

Safety Investigation Report

Ref. AAIU-2013-01-EBHN

Classification: Accident

Level of investigation: Standard

Date and hour: 02 January 2013 at 12:30 UTC

Aircraft: Robinson R-22 Beta II, msn 4133. The helicopter was registered in Belgium and held a Certificate of Airworthiness and a valid Airworthiness Review Certificate (ARC)

Total flight time: 2054.6 FH

Type of engine: One Lycoming O-360-J2A, sn L-40641-36A

Accident location: On EBHN airfield

Type of flight: General Aviation – Flight training – Local - Dual

Phase: Hover taxi

Persons on board: Two, a student pilot and an instructor.

Injuries: Minor

Abstract

During training flight, with a student and an instructor on board, the helicopter was flying at low height, alongside the runway. The flight was not stable and the student made several attitude corrections. The left hand skid touched the ground and the helicopter rolled to the left in a dynamic rollover.

Cause

The cause of the dynamic rollover is an inadequate lateral cyclic input while flying close to the ground.

Contributing factors:

The flight was conducted at low level while the student could not yet adequately master the controls and the instructor was late reacting to prevent the inadequate movement of the controls.

Recommendations:

None

Hazard identified during the investigation ¹:

Low level flying during training

Consequence ²:

Dynamic rollover

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

Factual Information

History of the flight

The instructor and the student started the flight from the Antwerp airport (EBAW). The pre-flight check determined that they needed to refuel to complete the whole flight back to EBAW, but there was enough fuel on board to get to the Hoevenen airfield (EBHN).

The purpose of the flight was to exercise low level flights. Upon arrival in EBHN, they started exercising set-downs and pick-ups. They then proceeded to the fuelling on to the helibed located alongside the runway.

After that, the student took the helicopter for a hover taxi towards the hangars of EBHN.

At a moment, the helicopter deviated to the right, the student corrected with left cyclic. The helicopter lost some height and the rear end of the LH skid contacted the ground. The instructor reacted, moving the cyclic to the right, but the dynamic rollover was initiated and the helicopter fell on its left side.

The instructor and the student climbed out with minor injuries.

Injuries to persons.

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

Damage to aircraft.

One main rotor blade is broken.

Damage to the helicopter structure; Vertical firewall deformed. Tail boom deformed on both ends. LH door window broken.

Engine power transmission belts broken.

The B223 yoke and A947-2 flexplate are deformed under torsion (transmission from V-belts to the tail rotor).

Pilot information

Instructor: Male, 34 years old
Holder of a Commercial Pilot Licence (Helicopter), first issued on November 25th, 2010, valid until November 24th, 2015
Ratings:
Robinson R44, last issued November 3rd, 2012, valid until November 30th, 2013.
Robinson R22, last issued November 3rd, 2012, valid until November 30th, 2013.
Flight Instructor, last issued December 11th, 2011, valid until December 10th, 2014

Flight experience:
Total FH: 529, PIC: 328 FH, FI(H): 223 FH
Types:
Robinson R-22: 138 FH (PIC: 119 FH, FI(H): 119 FH)
Robinson R44: 217FH (PIC: 155 FH, FI(H): 104 FH)
Other types: EC135, Hughes269

Student: Male, 24 years old
Holder of a Student Pilot License, issued on January 9th, 2013.
Total flight experience: 12:12 FH.
The student had completed 10 training sessions of which 6 were performed in EBAW and 4 in EBHN.
Training included 3 completed sessions with hover taxiing and spot turns.

The helicopter

The R-22 is a single-engined 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 fiberglass and aluminum with a Plexiglas canopy. The tailcone, vertical and horizontal stabilizers are made in aluminum. 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.

General characteristics

- **Crew:** 1
- **Length:** 8.7 m
- **Rotor diameter:** 7.7 m
- **Height:** 2.7 m
- **Empty weight:** 389 kg
- **Max. takeoff weight:** 635 kg
- **Powerplant:** 1 × Lycoming O-360 flat 4 piston engine,
- **Main tank total capacity:** 75 liters

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:** approx. 2 hours, with 30-minute reserve

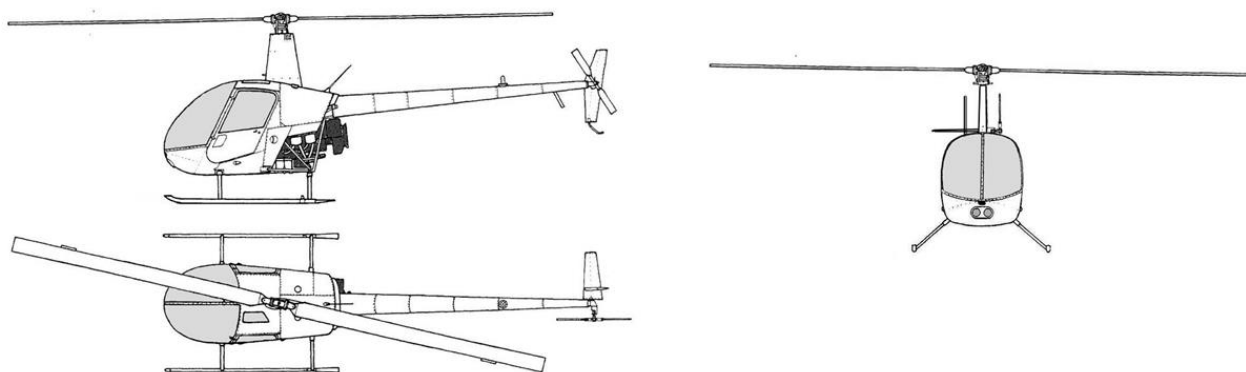


Figure 1: 3-view

1. **Airframe**

- Manufacturer: Robinson
- Type: R22 Beta II
- Serial Number: 4133
- Total Flight Time: 2054.6 FH
- Built year: 2007

Certificate of Registration: N°10165 issued by BCAA on August 14th, 2007.
Certificate of Airworthiness issued on October 2nd, 2007. Airworthiness Review
Certificate last issued on September 13th, 2012, valid until September 12th, 2013
Authorized flights: first flights, training, aerial photography, aerial surveillance.

2. **Engine**

- Manufacturer: Lycoming.
- Model: Lycoming O-360-J2A,
- Serial Number: L-40641-36A
- Total Flight Time: 2054.6 FH

Meteorological information

Situation at Antwerp airport (EBAW) 12:20 UTC

Wind Direction: 240 degrees, variable between 220 and 280 degrees
Wind speed: 8kt

Visibility: more than 10km

Temperature: 8°C
Dew point: 5°C

QNH: 1024 hPa

Airfield information

Hoevenen airfield is located north of the city of Antwerp. It features a 600m long and 18 m wide grass bi-directional runway, oriented 153° / 333°

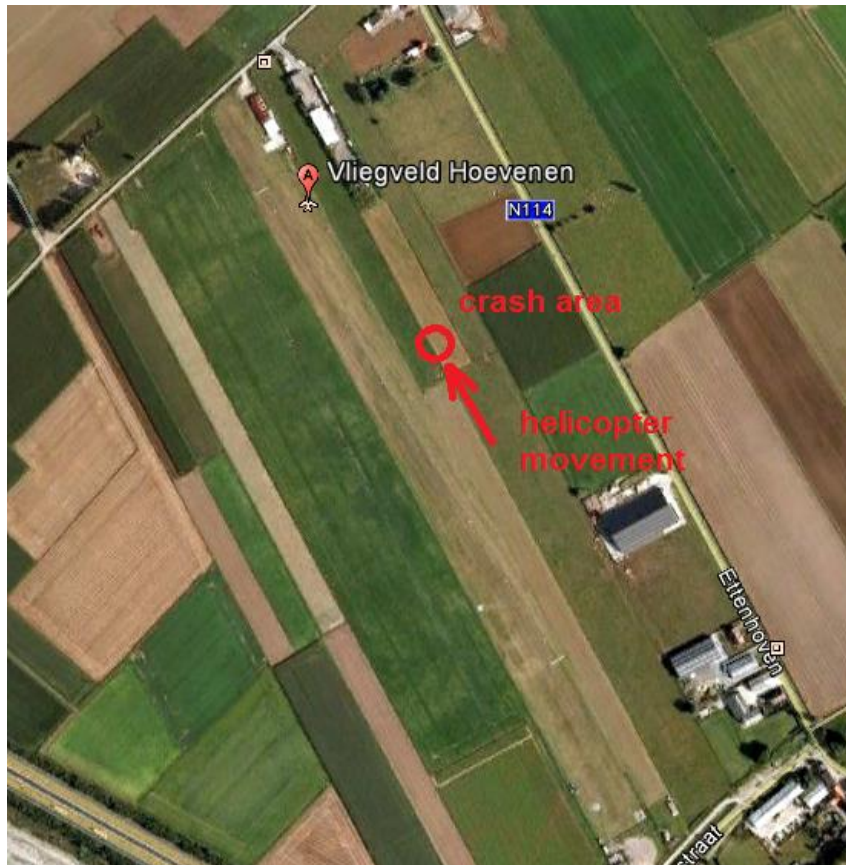


Figure 2: Airfield EBHN

Flight recorders.

The helicopter was not equipped with any flight recorder, nor was it supposed to. However, the crew had a video camera installed on-board.

Images of the flight were recorded.



Fig. 3: Hover taxi towards the EBHN hangars.



Fig.4: 09 min 37secs: nose deviates to the right.



Fig. 5: 09min 38secs: LH skid touches the ground



Fig. 6: 09min 39 secs: dynamic rollover



Fig. 7: 09min 40secs: Helicopter rolls over.

Wreckage and impact information

The wreckage was inspected on the day after the accident. All damage found are consistent with a dynamic rollover.



Fig. 8: The crash site



Fig. 9: The crash site

The impact traces on the ground and inspection of the left skid show the rear of the skid contacted the ground. The traces show further the impact of the rotor blades with the ground.

Test and Research

Accident report database from NTSB, AAIB, BEA-fr and AAIU(Be) were consulted for accidents during helicopter flight training.

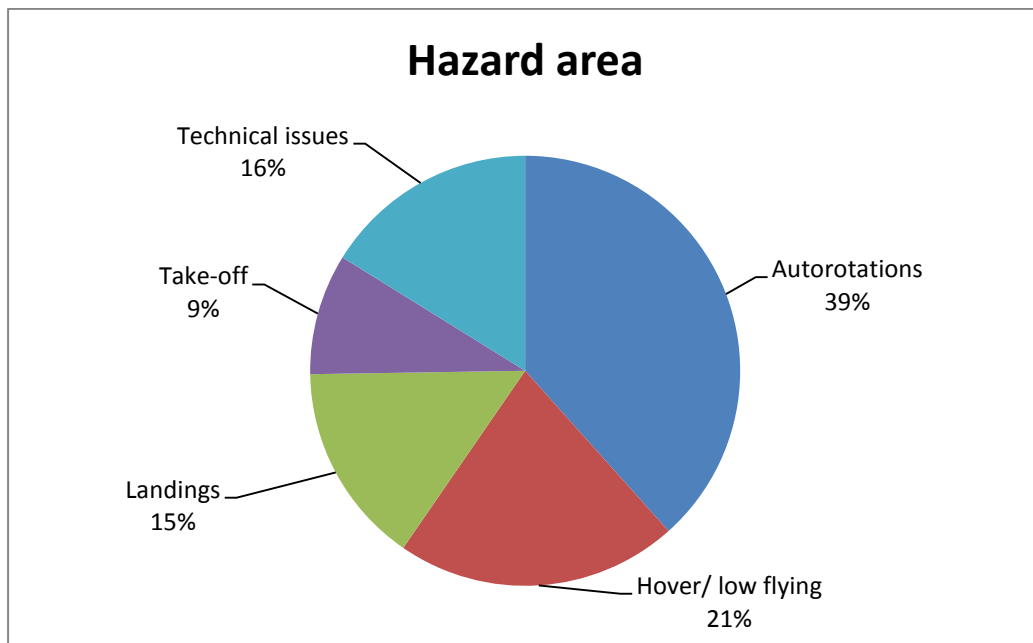
The combined database showed 151 helicopter training accident reports filed for the period 2000-2012. Helicopter flight training accidents were accounting for 25 % of all helicopter accidents.

Out of the these accidents;

- 71% occurred during basic training,
- 19% occurred during refresh course, flight review exams and check rides.
- 10% occurred during advanced training (conversion, type training)

- 5% were fatal accidents.
- 7% involved serious injuries.
- 87% involved only material damage and minor injuries.

Breaking down the hazard area,



With respect to hover and low flying (the second most frequent hazard after autorotation), the reports identify in 53% of the cases the inadequate input from the student as the main cause of the accident. The reports identify also (in 40% of the cases) the late response of the flight instructor as a major contribution factor.

Analysis

On the day of the accident, when the helicopter was hover taxiing along the runway, on a heading of 333° the wind was blowing from the left (240°). The student let the helicopter nose to turn right and thereafter tried to correct with left cyclic. The helicopter banked to the left, allowing the rear of the left skid to contact the ground.

The instructor reacted by pulling the cyclic to the right but too late to avoid the dynamic rollover.

Note: For flights close to the ground conducted by a student with an instructor on board, it is customary that the instructor keeps discreetly one hand around the control column, in order to feel the movements and be able to react immediately upon inadequate cyclic inputs by the student.

Dynamic Rollover.

Three conditions are necessary for dynamic rollover to occur;

1. There must be main rotor thrust sufficient to lift the helicopter.
2. The helicopter must be restrained to the ground or in contact with the ground.
3. There must be a roll rate about the ground contact point (pivot).

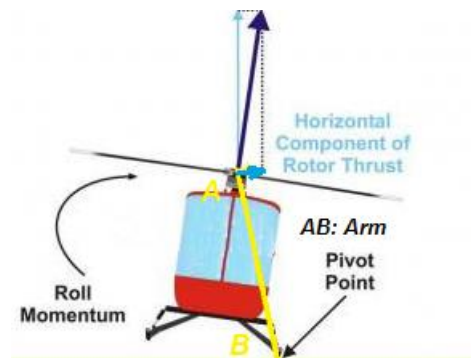


Fig. 10: Dynamic rollover

The bank angle or side drift can place the helicopter in a situation where it is pivoting about a skid/wheel which is still in contact with the ground. When this happens, lateral cyclic control response becomes more sluggish and less effective than for a free hovering helicopter. Consequently, if a roll rate is permitted to develop, a critical bank angle (the angle between the helicopter and the horizon) may be reached where roll cannot be corrected, even with full lateral cyclic input and the helicopter will roll over its side. (FAA AC90-87).

The video taken and the traces on the ground show that the three conditions mentioned here-above were met.

Conclusions

Cause

The cause of the dynamic rollover is an inadequate lateral cyclic input while flying close to the ground.

Contributing factors:

The flight was conducted at low level while the student could not yet adequately master the controls and the instructor was late preventing the inadequate movement of the controls.

Safety Recommendations

None

Safety Actions

On January 25th, 2013 a refresher course for Flight Instructors was organised. AAIU(Be) presented the subject "Helicopter accidents related to instruction and lessons learned" based on a study of 150 investigation reports (NTSB, AAIB, BEA) of helicopter accidents during training.

About this report

As per Annex 13 and EU regulation EU 996/2010, each safety investigation shall be concluded with a report in a form appropriate to the type and seriousness of the accident and serious incident. For this occurrence, a limited-scope, fact-gathering investigation and analysis was conducted in order to produce a short summary report.

It is not the purpose of the Air Accident Investigation Unit to apportion blame or liability. The sole objective of the investigation and the reports produced is the determination of the causes, and, where appropriate define recommendations in order to prevent future accidents and incidents.