Air Accident Investigation Unit
(Belgium)
Federal Public Service
Mobility and Transport
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Safety Investigation Report

Ref. AAIU-2022-04-18-01
Issue date: 5 September 2023
Status: Final

Scope: Limited

As per ICAO Annex 13 and EU regulation EU 996/2010, decisions regarding whether to conduct a civil aviation safety investigation, and the extent of an investigation, are based on many factors, including the level of safety benefit expected to be drawn from such an investigation.
For this occurrence, a limited-scope, fact-gathering investigation and analysis was conducted in order to produce a short summary report. The investigation mainly focussed on the actions and conditions directly relating to the occurrence and might not cover all aspects of the aircraft operation and/or possible underlying safety factors due to the expected safety benefit of it and/or the extent of evidence/resources available.

SYNOPSYS

Occurrence class	Accident
Occurrence category	Loss of control - inflight (LOC-I) Low altitude operations (LALT)
Date and time[1]	18 April 2022 08:55 UTC
Location	Ecaussinnes, Belgium 50°33'50.23" N - 004° 9'12.90" E
Aircraft	ELA 09 Junior
Aircraft category	Rotorcraft - Gyroplane
Location of departure	Aerodrome of Buzet (Confluence) EBBZ
Planned destination	Idem
Type of operation	Non-commercial - Cross-country
Phase of flight	Maneuvring
Injuries	None
Aircraft damage	Substantial

What happened

The purpose of the flight was to fly over the garden of a children's home (orphanage) for an Easter egg hunt. When the passenger of the 2-seat autogyro threw a handful of Easter eggs, the pilot noticed an apparent loss of engine power followed by a rapid descent. During the emergency landing, the main rotor hit a low hanging branch of a tree. The gyroplane fell on its right side. Both occupants climbed out, uninjured.

[1] All time data in this report are indicated in UTC, unless otherwise specified

1. FACTUAL INFORMATION

1.1 History of the flight

The history of the flight is based on the pilot declaration

The pilot was requested to perform a flight over an orphanage garden with a passenger as a part of an Easter egg hunt event.

The aircraft took off from EBBZ at 08:38 and arrived above the area (16,2 km west of the aerodrome) shortly before 08:55.

The pilot stated the aircraft flew at an altitude of 1500 ft when crossing the railway.

The passenger threw a few eggs and at that moment, when the pilot wanted to increase the engine power, he sensed the aircraft was losing height rapidly. The engine power recovered shortly after, but the aircraft was too low and there was no other option than to land in the garden of the orphanage.

As he was above the garden, he made a final righthand turn. However, the vertical speed was still high (no / too little flare) and the gyroplane made a rebound. The rotor impacted low branches of a tree, the engine was still running at high power and the gyroplane rolled over onto its righthand side.

1.2 Injuries to persons

Table 1: List of injuries

Injuries	Crew	Passenger	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	
Minor	-	-	-	-
None	1	1	-	2
Total	1	1	-	2

1.3 Damage to aircraft

The rotor blades, the mast and propeller blades were damaged by the contact with the tree branches and the subsequent ground impact during the rollover.

Figure 1 : damage to the mast, rotor and propeller blades

1.4 Other damage

A tree branch was cut by the rotor.

1.5 Pilot information

Table 2 : General pilot data

Age	55
License	French ULM
Rating	'Autogire' (Gyroplane)

Table 3 : Flying experience pilot

Aircraft:	Gyroplane
Total time:	Ca 2000 FH
Total on this aircraft:	469 FH

1.6 Aircraft information

The ELA 09 Junior is a Spanish autogyro designed and produced by ELA Aviación of Córdoba, Andalusia**.**

The design features a two-bladed rotor, a two-seats-in tandem open cockpit, tricycle landing gear, a tail and a four-cylinder 100 hp engine in pusher configuration.

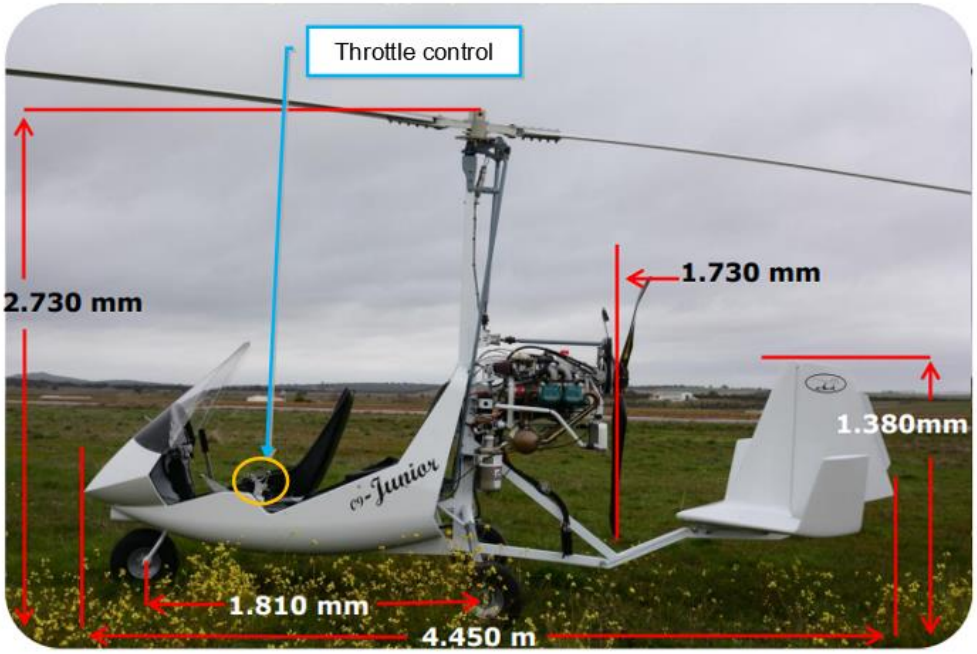

Figure 2 : The ELA 09 and its dimensions (from manufacturer's POH)

Table 4: Aircraft data

General	
Manufacturer	ELA Aviación
Model:	ELA 09 Junior
History	
Year of built:	2014
Registration:	Registered in France
Permission	Temporary permission to fly over Belgian territory issued by the Belgian CAA on 16 July 2021 and valid until 31 July 2022
Total hours:	469 hours
Occupants	
Crew	One
Capacity	One passenger
Weights	
Empty weight	240 kg
MTOW:	450 kg
Fuel	
Fuel capacity	45 liters
Rotor	
Main rotor diameter	8,25 m (27 ft 1 in)
Main rotor area	53 m^2 (570 sq ft)
Engine	
Engine type	horizontally-opposed four-cylinder, naturally-aspirated, four-stroke aircraft engine
Engine manufacturer and model	Rotax 912 ULS (uncertified) 100 HP
Propeller	
Propeller type	3-bladed carbon composite
Propeller manufacturer and model	DUC Hélices
Performance	
VNE:	160 km/h
Minimum Speed:	40 km/h
Landing distance:	0-20 m

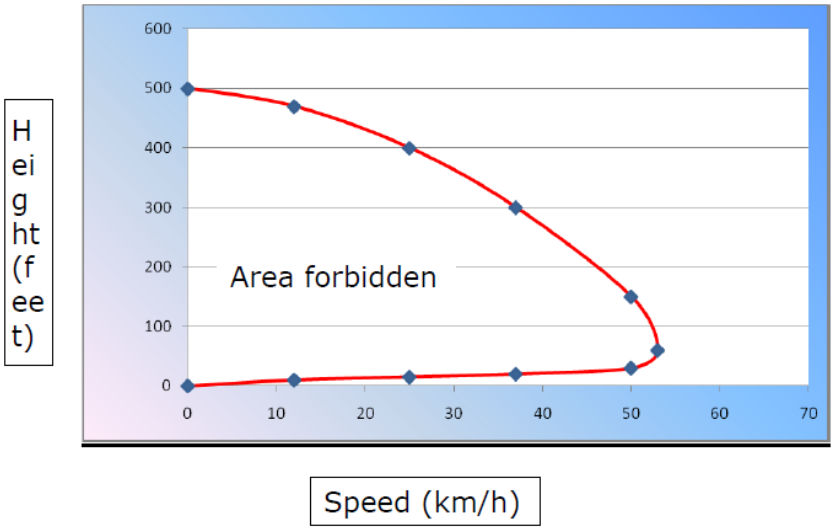

Figure 3 : Height/speed envelope from the flight manual

SLOW FLIGHT

Before perform this maneuver be sure you have at least 500 ft above the ground and go **into wind.**

Reduce the engine power from cruise speed keeping the nose attitude, the gyroplane will decelerate. Before arrive to the desired speed increase the power to keep a level flight.

To regain the speed gently move the nose down and adjust power at desired speed.

Figure 4 : slow flight procedure from flight manual

5.4 ENGINE FAILURE IN FLIGHT

INSTRUCTIONS:

1. Close throttle, engine failure may be sudden or accompanied by misfiring, typical of fuel starvation.
2. Low the nose down to keep best glide speed (60 mph), look for an area for landing into wind.
3. If time allows, an engine restart can be attempted, see "Engine restart procedure".
4. If the area for landing is rough or there are obstacles, make a higher flare over the obstacles to reduce forward speed.
5. Once in the ground, ignition and fuel pumps OFF.
6. Rotor brake ON.
7. Master OFF.

Figure 5 : Procedure 'Engine failure in flight' from flight manual

1.7 Meteorological conditions

METAR at Charleroi Airport (EBCI), about 24 km southeast of the accident area at time of the accident:

EBCI 180850Z 18007KT CAVOK 14/M01 Q1019 NOSIG=

1.8 Communication

None.

1.9 Recorded information

The aircraft was not equipped with any flight recorder, nor was it required by regulations. However, the final portion of the flight was filmed by by-standers with a smartphone. Their position is indicated on Figure 6.

1.10 Wreckage and impact information

The terrain has an elevation of 108 m. In the area, the main obstacle is a 30 m high mobile telephone mast, located on the other side of the railroad tracks.

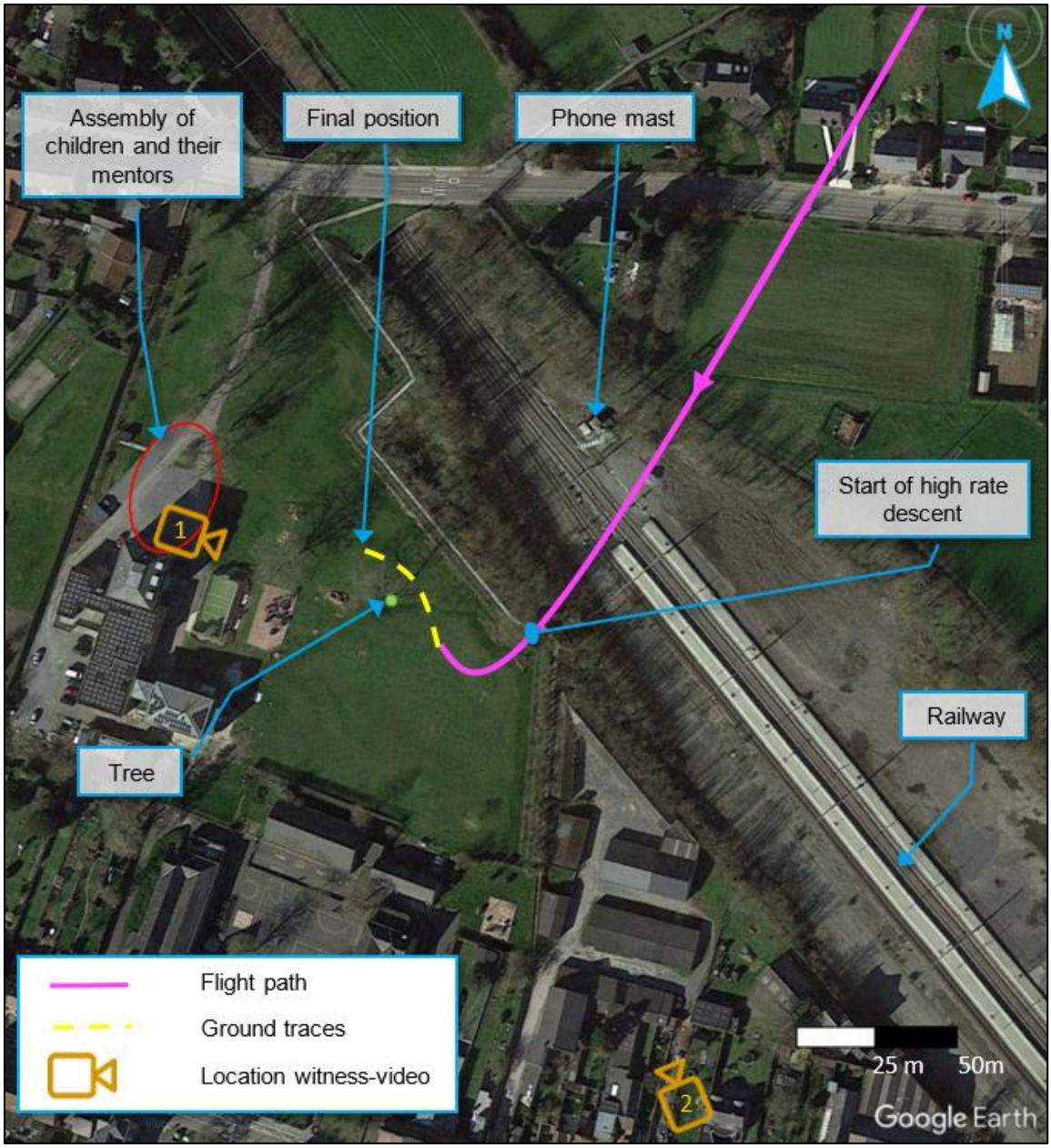

Figure 6 : reconstructed flight path based on pilot's statement and video-recordings of eye-witnesses

Distance between point of first touchdown and final position was about 30 meters

Figure 7 : ground path

The video seems to confirm the statement of the pilot; after the passenger dropped the eggs, the visible aspect of the engine propeller changes. The aircraft descends rapidly.

Time from the moment the passenger throws the chocolate egg to the ground; 9 seconds
Time from the moment the engine is heard revving up and the ground; 5 seconds.

The second ground impact due to the rebound left a 10 cm deep ground trace.

Figure 8 : gyroplane after rebound and touching the tree's branch. Video taken from location #1 (see Figure 6)

Figure 9 : Final position of the gyroplane, laying on its right hand side

1.11 Survival aspects

Both occupants wore their seat belts and none were injured when the aircraft fell on its right side.

1.12 Organizational and management information

Regulation:

1.4.2 Minimum Heights (SERA.5005 (f))

Except when necessary for take-off or landing, or except by permission from the CAA, a VFR flight shall not be flown:

- over the congested areas of cities, towns or settlements, or over an open-air assembly of persons at a height less than 1 000 FT above the highest obstacle within a radius of 600 M from the aircraft;
- elsewhere, at a height less than 500 FT above the ground or water, or 500 FT above the highest obstacle within a radius of 150 M from the aircraft.

2. ANALYSIS

2.1 The flight

The pilot stated he approached the area at an altitude of 1500 ft above mean sea level (AMSL) and further lowered the altitude to get above the orphanage garden.

With help of 2 witness videos on 2 different positions (see also Figure 6), an estimation of the height was made. Both videos were synchronized based on the first impact (seen and heard on video #1, only heard on video #2).
At 22 seconds before that first impact, a phone mast - of which the height is known, being 30 meters - was clearly visible on both recordings. Via measurement and triangulation, the height of the gyroplane was at that moment calculated as already being 300 ft AGL (650 ft AMSL).

The gyroplane was already flying slow and in a shallow descent but still with power. On video #1 a chopping sound of the rotor blades is clearly heard. According to an experienced autogyro pilot this is typical for flying at low speeds.

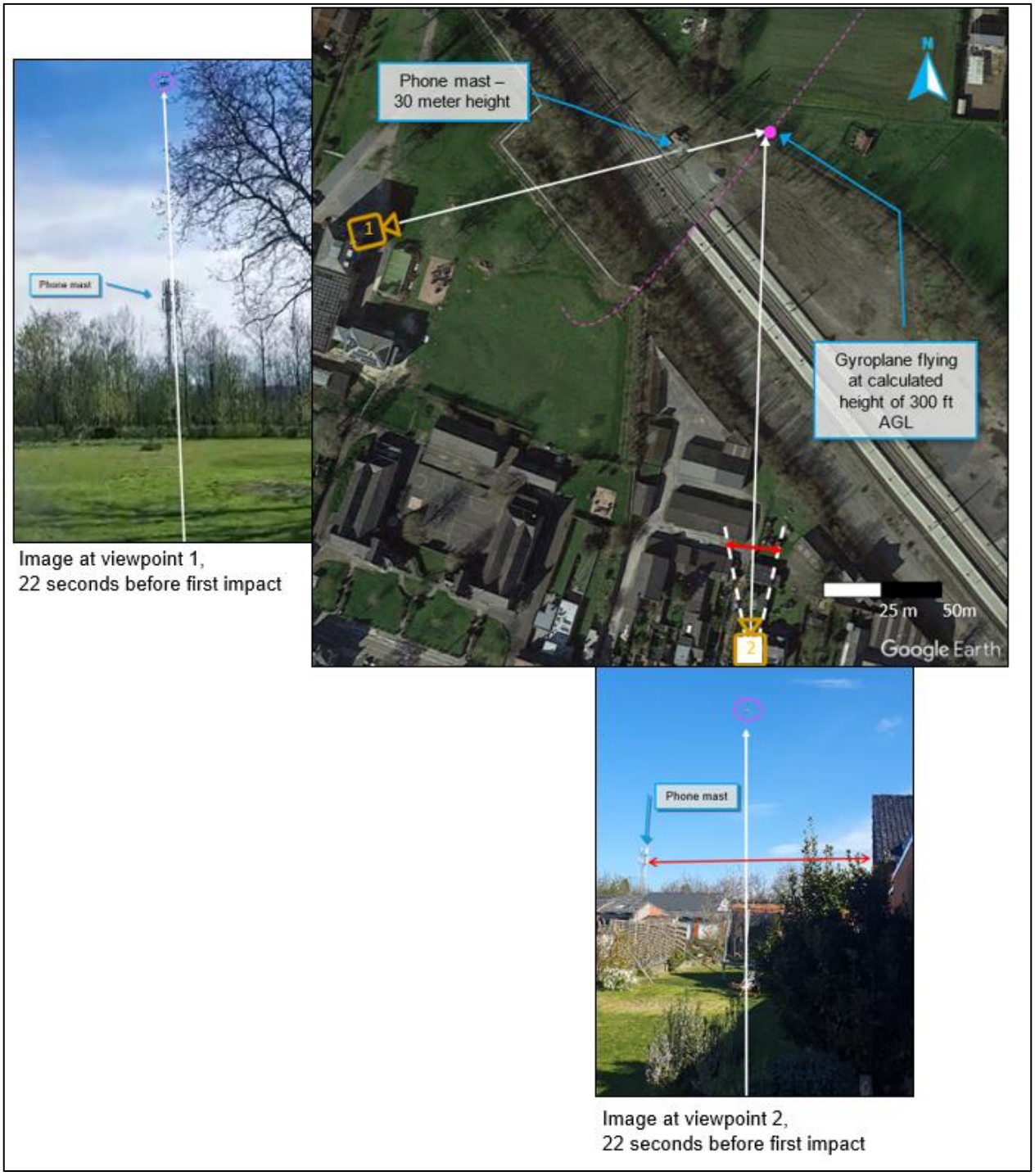

Figure 10 : Determination of position and height above ground based on 2 video recordings

Based on the video #1 recordings, the travelled distance on a time interval could be measured and hence the speed calculated. The first position was when the gyroplane was lined up with the phone mast (time: impact – 22 seconds) and the second position when the aircraft was lined up with the trunk of the tree in the garden (time: impact – 10 seconds). It was measured that the gyroplane flew a ground path of 107 m in this 12 seconds interval, giving a groundspeed of 32 km/h. With a headwind component of 5 kt/ 9 km/h this results in an average airspeed of 41 km/h at that time (so close to or at the minimum level flight speed).

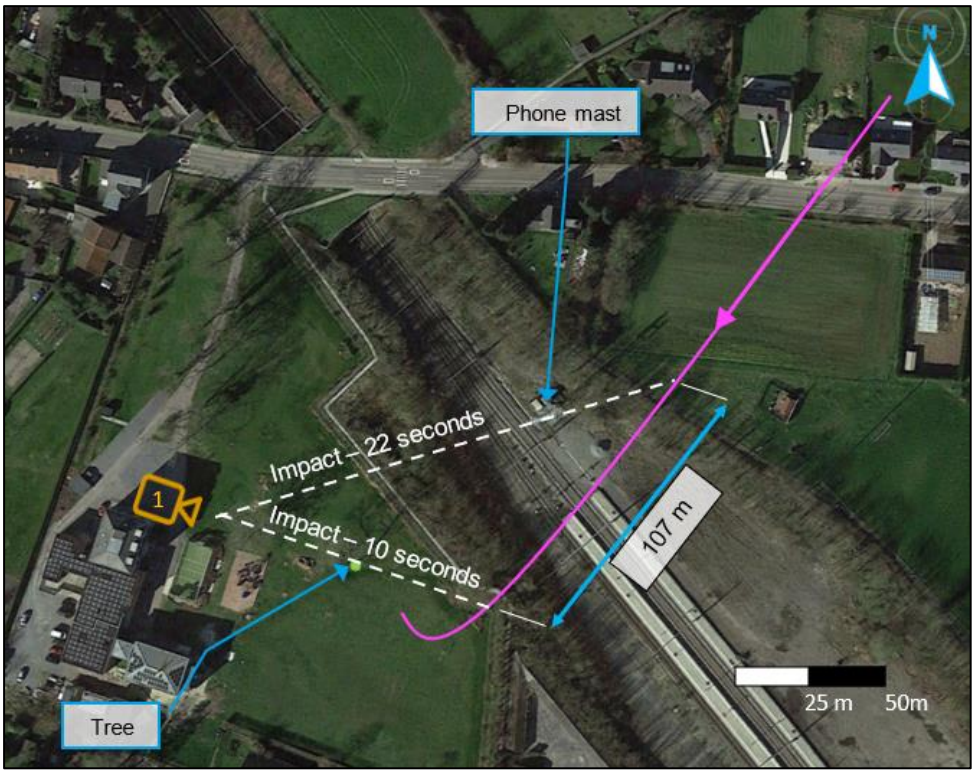

Figure 11 : calculation of travelled distance

Taking into account some accuracy errors, it is acceptable to state that the gyroplane was flying in the dashed zone on the height-velocity diagram, so close to or even in the so-called 'forbidden area'.

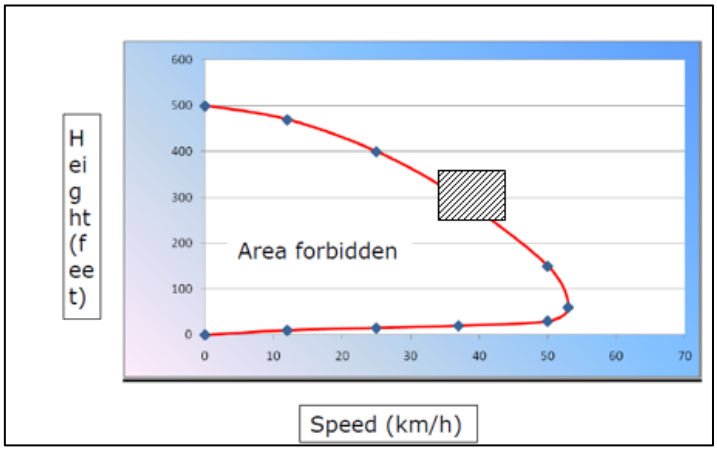

Figure 12 : gyroplane was flying in dashed zone before loss of power and steep descent

The latter is an operational limit and is independent of the legal rule SERA.5005 (f) stating that VFR flights shall not be flown over the congested areas of cities, towns or settlements, or over an open-air assembly of persons at a height less than 1000 ft above the highest obstacle within a radius of 600 m from the aircraft.

2.2 Loss of power

The pilot stated that when arriving above the garden, shortly after the passenger was seen throwing the chocolate eggs, he felt the engine losing power and the gyroplane started to descend steeply and rapidly, before the engine revved up.

A video taken by a witness of the event shows the movement of the propeller through a strobe effect. There is a change in propeller RPM visible (to a lower value) from the moment the passenger throws the eggs (9 seconds before impact) and another in relation with the sound of the engine revving up to a high power setting again. The engine seems running smooth at that moment.
the propeller blade Impact damage also confirmed that the engine was rotating during landing.

There were no obvious deficiencies that could have caused the (temporary) loss of power.

Also the occurrence of carburettor icing is highly unlikely; Meteo conditions (temperature of 14°c, dew point -1°c weren't of that kind to induce icing at other than descent power settings (the loss occurred at low speed when still flying straight and around the moment passenger dropped the eggs) and it's heard that the engine regained relatively quick (terms of seconds high power again. In case of carb icing this would have taken much more longer, especially when not using carb heat.

Seen the location of the throttle control (left of the front seat), interference with the controls by the passenger during the drop of the eggs, is also excluded.

2.3 Landing

The gyroplane was at low height when the passenger threw the chocolate eggs; from that moment, it took only 9 seconds for the gyroplane to reach the ground.

Backside of the power curve

As stated earlier, it is heard on the videos, that the engine is revving up during the steep descent but still the aircraft didn't recover any altitude. This - as well as the typical chopping rotor sound - is typical for a flight regime 'behind the power curve' (also called 'the region of reversed commands'). At speeds in this zone, as pitch is increased to slow the gyroplane, more and more power is required to maintain level flight. At the point where maximum power available is being used, no further reduction in airspeed is possible without initiating a descent. This speed is referred to as the minimum level flight speed (which is 40 km/h for this aircraft).

If the gyroplane is flown below minimum level flight speed, a descent results even though full engine power is applied.

The FAA's *Rotorcraft Flying Handbook (For Gyroplanes)* perfectly describes this phenomenon and how to recover from or below minimum level flight speed. It requires

1) lowering the nose of the gyroplane and
2) using altitude to regain airspeed.

It is seen that at 4 seconds before impact and from the video estimated at about 100 ft AGL, the nose is slightly lowered, however the gyroplane was already too close to the ground to regain sufficient airspeed.

Figure 13 : nose pitching down at 4 seconds before impact. Video taken from location #2 (see Figure 6)

Figure 14 : Showing descent, righthand turn and first touchdown. Video taken from location #1 (see Figure 6)

The only option left was to land in the garden of the orphanage. At the end of the descent, he turned right before touching down with a rather high vertical speed, causing the gyroplane to bounce. During the landing run, due to the engine running at high power setting, the rotor blades hit a low hanging branch of a tree.

Because the engine was powered up before touchdown and throttle wasn't brought back to idle, there was still some excessive thrust left, causing an acceleration and quite a violent impact due to this acceleration.

3. CONCLUSIONS

3.1 Findings – general

- The gyroplane was found without obvious deficiencies that could have caused the loss of power.
- The pilot held a valid ULM pilot licence.
- The pilot had experience flying the gyroplane.

3.2 Findings as to causes and contributing factors

- The nature of the flight caused the pilot to descend to a low altitude.
- Concentrated on getting the gyroplane on its intended spot to attract the children's attention, the pilot most probably allowed the aircraft to slow down close to minimum level flight speed (on the backside of the power curve)
- The engine experienced a temporary loss of power but the reason for this could not be determined. However, the engine was running at high power setting (again) upon impact.
- The aircraft was already flying too slow and too low to recover from this situation
- The power wasn't brought back to idle when touching down, contributing to the resulting impact and damage

3.3 Findings as to factors that increase(d) risk

- Flying low and slow in the vicinity of assembly of people introduces high risks in case a forced landing is needed. The regulation already addressed this risk by SERA rule 5005(f).
- Flying at low altitude limits the choice of a suitable landing area as well as the options on how (which side, direction,…) to approach the chosen landing area.

4. SAFETY ACTIONS AND RECOMMENDATIONS

None issued.

ABOUT THIS REPORT

General	
What?	Safety investigation reports are a technical document that reflects the views of the investigation team on the circumstances that led to the accident or serious incident and is conducted in accordance with Annex 13 to the Convention on International Civil Aviation and Regulation (EU) No 996/2010.
Objective	**The sole objective of safety investigations is the determination of the causes, and to define safety recommendations in order to prevent future accidents and incidents. It is not the purpose of this investigation to apportion blame or liability.** In particular, Article 17-3 of Regulation (EU) 996/2010 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility.
Investigation authority	The Air Accident Investigation Unit of Belgium, (AAIU(Be) for the rest of this publication). It is the Belgian permanent national civil aviation safety investigation authority as defined in Article 4 of Regulation (EU) No 996/2010 and established in accordance with the Royal Decree of 8 December 1998. This unit is part of the Federal Public Service Mobility and Transport and is functionally independent from the Belgian Civil Aviation Authority and other interested parties.
This investigation	
Investigation initiation	AAIU(Be) was notified of the accident by the police at 09:25 UTC on 18 April 2022. On 09:43 UTC, 1 investigator deployed to the accident site, where he arrived at 10:40 UTC to conduct the on-site examination.
Scope	**Limited** For this occurrence, a limited-scope, fact-gathering investigation and analysis was conducted in order to produce a short summary report. The investigation mainly focussed on the actions and conditions directly relating to the occurrence and might not cover all aspects of the aircraft operation and/or possible underlying safety factors due to the expected safety benefit of it and/or the extent of evidence/resources available.
Other parties involved	None
	AAIU(Be) would like to thank the mentioned parties above and all other entities and individuals that have contributed to this safety investigation.