Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

Air Accident Investigation Unit - (Belgium)
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Safety Investigation Report

ACCIDENT TO HELICOPTER ROBINSON R-22 AT HUY ON 6 APRIL 2012

Ref. AAIU-2012-06-Huy
Issue date: 30 January 2013
Status: Final

FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident.

In accordance with Annex 13 of the Convention on International Civil Aviation and EU Regulation 996/2010, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and define recommendations in order to prevent future accidents and incidents.

In particular, Article 17-3 of the EU regulation EU 996/2010 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility in the accident.

Unless otherwise indicated, recommendations in this report are addressed to the Regulatory Authorities of the State having responsibility for the matters with which the recommendation is concerned. It is for those Authorities to decide what action is taken.

The investigation was conducted by Sam Laureys, Henri Metillon and Luc Blendeman

The report was compiled by Henri Metillon and was published under the authority of the Chief Investigator.
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NOTES:

1. For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

2. ICAO document 9859 “Safety Management Manual” was used to identify the hazard and the consequences related to the accident.

SYNOPSIS

Date and hour of the accident:	06 April 2012 at 15:50
Aircraft:	Helicopter Robinson R-22 Beta II
Accident location:	Huy, Belgium. On a park bordering the N66 “Route du Condroz” N 50° 30.977 E 005° 14.486
Aircraft owner:	BEST IN SKY S.N.C.
Type of flight:	Aerial work (Photography)
Persons on board:	2

Abstract:
The helicopter took off from EBNM at 15:20, with a photographer on board for the purpose of taking aerial photographs of the center of Huy.
Three witnesses in Huy confirm that they saw the helicopter “coming from the North” making a turn, and starting to hover close to the city cableway cable. After a short period, they saw the helicopter slightly moving aft; they stated they saw the rear of the helicopter colliding with the cableway cable, and falling “like a stone”. The helicopter crashed into a small park, bordering the N66 “route du Condroz”.
Upon impact, the helicopter caught fire and was totally destroyed. The two occupants died from the impact forces.

Cause(s):
The accident was probably caused by the pilot not seeing or losing visual contact with cableway cables during hover flight at low altitude in the close vicinity of the cableway, causing the main rotor blades to collide with the cables and subsequent loss of control of the helicopter.

Hazard identified during the investigation[1]:
Flying under the minimum required safe height and distance from obstacle.

Consequence[2]:
Controlled flight into or toward terrain (CFIT) and loss of control – in-flight (LOC-I)

[1] Hazard – Condition or object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.
[2] Consequence – Potential outcome(s) of the hazard

1 Factual information.

1.1 History of flight.

Further to extensive works to the sewer system in the centre of the town of Huy, the local merchants decided to file a case against the town management and asked a local photographer to prepare a photo report to highlight the troubles caused by these works.

Figure 1: view of the works rue du Houyoux

The local photographer hired the company “Best in Sky”, located on the Namur airfield (EBNM) to provide the means to take aerial photographs.

On this day the meteorological conditions were adequate to take pictures.
The photographer arrived at Namur airfield around 15:00. The pilot prepared an over flight tour of the city in collaboration with his customer, using a “Low-Air” aeronautical chart (Scale: 1/250000).

The helicopter took off from EBNM at 15:20, with the photographer on board.

As seen on the following drawing, the flight path was reconstructed based on the recorded radar echoes and was superimposed on a map of the city. The general path of the helicopter began with a counter clockwise flight around the most densely populated areas and finished by an over flight of the market place (Grand Place) before proceeding near the cableway cable.

The city of Huy features a cableway starting from the north bank of the river Meuse and going west to the “Plaine de la Sarte”, 1290 meters
Further on.

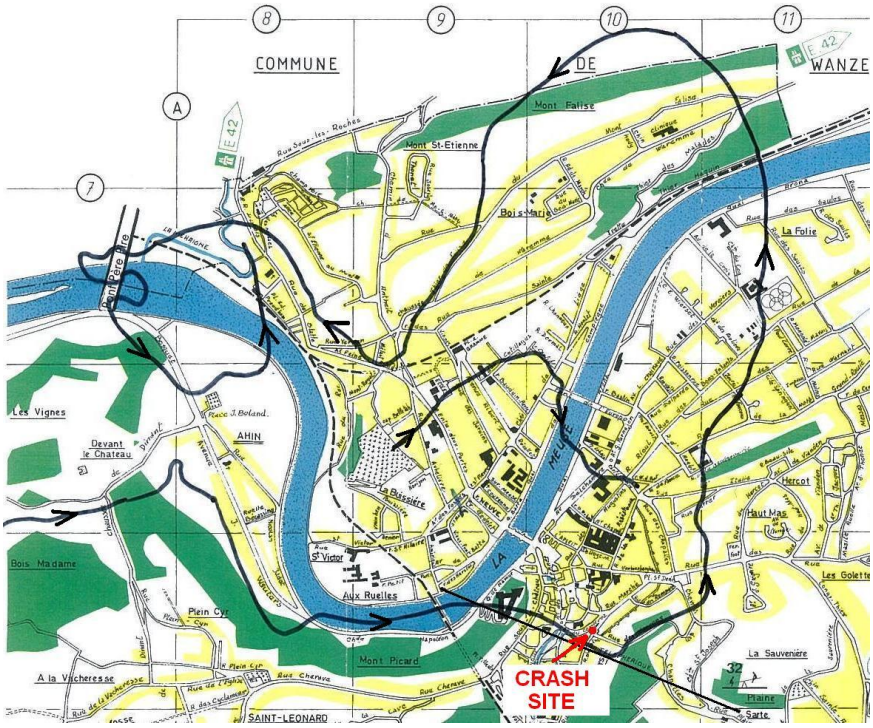


Figure 2: Flight path above Huy

Three witnesses declared that they saw the helicopter flying above the city and starting to hover approximately at the height of the cableway cables, close to them. The helicopter was hovering north of the cable with the cabin pointing to the North North-East and the tail pointing to the South South-West.

Most of the witnesses immediately realized that the helicopter was hovering in the close vicinity of the cables.

After a short period, they saw the helicopter slightly moving aft; they stated they saw the tail of the helicopter colliding with the cableway cable, and falling down rapidly. One of the three witnesses, sitting on the North East corner of the Main Plaza saw a slight movement to the right when the helicopter was coming down.

Figure 3: View of the crash site.

The helicopter crashed into a small park, bordering the N66 “route du Condroz”, slightly before 16:00.

It fell down between three trees located close together causing a few broken branches.

The quarter where the crash occurred is called “Saint-Remy”. It is close to the Huy hospital and on the border of a non-built-up area located East (Wood …)

Upon impact, the helicopter caught fire and was totally destroyed.

The two occupants died from the impact forces.

1.2 Injuries persons.

Injuries	Pilot	Passenger	Others	Total
Fatal	1	1	0	2
Serious	0	0	0	0
Minor	0	0	0	0
None	0	0	0	0
Total	1	1	0	2

1.3 Damage to aircraft.

The helicopter was totally destroyed upon impact with the ground and immediately caught fire.

1.4 Other damage.

The accident caused the rupture of a main and a secondary (rescue) cable of the cableway and therefore significant damage to the entire installation.

Upon the rupture, the heavy steel cables (40 mm diameter) fell into the city, causing extensive damages to several houses.

The cables also fell into the Meuse river, with the consequence that navigation on the river was interrupted as well as the traffic inside the city for more than 24 hours.

Figure 4: Damage to the roofs.

Figure 5: Main and secondary cables.

1.5 Personnel information.

Pilot:

- Sex: Male
- Age: 56 years old
- Nationality: Belgian
- License: Holder of a Commercial Pilot Licence (Helicopter), first issued on 18 March 1998, valid until 31 May 2015.
  Flight instructor valid until 30 April 2014.
  Flight examiner valid until 30 June 2013.
  Rating:
  BELL 206/206L valid until 31 march 2012.
  AS 355/355N valid until 30 April 2012.
  R 22 and 44 valid until 31 May 2012.

- Flight experience:
  Extensive experience as military helicopter and multi-engine piston airplane pilot beginning in 1981.
  Total flight hours exceeding 10.000 FH
  Total flight hours on helicopter: around 8000 FH
  Total flight hours on R 22: around 3900 FH

- Flights performed during the last two days (Approximate Time as the log books were destroyed by fire)
  Thursday 05/04:
  08:00-09:00: Training R44
  09:00-10:00: Training R22
  13:00-14:00: Training R22
  14:00-15:00: First Flight of a passenger R22
  Friday 06/04:
  07:30-08:30: Training R22
  09:00-10:00: Training R22
  12:00-13:00: Training R44
  15:00-16:00: Fatal Flight

Passenger:

The passenger had no aeronautical background.

1.6 Aircraft information.

General information

The R-22 is a single-engine helicopter with a semi-rigid two-bladed main rotor and a two-bladed tail rotor. The main rotor provides a teetering hinge and two coning hinges. The tail rotor provides only a teetering hinge.

The basic structure is welded chromoly steel tubing. The forward fuselage is made of fibreglass and aluminium with a Plexiglas canopy. The tail cone, vertical and horizontal stabilizers are aluminium.

It has an enclosed cabin with side-by-side seating for a pilot and passenger. The doors may be removed for flight, and are often done so for photographic flights.

The R22 Beta II is equipped with a de-rated Lycoming 0-360 engine. It allows greater altitudes for hovering in and out of ground effect.

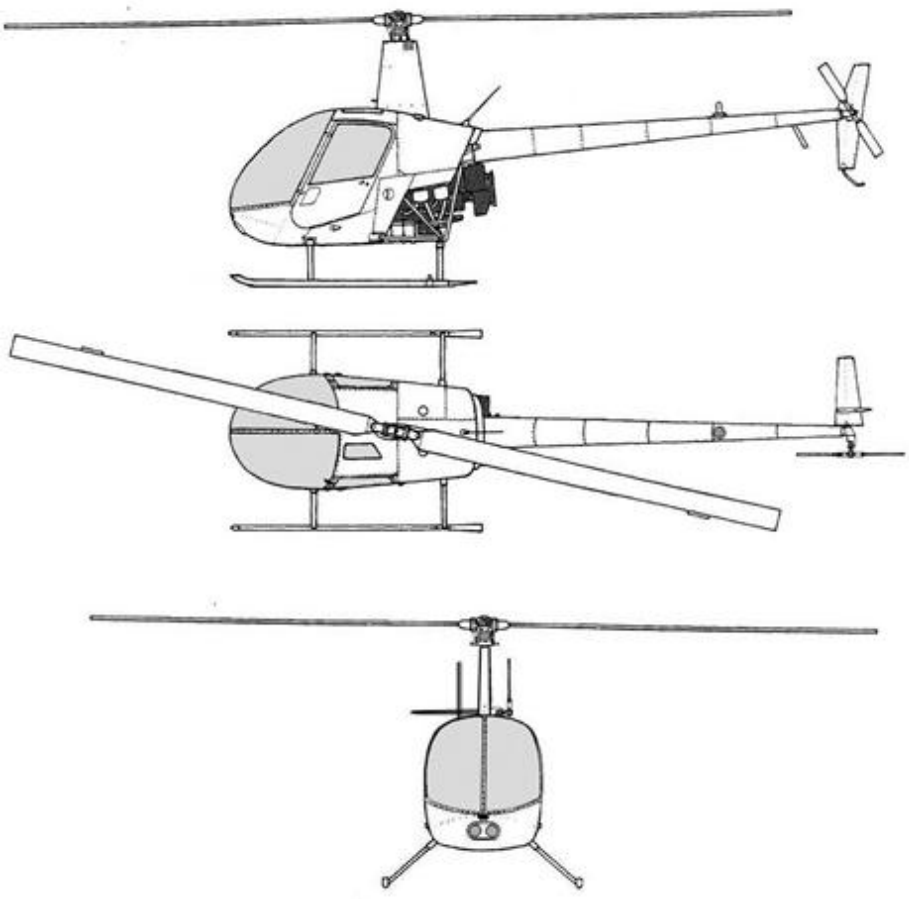


Figure 6: Schematic view of the Robinson R-22.

General characteristics

○ Crew:	1
○ Length:	8.7 m
○ Rotor diameter:	7.7 m
○ Height:	2.7 m
○ Empty weight:	389 kg
○ Loaded weight:	417 kg
○ Max. takeoff weight:	635 kg
○ Power plant:	1 × Lycoming O-360 piston engine

Performance

○ Cruise speed:	96 kts, (177 km/h)
○ Range:	386 km
○ Service ceiling:	14,000 ft (4,267 m)
○ Rate of climb:	1,200 ft/min (6.1 m/s)
○ Endurance:	+/- 2 hours, with 30-minute reserve

Airframe:

○ Manufacturer:	Robinson Helicopter Company
○ Type:	R22 B
○ Serial number:	847
○ Built year:	2005
○ Certificate of registration:	Delivered by BCAA - Number 5488
○ Certificate of airworthiness:	Delivered by BCAA on 30 June 2005
○ Airplane total time:	1307,3 FH on 1st March 2012

Engine:

○ Manufacturer:	Lycoming
○ Type:	O-360-J2A
○ Serial number:	L-39995-36A
○ Total flight hours:	1307,3 FH on 1st March 2012

Construction of the main rotor blades.

The main rotor blades are constructed using a single piece of steel leading edge which is also the beam of the blade.

The leading edge is mostly hollow except close to the end of the blade where weights are installed.

The shape of the blade is obtained by using formed honeycomb material and aluminium sheet metal which are glued together and to the beam.

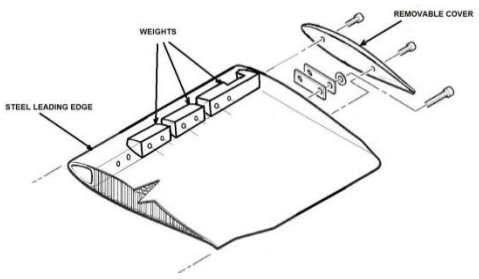


Figure 7: Main rotor blade tip

1.7 Meteorological conditions.

The meteorological conditions were obviously acceptable for VFR flight. The METAR of EBLG airport between 13:20 and 17:50 shows that the wind was around 7 kts and the visibility was more than 10 Km.

At 15:50, the sun was oriented at 252°, with an elevation of 23°. In other words, the sun was located behind the cable, with respect to the helicopter.

1.8 Aids to navigation.

The helicopter was equipped with a mode S transponder which allowed the EBLG radar to follow and record the helicopter flight path.
The flight path could be divided in different sections:

- From 15:30 to 15:50, the helicopter is clearly detected and identified. As from 15:30 to 15:41, the helicopter's pilot radioed with Liège tower, it was possible to synchronize the helicopter position and the recorded communications.
- Around 15:41 the helicopter disappears from the radar screen for about 100 seconds.
- Around 15:42, a code A7000, likely to be the helicopter, re-appears on the radar screen and is flying to the east for around 2 minutes before finally disappearing around 15:48 approximately 500 m from the crash site.

1.9 Communication.

As seen hereunder, the pilot asked authorization to enter the EBLG CTR and explained the purpose of the flight.
The conversation with EBLG tower stopped around 10 minutes before the crash, after having received the authorization to enter the CTR.

Time	Calling station	
15:32:27	Helicopter	Liège, good afternoon,
15:32:30	EBLG TWR	Good afternoon Sir, radar contact, go ahead
	Helicopter	Helicopter, Robinson 22; VFR from Namur to Namur, for reconnaissance of the traffic on the roads in the vicinity of Huy, request permission to enter
15:32:50	EBLG TWR	Calling you back
15:32:57	EBLG TWR	Helicopter, say again your routing requested
15:33:05	EBLG TWR	Helicopter, say again your requested routing
15:33:08	Helicopter	In the vicinity of Huy, overhead the city for reconnaissance of the traffic on the roads in the vicinity of the city
15:33:18	EBLG TWR	OK, helicopter, clear to enter the CTR, QNH1010, Runway 05 Right in use
15:33:25	Helicopter	1010, clear to enter, Helicopter
15:39:00	EBLG TWR	Helicopter
15:39:06	EBLG TWR	Helicopter, report level
15:39:08	Helicopter	2000ft Helicopter
	EBLG TWR	Roger, that's copied; if you need to climb above 2500, advise me; you would enter the TMA then
15:39:28	Helicopter	I will do so, but I don't think we need to climb above 2000ft.

1.10 Aerodrome information.

Not relevant

1.11 Flight recorders.

There was no flight recorder on board.
The helicopter was GPS equipped but this equipment was entirely destroyed by the fire as well as the camera of the photographer.

1.12 Wreckage and impact information.

Parts found in the main wreckage area

Most of the helicopter parts were found on the crash scene, badly crushed by the contact with the ground and burned from the resulting fire.

The wreckage orientation was with the cabin pointing to the East and tail pointing to the West.
The wreckage was surrounded by trees showing minimal damage. However, the trees were partially burned.

The left part of the "T-bar", left collective control, and left tail rotor pedals were not retrieved in the wreckage. Obviously, they had been removed for the flight. The main rotor transmission and hub were found located above the remains of the cabin, but the entire transmission had been moved by the rescue services when the investigators arrived on the crash site.

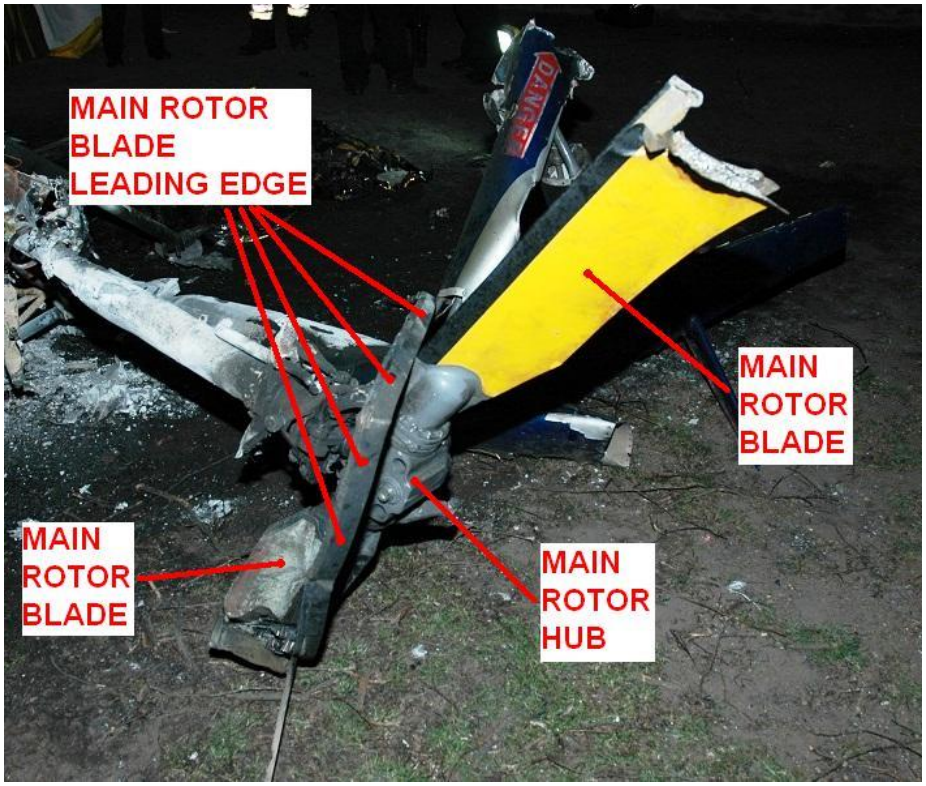
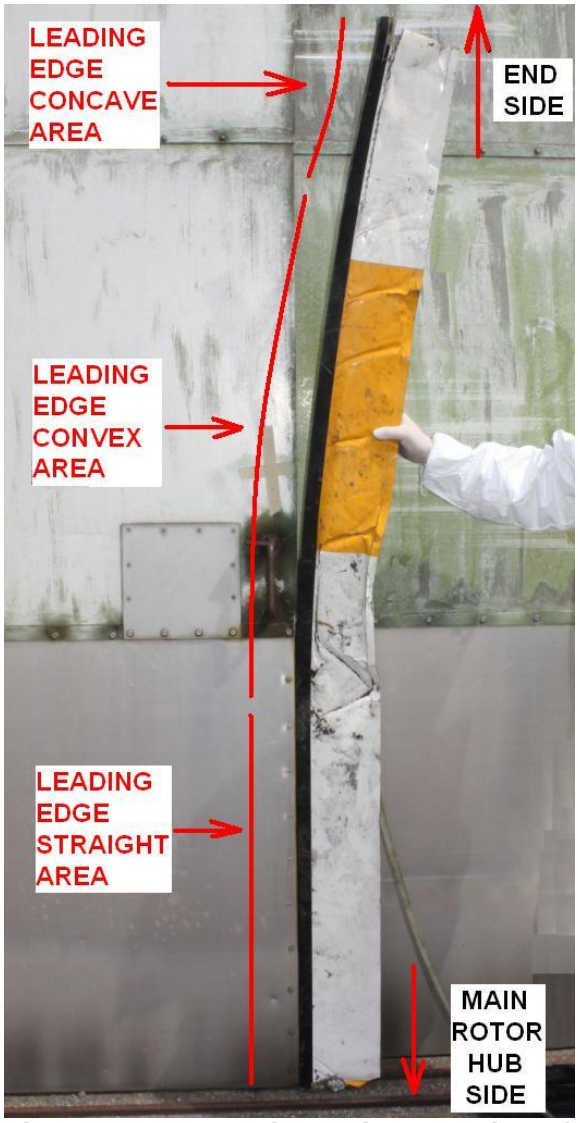


Figure 8: Main rotor hub and remains of MR blades as found on the crash site.

A 0,70 meter long remnant of one main rotor blade was still attached to the main rotor hub (The extrados in yellow on the picture).

The second main rotor blade was also attached to the hub, beginning with a damaged (bent) 0,65 m long (grey on the picture) blade extending with a

burned 2,9 m long remnant of the leading edge. Actually, the intrados and extrados sheet metal remains were found in the wreckage, separated from the leading edge by the fire.



A 2,3 meters long section of the other main rotor blade (not burned) was found on the ground 5 meters away North East from the wreckage.

Figure 9: Separated 2,3m long section of MR blade.

None of both main rotor blade ends were found in or close to the main wreckage.

One blade of the tail rotor was found damaged by fire and still attached to the hub while the second blade of the tail rotor had been severed at the root and was not present in the main wreckage.

Parts found at 30 meters south of the main wreckage

Figure 10: Separated tail rotor blade.

The separated tail rotor blade was retrieved in a swimming pool located in the rear garden of a house located in “rue Haut du Chêne”, 9.

A cabin door and door parts were also found further away on the terrace of the same house.

Figure 11: Separated main rotor tip end.

A 12 cm-long part of the removable blade tip cover, identified “A300-2” was found at N 50° 30.987’ E005° 14.540’
A part of a weight was still attached.

Part found at 130 meters east of the main wreckage

A 15-cm long steel part, weighing 543g, featuring weights was found at N 50° 30.982' E 005° 14.598' (rue des Larrons 4, near a school gate).

This part, showing sharp edges and weights, was determined to be a main rotor blade beam end.

Figure 12: Separated main rotor beam/leading edge end.

Part found 150 meters east of the main wreckage

A 0,75 m section of the extremity of a main rotor blade trailing edge was found east from the above 15 cm long part, in a playground near the school.

Figure 13: Separated 0,75m section of MR blade without beam/leading edge.

Position of the wreckage and of retrieved separated parts.

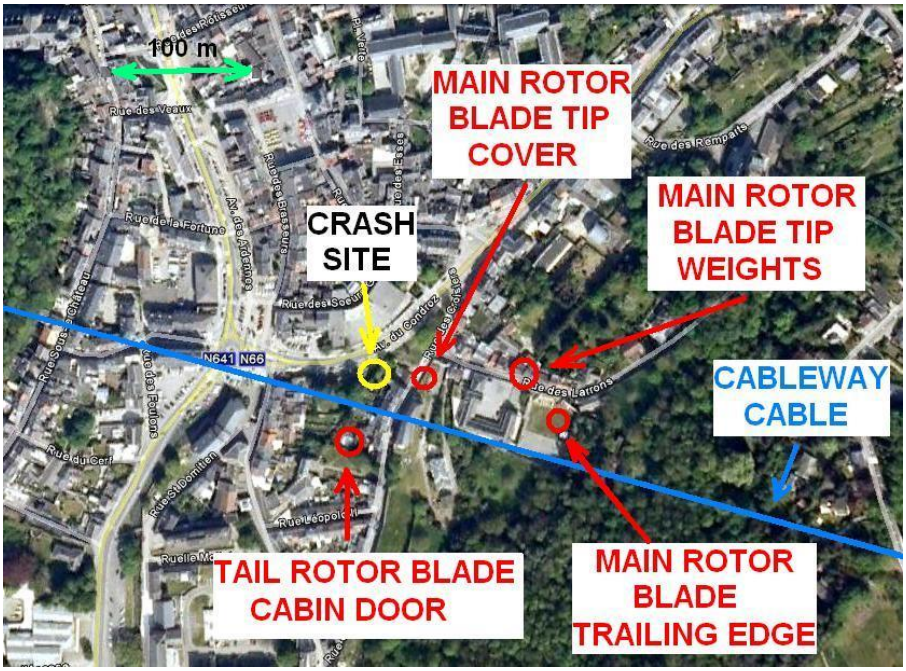


Figure 14: View of the in-flight separated parts.

1.13 Medical and pathological information.

The occupants died from the forces of impact. The two bodies were severely burned during the subsequent fire, and were sitting at the location of the seats when the Medical examiner first saw them. The examination of the bodies confirmed that the photographer was holding the camera in his hands during the impact.

1.14 Fire.

The helicopter caught fire upon impact. All non-metallic parts were completely burned.

1.15 Survival aspects.

The accident was not survivable, even if no fire had occurred.

1.16 Tests and research.

Not relevant

1.17 Organizational and management information.

Not relevant

1.18 Additional information.

The Belgian Rules of the Air prescribes to fly at some minimum specific altitudes and distances above/from obstacles.
These rules can be found in the Belgian “Code de l’Air” - “Luchtwetboek” reference AR/KB 15 September 1994 - Article 74 (This article 74 is enclosed at the end of this report)

At the end of 2010 the hospital (CHRH) located south of the crash site (and south of the cableway cable) requested preliminary information from the Belgian CAA in order to operate rescue helicopter from and to the hospital. After a first evaluation, Belgian CAA determined that the installation of a heliport was possible provided the approach route followed two patterns, one parallel to the cableway and the other coming from the South, not crossing the cableway.

1.19 Useful or effective investigation techniques.

Not relevant

2 Analysis.

2.1 Wreckage examination

The wreckage was stored and thoroughly examined on 24 April 2012 in the military installations located in Amay.

An attempt was made to reconstruct the main parts of the wreckage although many parts disappeared in the fire.

Engine

The engine was significantly damaged by the ground impact forces and by the subsequent fire. The carburettor was destroyed as well as one magneto. The other magneto was severely damaged. Therefore it was impossible to assess the condition of the carburettor and the ignition system. Evidence of structural damages and broken bolts at the oil sump originated obviously from the helicopter ground impact. An in-depth examination of the engine was performed. No anomaly was found to the cylinders, valves, pistons and connecting rods. The crankshaft integrity was verified including the mechanical continuity between the crankshaft and the camshaft. The engine oil suction screen filter was also inspected.

No sign of an engine failure was found, moreover:

- No witnesses reported any engine sputtering or any modification of engine noise before impacting the cables.
- The witnesses reported that the helicopter was hovering close to the cable before slowly moving rearward towards the cables.
- The witnesses didn't report any sign the helicopter falling vertically before impacting the cables nor did they see any significant change in the helicopter attitude.
- The witnesses didn't reported any yawing of the helicopter to the left which typically appears in case of engine failure before the pilot stabilises the helicopter.
- One blade of the tail rotor separated in flight due to significant chocks in the transmission, demonstrating that the transmission was turning at a significant speed.

As seen above, it is very unlikely that an engine loss of power occurred immediately before impacting the cables.

No evidence of impact of the helicopter skid or of the tail boom structure with the cables was found. Therefore, the examination of the remains focused on the main and tail rotor blades and to the flight controls.

Flight controls

No pre impact anomaly was found to the flight controls

Main rotor blades

The remains of the main rotor blades were reconstructed using both the parts found in the main wreckage and those found elsewhere.

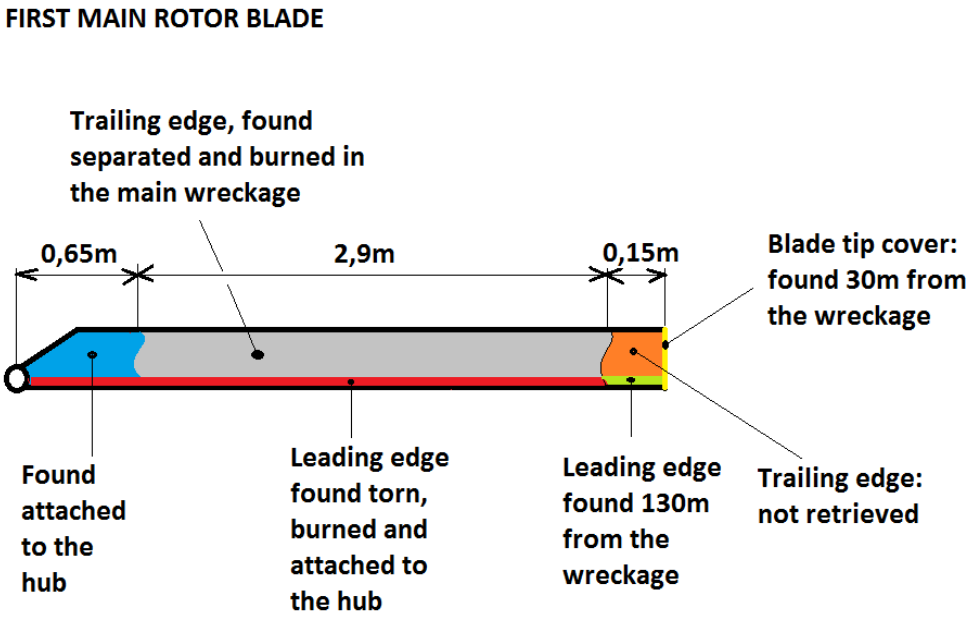
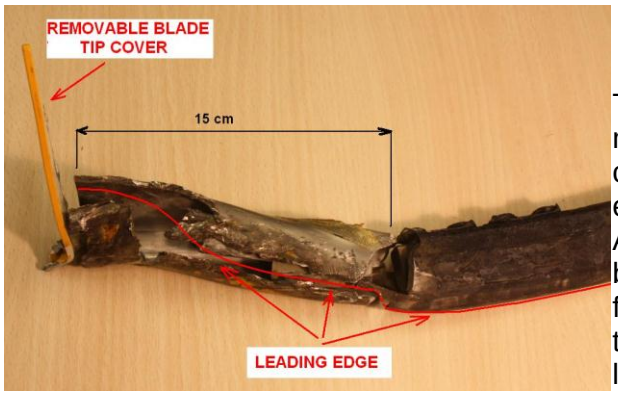


Figure 15: Sketch of first reconstructed MR blade.

The first main rotor blade to be examined was featuring a 0,65m bent and burned section attached to the hub. This section was extended by a burned approximate 2,9 m long section of the leading edge where the intrados and extrados sheet metal were missing. Measuring the total length of the remains of this blade demonstrated that around a 15 cm section of the leading edge was missing at the end of the blade.



The 15 cm long part found 130 m far from the wreckage was clearly corresponding to the extremity of the burned beam. Additionally, the removable blade tip cover, found 130 m from the main wreckage, fits to the end of the 15 cm long leading edge.

Figure 16: Reconstructed MR blade beam/leading edge and tip.

Therefore, this first reconstructed blade was determined to be complete.

The 15 cm long leading edge was found open, twisted and showed some groves corresponding to the strands of the cableway main cable. The underside of the leading edge of the removable tip cover was crushed as well as the intrados, but the extrados of the profile was undamaged.

We can conclude that the last 15 cm section of this main rotor blade collided with the cable (likely the main cableway 4 cm diameter cable) with the underside of the leading edge and was severed by the impact forces.

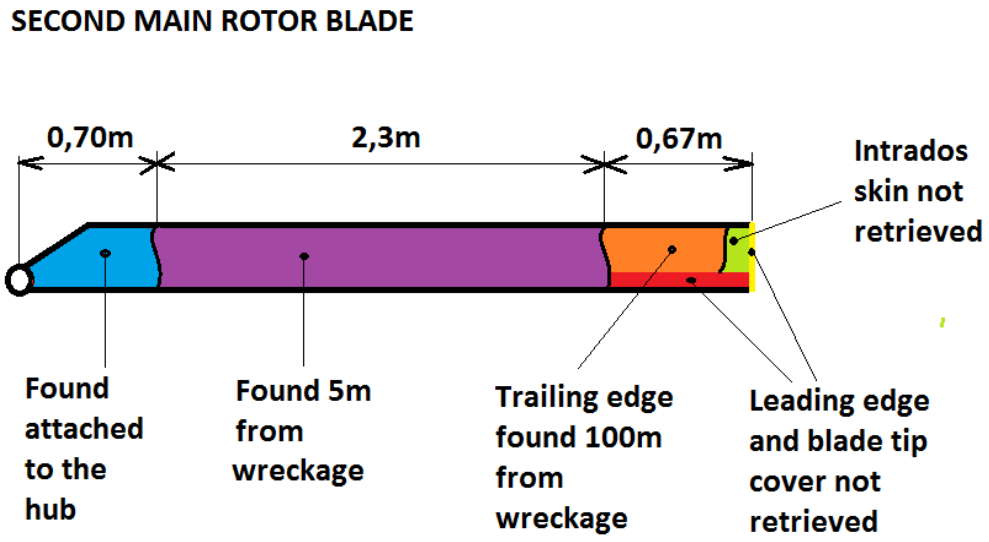


Figure 17: Sketch of second reconstructed MR blade.

The second main rotor blade was also reconstructed as follow:

- the 0,70 meter long remnant found still attached to the main rotor hub,
- another 2,3 meters long section (not burned) found on the ground 5 meters away North East from the wreckage,
- and the 0,67 m section of the trailing edge found in the playground of the school, around 100 m from the main wreckage.

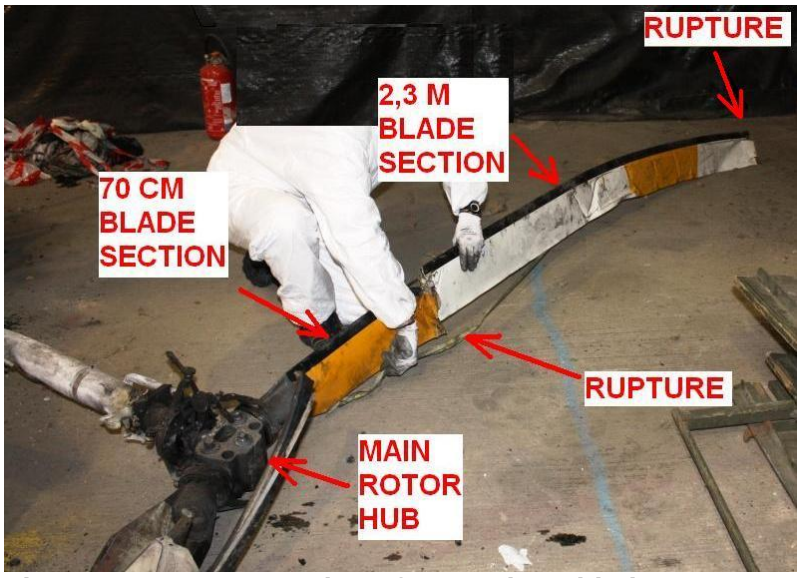


Figure 18: Reconstruction of second MR blade.

As seen on the above picture a 70 cm long section of one main rotor blade remained attached to the rotor hub while the 2,3 m section probably separated with the impact with the ground (found 5 meters away North East from the wreckage).

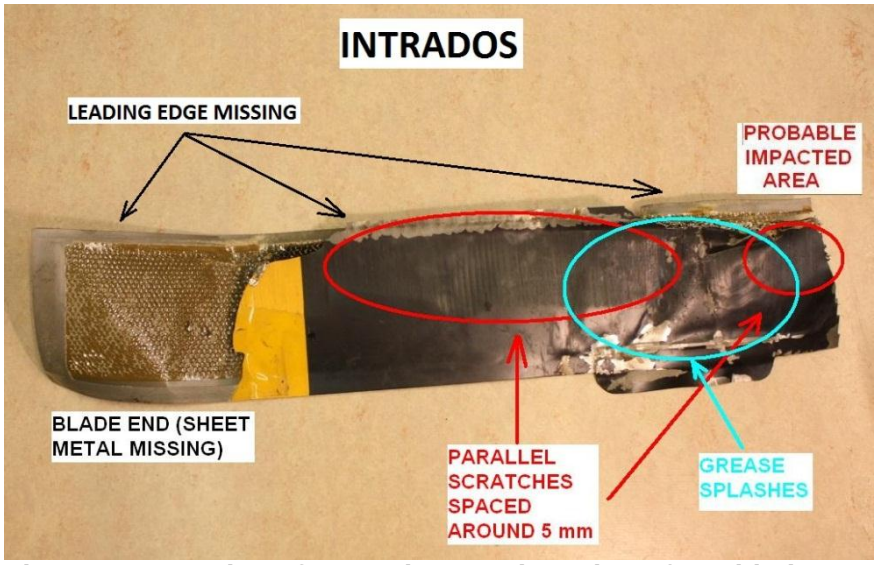


Figure 19: Intrados of 0,67m long end section of MR blade.

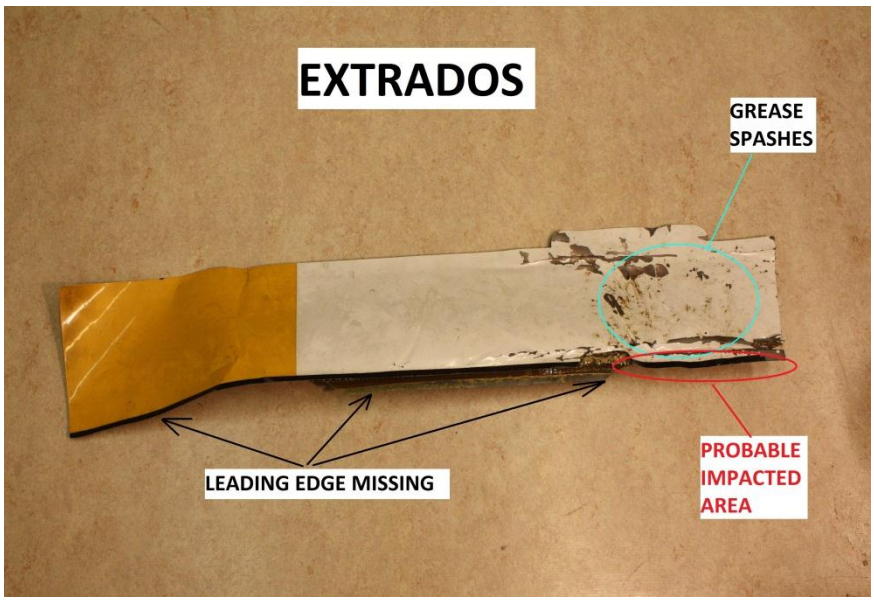


Figure 20: Extrados of 0,67m end section.

The two pictures above show the intrados and the extrados skins of the 0,67 m end section of the blade.

Obviously, the total length of the three sections corresponds to the length of an entire blade.

The last 0,67 m section of the leading edge (being also the main beam) including the weights was not retrieved as well as the last 20 cm of the intrados skin and related honeycomb.

It is likely the missing leading edge and weights flew away at a long distance from the wreckage, maybe into the wood located east of the other parts.

The intrados and extrados skins are crushed as well as the internal honeycomb structure in the area of the separation. The intrados shows two different types of parallel scratches in the black paint coming from a friction with one or two cables. Some traces were spaced 5 mm from each other and the other scratches are spaced around 3 mm showing that the blade intrados entered twice in contact with the cable(s).
The part of the intrados and extrados skins located near the separation area (near the flattener) was splashed by grease coming from the cable.

From the above, we can conclude that friction with one or two cable(s) occurred first at the intrados of the blade followed by a violent impact on the leading edge located at around 75 cm from the end of the blade. This impact caused the end of the blade to separate from the main part of the blade. At the same time the leading edge and the skin of this section separated from each other.

Conclusion of the wreckage examination
The examination of the wreckage could determine that both main rotor blades extremities collided the cableway cable(s). First contacts of the blades with cables occurred with the underside of the leading edges and at the intrados before striking directly the cable(s). One 15 cm long part separated in flight from the end of one blade as well as a 67 cm long part of the other blade.

2.2 Flight path

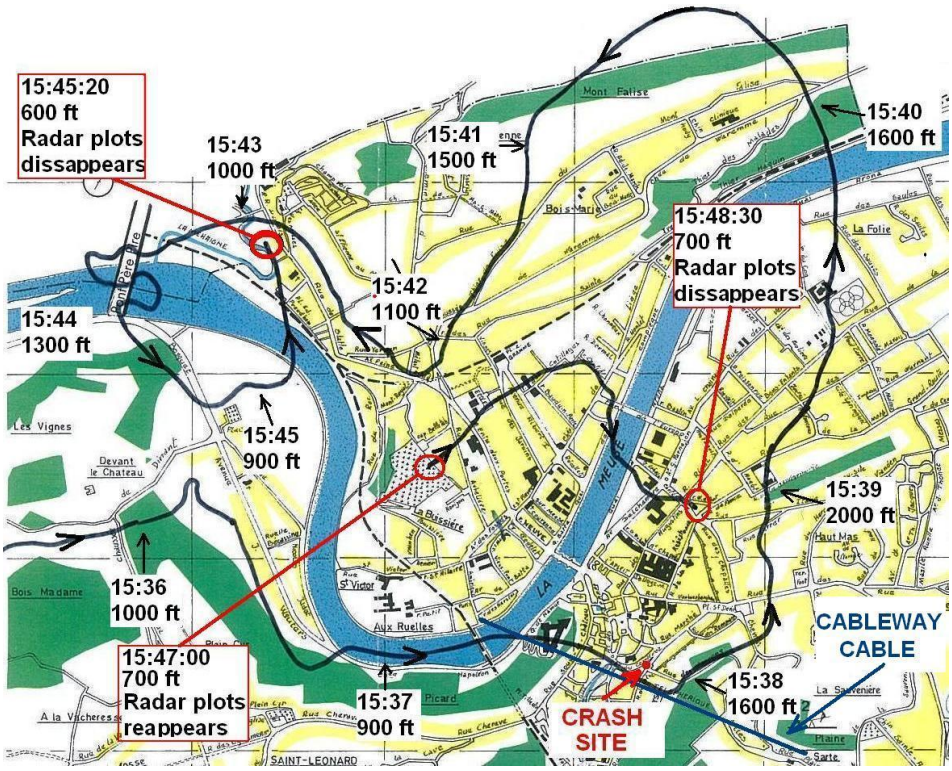


Figure 21: Flight path above Huy, including time and MSL altitude.

As seen on the left side of the above drawing, the helicopter appeared in the vicinity of Huy around 15:36, likely coming directly from its home base EBNM. At that time the helicopter was flying at 1000 ft QNH and was already cleared to enter the CTR of Liège. (Note: Huy is around 250 ft above mean sea level).

The helicopter crossed along the cableway cables at an estimated altitude of 1500 ft. Thereafter, it flew to the north above the city, first turned west and then south west, before making a turn and hovering above the Meuse river in the vicinity of the “Père Pire” bridge . The entire flight was performed, up to that moment, at a safe altitude.

At 15:45:20, the radar plots disappeared when the helicopter was flying at 600 ft and reappeared above “La Buissière” cemetery 100 seconds later at 700 ft altitude.

The last radar trace shows the helicopter flying north east and then south east before disappearing above “Wilmotte - Dupont” street at 500 m from the crash site.

The witnesses present in the centre of the city saw the helicopter coming at low speed from the north, hovering in the area of the “Grand Place” and then flying

slowly to the south, in direction of the cableway cables. The helicopter turned toward east and hovered close to the cableway cables.

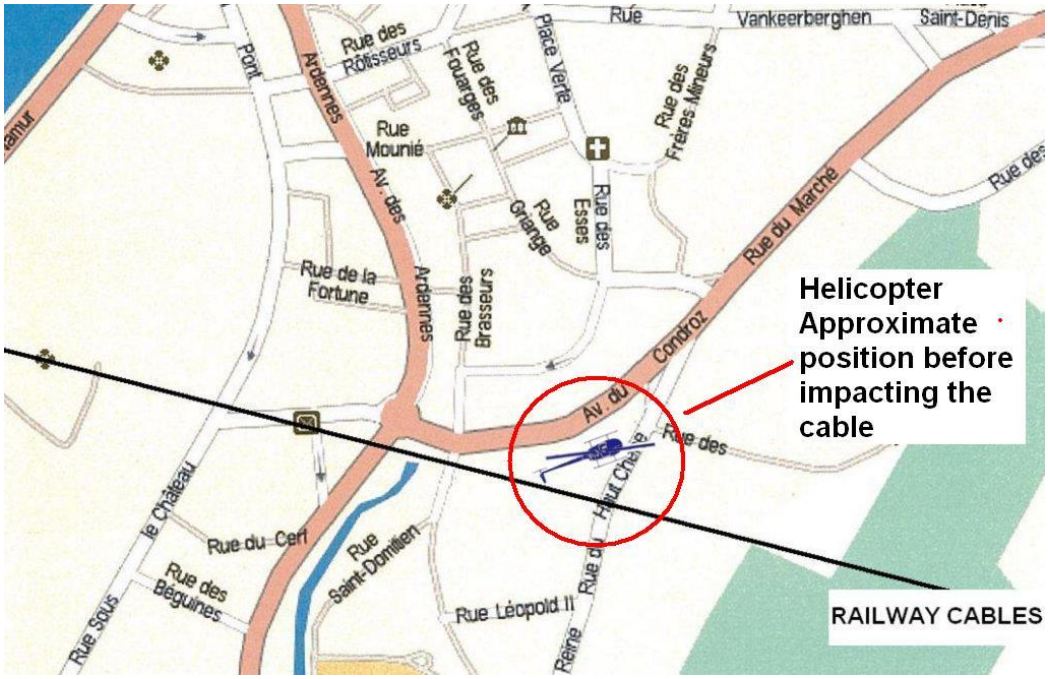


Figure 22: Approximate helicopter position and direction when impacting cables.

After a few seconds hovering in that position the witnesses saw the helicopter moving slowly rearwards and hitting the cableway cables with “the rear of the helicopter”.

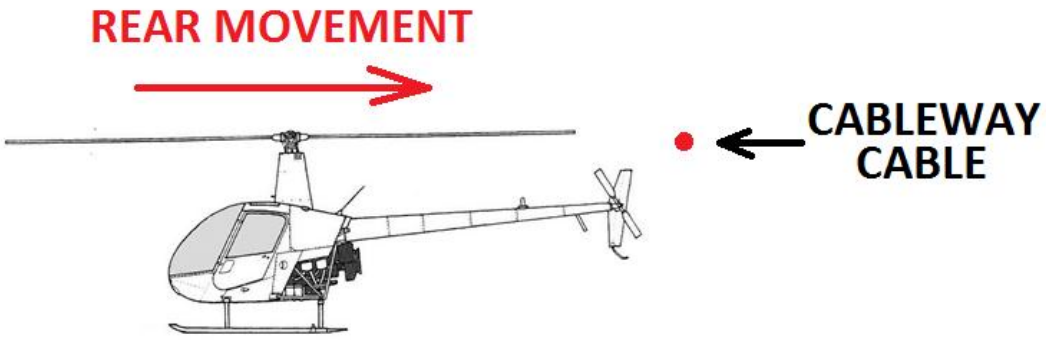


Figure 23: Relative position of helicopter and cable before impact.

Actually, as seen in chapter 1.1 above, only the main rotor blades hit the cables.

2.3 Aeronautical charts and cableway cable.

The pilot and its passenger prepared together the overflight of the city using a "Low-Air" aeronautical chart (Scale 1/250000). Reportedly all the photograph missions performed by the pilot were prepared in collaboration with the photographer using this type of aeronautical chart.

The cableway is not represented on this chart nor is it compulsory to mention it when obstacle height is lower than 100m AGL (See annex 4 of Convention on International Civil Aviation).

Note: ICAO Annex 4 § 17.9.3.1 prescribes the following: Obstacles shall be shown on Aeronautical Chart.
(Objects of a height of 100 m (300 ft) or more above ground are normally regarded as obstacles).

2.4 Altitude analysis and cableway cable height

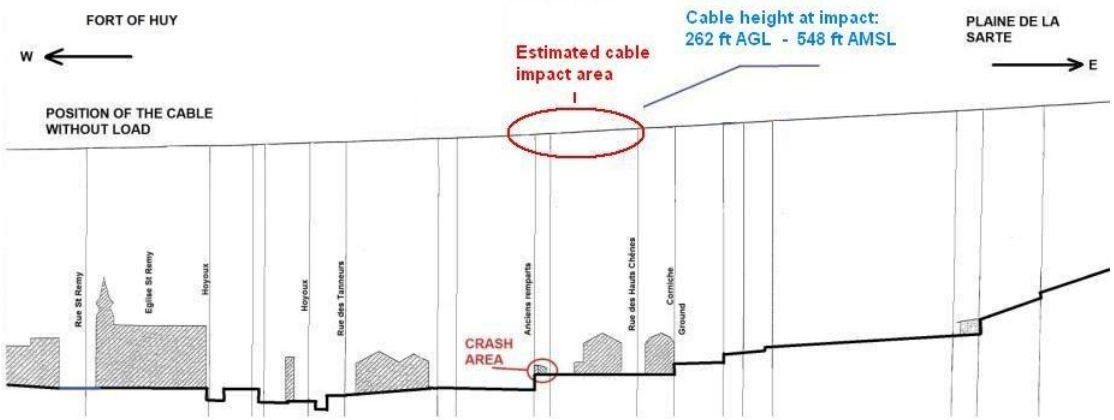


Figure 24: Cable height at estimated impact area.

The last radar plot of the helicopter above the "Wilmotte - Dupont" street at 500m from the crash site showed an altitude of 700 ft MSL which corresponds approximately to 450 ft AGL.

The cable height in the impact area was about 262 ft AGL (± 80 m). The witnesses didn't report any visible change in altitude from the time they observed the helicopter coming from the north to the impact with the cables, therefore it is likely that the helicopter trajectory during the last 500 m described a slow estimated 10° descent slope down to the height of the cables.

2.5 Cable vision

The pilot had extensive experience and the weather conditions were adequate to control perfectly a stationary flight.
The witnesses report no sign of a loss of control prior to the impact with the cable and the examination of the wreckage did not reveal any evidence of technical anomaly.

Therefore, two hypotheses could explain why the helicopter hit the cables:

1. The pilot didn't see the cables, or
2. The pilot saw the cables, performed an intentional stationary flight close to them and thereafter loss visual contact with the cable for an undetermined reason, leading to a slow rear motion and the fatal contact of the main rotor blades with the cables.

Hypothesis 1:
The possibility exists the pilot didn't see the cables because of the 10° descent slope approach causing the cables to be positioned between the helicopter (and pilot's eyes) and the dark landscape. The cable car season was not yet started causing the cables to be dark and unpolished and therefore less visible. In other words, there was a poor visual contrast between the cables of a dull colour and the dark landscape.
Moreover, at 15:50 the sun was oriented at 252°, with an elevation of 23° which could have caused the pilot to be dazzled.

Figure 25: Example where cables are visible due to a light background.

Figure 26: Example where cables are invisible due to a dark background.

Hypothesis 2:
However, the second hypothesis is likely to be the actual scenario for the following reasons:

1. The pilot was probably aware of the presence of the railway cable because he flew over the cables a few minutes before. Moreover he was an ex-military pilot based in the Bierset airport located 20 km from the crash site and his present home base (Temploux airfield) was also not far from the crash site, at a distance of 35 km. Indeed, the crash site is located between both bases.
2. The passenger was obviously aware of the railway cables as he lived in Huy, close to the crash site.
3. The helicopter came close to the railway cables very slowly and stopped moving in front of it leaving time enough to both the pilot and the passenger to see the obstacle before turning the nose of the helicopter to the north east.

Reportedly, the only way for an helicopter pilot to evaluate precisely his distance from a cable during a stationary flight is to fly close enough of the cable to distinguish the cable strands (probably between 10 to 15 meters taking into account the size of cable strands). Therefore, the pilot had to choice between maintaining a significant safe distance from the obstacle, likely to be unacceptable for the visual field of the photographer, or to fly close enough to distinguish the cable strands.

In conclusion, it is likely that the pilot performed an intentional stationary flight close to the cableway cable to give the photographer the best possible visual field toward the city centre.

2.6 Rules of the air

Royal Decree of 15 September 1994, article 74 prescribes the following minimum height for helicopters (In summary):

- 1000 ft (300 m) minimum above the lowest obstacle when flying above the cities or built up areas.
- 300 ft (100 m) AGL above the cities or built up areas provided a special authorization was granted by the Civil aviation Authority.
- 150 ft (50 m) minimum height and distance from obstacle when flying outside the cities or built up areas.

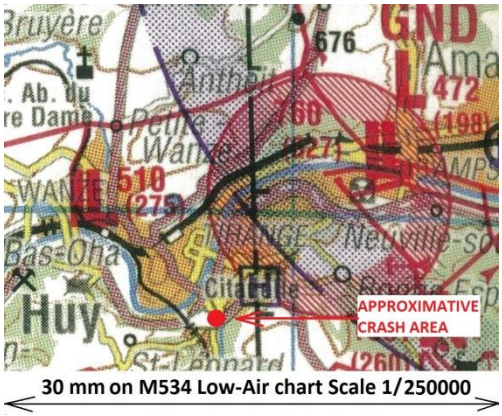
During the last 500 m of the flight path, the helicopter flew above the city of Huy at an estimated height between 450 ft (150 m) and 260 ft (80 m) when hitting the cables.

We found no special authorization had been granted by Belgian CAA for this flight to fly under 1000 ft (300 m), at a minimum height of 300 ft (100 m).

When hitting the cable the helicopter was positioned on the edge of the non-built-area.

However, this position is only approximate and no official aeronautical definition for built up area is available, therefore different interpretations for “built-up area” exist.

Reportedly, most pilots use a M534 Low-Air aeronautical chart (Scale: 1/250000) to determine where are located cities and built-up areas (Orange coloured on the map). This chart is the only “low-Air” aeronautical chart available for Belgium.



For the purpose of the investigation a zoom of the M534 Low-Air aeronautical chart was made to show the details of the information available for the city of Huy and its neighbourhood. Obviously, this chart is overloaded of details owing to the scale used and some details, as for example the word “Citadelle”, the letter “H” and a red circle, are superimposed on a part of the city.

Figure 27: Zoom of Low-Air aeronautical chart.

Consequently, the border of the built-up area is not clearly visible, proving that this chart is not suitable to determine precisely the location of the built-up areas.

As a conclusion of this paragraph, we can say:

- The helicopter was positioned above a zone on the edge of the built-up area of the city of Huy
- This zone featured houses but also areas likely to be used as landing area for the helicopter in case of emergency.
- We cannot positively be certain that the pilot actually saw the cableway in order for him to identify it as an obstacle.

Figure 28: The crash site is located on the edge of the not built up area.

2.7 Aerial work authorization

Aerial photography is considered as aerial work per Royal Decree dated 15 March 1954 and is subject to a specific authorization by BCAA.

BEST IN SKY, the helicopter operator, was granted an “Aerial Work Authorization” delivered by the Belgian Authority for the following activities: “First Flight”, “Aerial photography”, “Aerial survey” and “Dropping of objects”. This authorization N° 731 was valid until 24 January 2013.

There is no Standard or Recommended practices issued by ICAO on aerial work, at the exception of “Agricultural Operations”.

BCAA delivers Aerial Work Authorizations based on Royal Decree dated 15 March 1954 Articles 50 and 51 (Copies enclosed at the end of this report).

Specifically for aerial photography with helicopters the following information or documents are required:

- Identification of the applicant.
- Description of the type of aerial work.
- Listing of the aeroplane intended to be used.
- Identification of the pilot(s).
- Insurance certificate.
- Legal status of the company (if applicable)
- Rental contract of aircraft (if applicable)
- Contract with a CAMO (Continuing Maintenance Management Organisation).
- Additional airworthiness documents for non-Belgian registered aircraft.

Article 51 requires an assessment to be done concerning moral, financial and technical guaranties of the applicant. This article requires also guaranties about security.

As seen above, there is no requirement related to the operational capabilities and procedures of the company and no procedure manual is required.

The investigators have not found any written procedure or checklist in the company to support the flight preparation and also no record of the briefing made before the flight could have been retrieved.

The procedure applied by the company is believed to be an informal briefing prior the flight with the customer and the pilot to determine a flight path based on the low air chart.

3 Conclusions.

3.1 Findings.

- The helicopter was in airworthy condition.
- No pre impact technical anomaly was found in the wreckage.
- The declared purpose of the flight was to take pictures in the vicinity of Huy but actually also of the center of the city.
- A portion of the flight occurred above the city of Huy, and was performed under the minimum height as prescribed by Royal decree of 15 September 1994, article 74 (a).
- The pilot was duly qualified for the flight and had a wide experience.
- The company was duly authorized to perform aerial photography.
- There is no regulatory operational requirement linked to the issue of the Aerial Work Authorization.

3.2 Causes.

The accident was probably caused the pilot not seeing or losing visual contact with cableway cables during hover flight at low altitude in the close vicinity of the cableway, causing the main rotor blades to collide with the cables and subsequent loss of control of the helicopter.

Contributing factors:

- The cable condition and ambient lighting made it difficult to spot the cableway.
- The cableway is not identified on a chart.
- The extended experience of the pilot probably may have induced over-confidence.

4 Safety recommendations.

The recent series of helicopter accident showed that the human factors are playing a very significant role in helicopter accidents.

AAIU(Be) is of the opinion that safety promotion is a key element to improve pilot's awareness, and therefore supported the BCAA initiative of a "Helicopter Safety Day", as part of the Belgian Safety Plan.

The "Helicopter Safety Day" was organised by BCAA on Wednesday 27 June 2012.

AAIU(Be) participated with a presentation on helicopter accidents.

The Belgian State Safety Plan was also amended to ensure a yearly organisation of (or participation of BCAA / AAIU(Be)) in safety seminars.

Further to this action, the website of the Federal Public Service – Mobility and Transport – is relaying the publications of EHEST; the European Helicopter Safety Team.

However, some additional efforts may be useful. Therefore the following recommendation:

Recommendation 2013-P-01 to BCAA concerning the Safety Promotion of Aerial Photography

AAIU(Be) recommends BCAA to provide guidance material to pilots to promote good practices when performing aerial photography. BCAA could inspire oneself from the CAA UK published "General Aviation Safety Sense Leaflet - Aerial Photography".

5 Enclosure:

5.1 Royal Decree dated 15 September 1994, Article 74.

Extrait de l'AR du 15 septembre 1994	Uittreksel KB 15 september 1994
Art. 74.Sauf pour les besoins du décollage et de l'atterrissage ou sauf autorisation du Ministre chargé de l'administration de l'aéronautique ou du directeur général de l'Administration de l'Aéronautique, il est interdit de faire évoluer un aéronef selon les règles de vol à vue :	Art. 74.Behalve wanneer dit nodig is om op te stijgen of te landen, of behalve toestemming van de Minister belast met het bestuur van de luchtvaart of van de directeur-generaal van het Bestuur van de Luchtvaart, is het verboden te vliegen overeenkomstig de zichtvliegvoorschriften :
a) au-dessus des villes et des parties agglomérées de communes, des zones d'habitation, des complexes industriels, du terminal LNG de Zeebrugge, des centrales nucléaires, [1 es prisons, des établissements pénitentiaires]1 ou des rassemblements de personnes en plein air à une hauteur inférieure à 300 m (1 000 pieds) au-dessus de l'obstacle le plus élevé, situé dans un rayon de 600 m autour de l'aéronef.	a) boven steden en bebouwde kommen van gemeenten, industriële complexen, de LNG-terminal te Zeebrugge, woonzones, nucleaire centrales [1 , gevangenissen, strafinrichtingen]1 of mensverzamelingen in open lucht op een hoogte lager dan 300 m (1 000 voet) boven de hoogste hindernis binnen een straal van 600 m rond het luchtvaartuig.
Toutefois, pour les hélicoptères, une hauteur minimale différente peut être fixée par le Ministre chargé de l'administration de l'aéronautique ou le directeur général de l'Administration de l'Aéronautique, en tenant compte des caractéristiques de l'itinéraire d'accès visé à l'article 43, § 1er, de l'arrêté royal du 15 mars 1954 réglementant la navigation aérienne, modifié par l'article 3 de l'arrêté royal du 31 août 1970, sans qu'elle puisse être inférieure à 100 m (300 pieds) au-dessus de l'endroit survolé;	Voor hefschroefvliegtuigen evenwel kan een andere minimale hoogte worden vastgesteld door de Minister belast met het bestuur van de luchtvaart of de directeur-generaal van het Bestuur van de Luchtvaart, rekening houdend met de kenmerken van de toegangsweg bedoeld in artikel 43, § 1, van het koninklijk besluit van 15 maart 1954 betreffende de regeling der luchtvaart, gewijzigd door artikel 3 van het koninklijk besluit van 31 augustus 1970 zonder dat deze hoogte lager mag zijn dan 100 m (300 voet) boven de overvlogen plaats;
b) ailleurs, à une hauteur inférieure à 150 m (500 pieds) au-dessus du sol ou de l'eau et à une distance inférieure à 150 m de tout obstacle artificiel fixe ou mobile. Toutefois, en ce qui concerne les hélicoptères, ces hauteur et distance minimales sont ramenées à 50 mètres (150 pieds).	b) elders, op een hoogte lager dan 150 m (500 voet) boven de grond of het water en op minder dan 150 m van elke vaste of verplaatsbare kunstmatige hindernis. Voor hefschroefvliegtuigen evenwel worden deze minimumhoogte en minimumafstand teruggebracht op 50 m (150 voet).

5.2 Royal Decree dated 15 March 1954, Articles 50 and 51

Art. 50. <AR 31-08-1979, art. 11> § 1er. Tout travail aérien, notamment l'apprentissage, la photographie aérienne, la publicité et la propagande au moyen d'aéronefs, et l'organisation de spectacles comportant des évolutions d'aéronefs, est soumis à l'autorisation préalable du Ministre chargé de l'administration de l'aéronautique, ou de son délégué. Sont également soumis à cette autorisation les baptêmes de l'air. La demande d'autorisation mentionne : 1° le nom et le domicile ou la dénomination et le siège social de l'exploitant; 2° les caractéristiques des services envisagés, notamment les types d'avions exploités et leur capacité. La demande est accompagnée de la preuve qui l'exploitant a pris les dispositions requises pour faire face aux responsabilités civiles qui peuvent découler de ce travail aérien ou des baptêmes de l'air. § 2. Le Ministre arrêté les conditions de délivrance, de suspension et de retrait des autorisations. L'autorisation fixe les conditions particulières d'exploitation et la durée pour laquelle elle est accordée. Art. 51. (§ 1er.) (Les autorisations visées aux articles 46 et 50, ainsi que les permis d'exploitation visés aux articles 47, § 1er et 49, § 1er, ne peuvent être accordés qu'après enquête portant notamment sur les garanties morales, financières et techniques que présente le demandeur et sur l'opportunité de la création de services nouveaux.) <AR 31-08-1979, art. 11> (§ 2. En exécution des dispositions internationales en matière de sûreté de l'aviation civile, le Ministre chargé de l'administration de l'aéronautique ou le directeur général de l'administration de l'aéronautique fixe les prescriptions de sûreté et les modalités de leur exécution qui doivent être respectées par les titulaires des autorisations visées aux articles 46, § 1er et 50, § 1er et des permis d'exploitation visés aux articles 47, § 1er et 49, § 1er. Le Ministre susmentionné désigne les fonctionnaires de l'administration de l'aéronautique qui veillent au respect de ces prescriptions. Ils ont accès aux lieux où ces prescriptions sont d'application.) <AR 1989-12-06/30, art. 2, 002; En vigueur : 12-12-1989>	Art. 50. <KB 31-08-1979, art. 11> § 1. Iedere luchtarbeid, onder meer opleiding, luchtfotografie, publiciteit, propaganda door middel van luchtvaartuigen en de inrichting van vertoningen welke evoluties van luchtvaartuigen omvatten, is onderworpen aan de voorafgaande machtiging van de Minister die met het bestuur der luchtvaart belast is, of van zijn gemachtigde. De luchtdopen zijn eveneens onderworpen aan deze machtiging. De aanvraag tot machtiging vermeldt : 1° de naam en de woonplaats of de benaming en de maatschappelijke zetel van de exploitant; 2° de karakteristieken van de geplande diensten, inzonderheid de type(s) van geëxploiteerde vliegtuigen en hun laadvermogen. De aanvraag is vergezeld van het bewijs dat de exploitant het nodige heeft gedaan om te kunnen voldoen aan de burgerlijke aansprakelijkheid die kan voortspruiten uit die luchtarbeid en uit de luchtdopen. § 2. De Minister bepaalt de voorwaarden van aflevering, schorsing en intrekking van de machtigingen. De machtiging bepaalt de bijzondere exploitatievoorwaarden en de termijn waarvoor zij wordt verleend. Art. 51. § 1. De machtigingen, bedoeld in de artikelen 46 en 50, alsook de exploitatievergunningen, bedoeld in de artikelen 47, § 1 en 49, § 1, kunnen slechts worden verleend na onderzoek betreffende onder meer de morele, financiële en technische waarborgen die de aanvrager biedt en de opportuniteit van het creëren van nieuwe diensten. <KB 31-08-1979, art. 11> § 2. In uitvoering van de internationale bepalingen inzake de beveiliging van de burgerluchtvaart stelt de Minister belast met het bestuur der luchtvaart of de directeur-generaal van het bestuur der luchtvaart de beveiligingsvoorschriften en hun uitvoeringsmodaliteiten vast die dienen nageleefd te worden door de houders van de machtigingen bedoeld in artikelen 46, § 1 en 50, § 1 en van de exploitatievergunningen bedoeld in artikelen 47, § 1 en 49, § 1. Voormelde Minister wijst de ambtenaren van het bestuur der luchtvaart aan die toezicht uitoefenen op de naleving van deze voorschriften. Zij hebben toegang tot de plaatsen waar deze voorschriften gelden. <KB 1989-12-06/30, art. 2, 002; Inwerkingtreding : 12-12-1989>

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