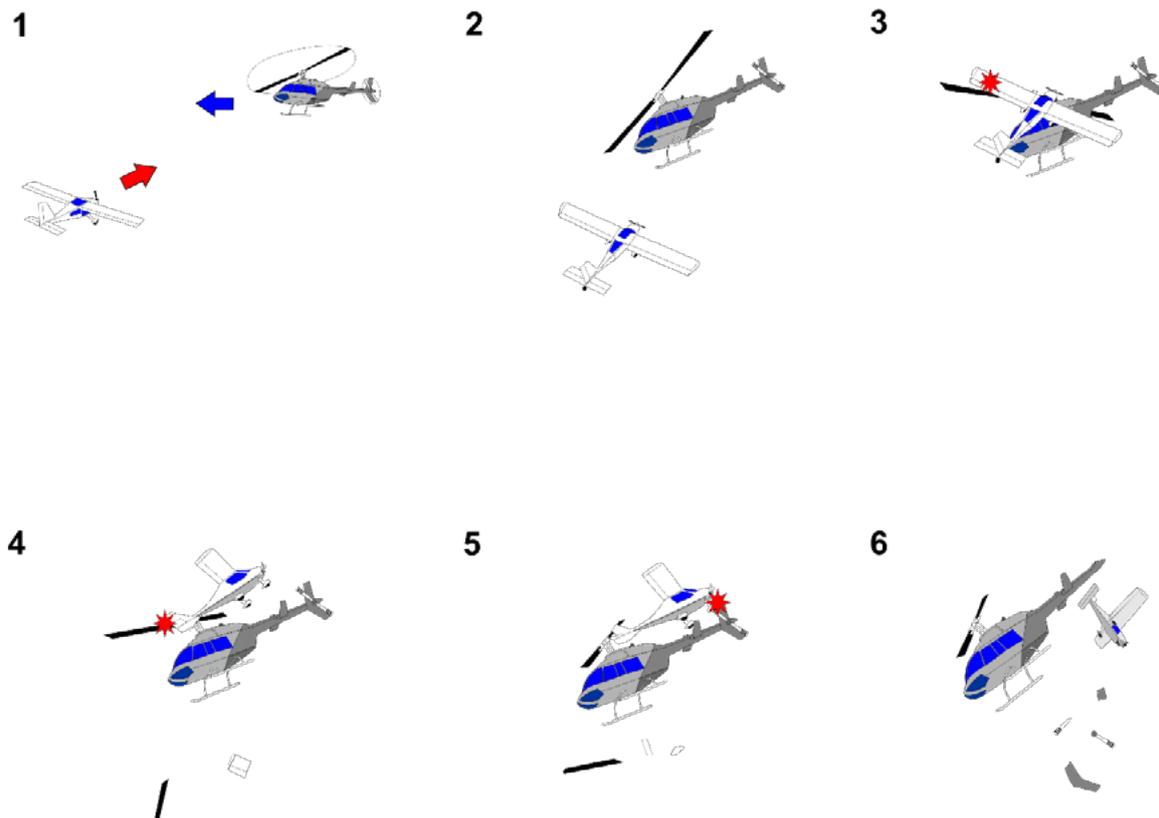


Fig. no. 11 - Impact sequence

At that moment, the blade that rotates in an anti-clockwise direction hits the ultralight's left wing, severing the tip and its flaperon.

Subsequently, and as a consequence of losing lift from its left wing, the ultralight veers sharply to the left, moving its stabiliser and rudder towards the side of the helicopter and, more specifically, towards the main rotor's plane of rotation, which results in the next blade completely severing the top of the stabiliser and partially severing the rudder. At the same time, the ultralight's forward momentum causes its front underside to hit the helicopter's vertical stabiliser, which houses the tail rotor, causing it to break into two parts and subsequently fall off.

The ultralight, which is now missing part of its left wing and its stabiliser, enters a left-hand spin, causing it to impact the ground in an inverted position.

The helicopter, with its main rotor blades damaged and without a tail rotor or vertical stabiliser, begins to spin out of control in a clockwise direction, descending until it finally crashes into the ground.

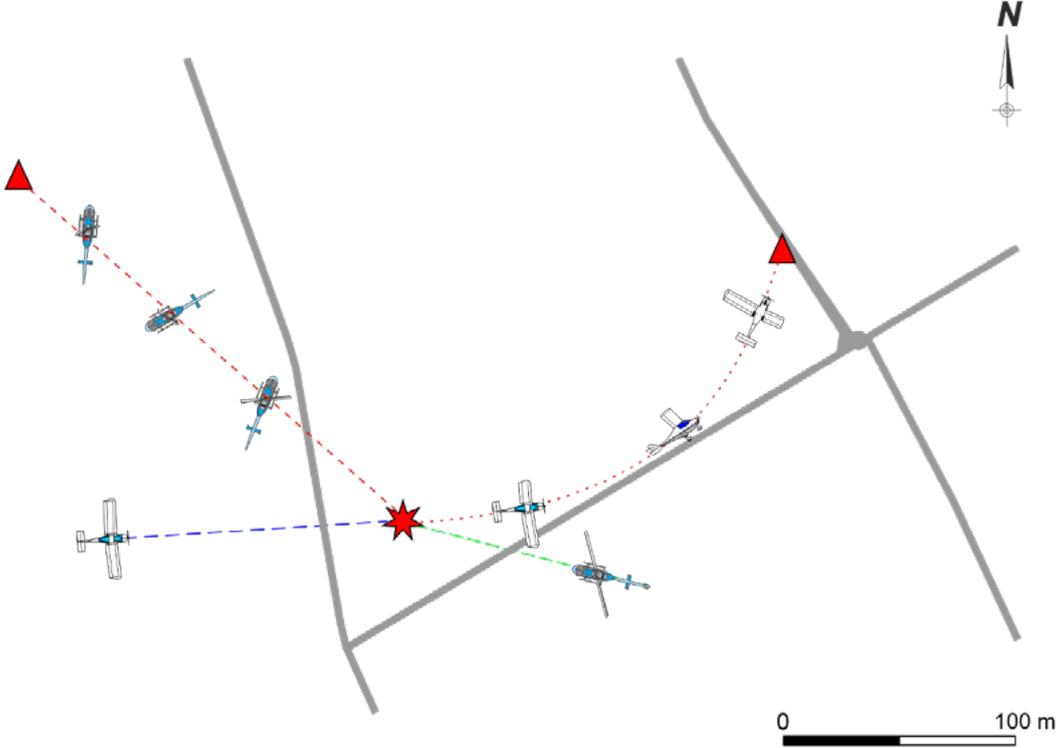


Fig. no. 12 - Sketch of the impact trajectories

3. CONCLUSIONS

3.1. Confirmed findings

The aircraft pilots held the required licenses, ratings, and relevant medical certificates for the flights they were carrying out.

Both aircraft had valid certifications and licenses for the flight.

The take-off weights of both aircraft were within the operational limits of their respective flight manuals.

There were no limiting meteorological conditions for the flight.

The flight was carried out under visual flight rules.

The aircraft were flying in a "G" classified uncontrolled airspace.

The aircraft were not flying below 500 ft.

In the moments leading up to the collision the aircraft were on converging trajectories.

The pilots did not see or detect the presence of the other aircraft until moments before the collision, at which time they initiated evasive manoeuvres.

During the collision, both aircraft lost critical control elements and surfaces, which made it impossible for them to complete their flights safely.

3.2. Causes/contributing factors

The most likely cause of the accident was insufficient airspace surveillance.

4. RECOMMENDATIONS

None.