Australian Government
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ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Investigation – AO-2007-026

Preliminary

Rotor Strike – Maryfield Station, NT
24 July 2007
VH-VHQ
Robinson Helicopter R22 Beta

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Abstract

On 24 July 2007 at 1500 Central Standard Time, a Robinson R22 Beta helicopter, registered VH-VHQ, with the pilot the sole occupant, departed from a helipad at Maryfield Station, NT, in order to recommence cattle mustering activities. Visitors to the station, who had recently been given scenic rides in the helicopter, were still in the general area of the helipad at that time.

During the initial climb after takeoff, and at a height of about the tops of the surrounding trees, the helicopter's 'low RPM' warning horn activated. During the recovery manoeuvre by the pilot, one of the visitors was struck in the head by the helicopter's main rotor and was fatally injured. The pilot immediately landed the helicopter.

The investigation is continuing.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

FACTUAL INFORMATION

History of the flight

On 24 July 2007 at 1500 Central Standard Time[1], a Robinson R22 Beta helicopter, registered VH-VHQ, with the pilot the sole occupant, departed from a helipad at Maryfield Station, NT, in order to recommence cattle mustering activities. Visitors to the station, who had recently been given scenic rides in the helicopter, were still in the general area of the helipad at that time.

During the initial climb after takeoff, and at a height near the tops of the surrounding trees, the helicopter's 'low RPM[2]' warning horn activated. During the recovery manoeuvre by the pilot, one of the visitors was struck in the head by the helicopter's main rotor and was fatally injured. The pilot immediately landed the helicopter (Figure 1).

Figure 1: Position of the helicopter after landing. The helipad and hangar are in the background.[3]

That morning, the pilot had conducted about 6 hours of mustering operations in the accident helicopter. A second pilot in another R22 helicopter also participated in those mustering operations. During lunch at the homestead, the pilot of the accident

1 The 24-hour clock is used in this report to describe the local time of day, Central Standard Time (CST), as particular events occurred. Central Standard Time is Coordinated Universal Time (UTC) + 9.5 hours.

2 RPM refers to the revolutions per minute or speed of the main rotor.

3 The quad-bike in Figure 1 was not at the location shown at the time of the accident. The person fatally injured was positioned immediately beyond the location of the bike in the photograph.

helicopter was unexpectedly asked by the station owner if he would give some relations, who were visiting from Italy, a scenic flight.

The pilot then conducted five scenic flights around the station, each of about 2 to 3 minutes duration. The visitors (four adults, two children) and the station owner waited inside the hangar during that time. The pilot reported that he conversed very little or not at all with the visitors as some could not speak English.

During the first scenic flight, the pilot contacted another station owner by radio to find out the progress of the current mustering. As a result of that conversation, the pilot understood that the helicopter would be soon needed in support of that mustering.

Following the scenic flights, the pilot refuelled the aircraft from drum stock with the engine running and rotors rotating. One of the visitors and the station owner commenced walking south toward the homestead and another adult and the two children mounted a quad-bike near the corner of the hangar. The remaining two adults then started walking back to the homestead, after one of them had assisted the children getting onto the quad-bike.

The pilot reported that, as he was preparing to enter the helicopter for takeoff, he saw the latter two adults (one man and one woman) walking slowly from left to right in front of the helicopter, and between the helicopter and the road (Figure 2). The children and adult on the quad-bike had not moved from their original position and the other two adults were some distance from the helipad at this stage.

Figure 2: View of takeoff area from the helipad (note the two largest trees immediately to the left of the parked quad-bike).

The pilot stated that he intended to manoeuvre the aircraft forward and to his right (south-east), away from the children and between the two groups of adults. He then intended to turn the helicopter left into the wind and to fly away in a north-easterly direction. After rechecking the position of the children, he departed from the ground forwards (without hovering) and then noticed that the man and woman closest to the helicopter had walked further to the right than he had expected.

The pilot continued his planned take-off profile, but now had to manoeuvre the aircraft further right than initially intended. After passing in front of the man and

woman, he banked the helicopter left to re-intercept that profile. The pilot reported that, as he approached the tops of the two largest of the trees in the early climb-out (Figure 2), the helicopter was struck by a gust of wind and that the helicopter's low RPM warning horn sounded.

In response to the warning horn, the pilot reported that he:

- opened the throttle, with the effect of over-riding the engine RPM governor[4]
- lowered the collective lever[5]
- pushed forward on the cyclic stick[6].

The pilot stated that the low RPM resulted in a loss of altitude and airspeed before he was able to recover control of the aircraft. The pilot reported that, just as he regained control of the aircraft, he heard and felt the main rotor blade strike something, and saw the woman fall forward. The pilot immediately faced the helicopter into the wind and landed.

The man walking with the fatally-injured woman reported that they had been talking about the scenic flights and, although he noticed the increasing noise from the helicopter, they did not take any notice of it as it was behind them. He described suddenly noticing 'more wind', before turning to see that the helicopter's skids were at his shoulder height and about 3 m away. He instinctively bent forward and noticed the helicopter move in front of him. He then heard the rotor strike the woman who was on his left, and then noticed her on the ground.

Accident site

Maryfield Station was located about 200 km south-east of Katherine, NT. The terrain was generally flat and lightly vegetated. The elevation of the bitumen helicopter landing area (helipad) was about 650 ft above mean sea level (AMSL).

The hangar was at one end of a 12 by 30 m farm shed, with a roller door and a concrete floor that extended onto the helipad (Figure 1).

There were various trees and other buildings located in the vicinity of the landing area. In addition, there were a number of disused or rarely used farming implements in the areas of long grass near the landing area.

Figure 3 shows a scale diagram of the helipad, take-off area and accident site.

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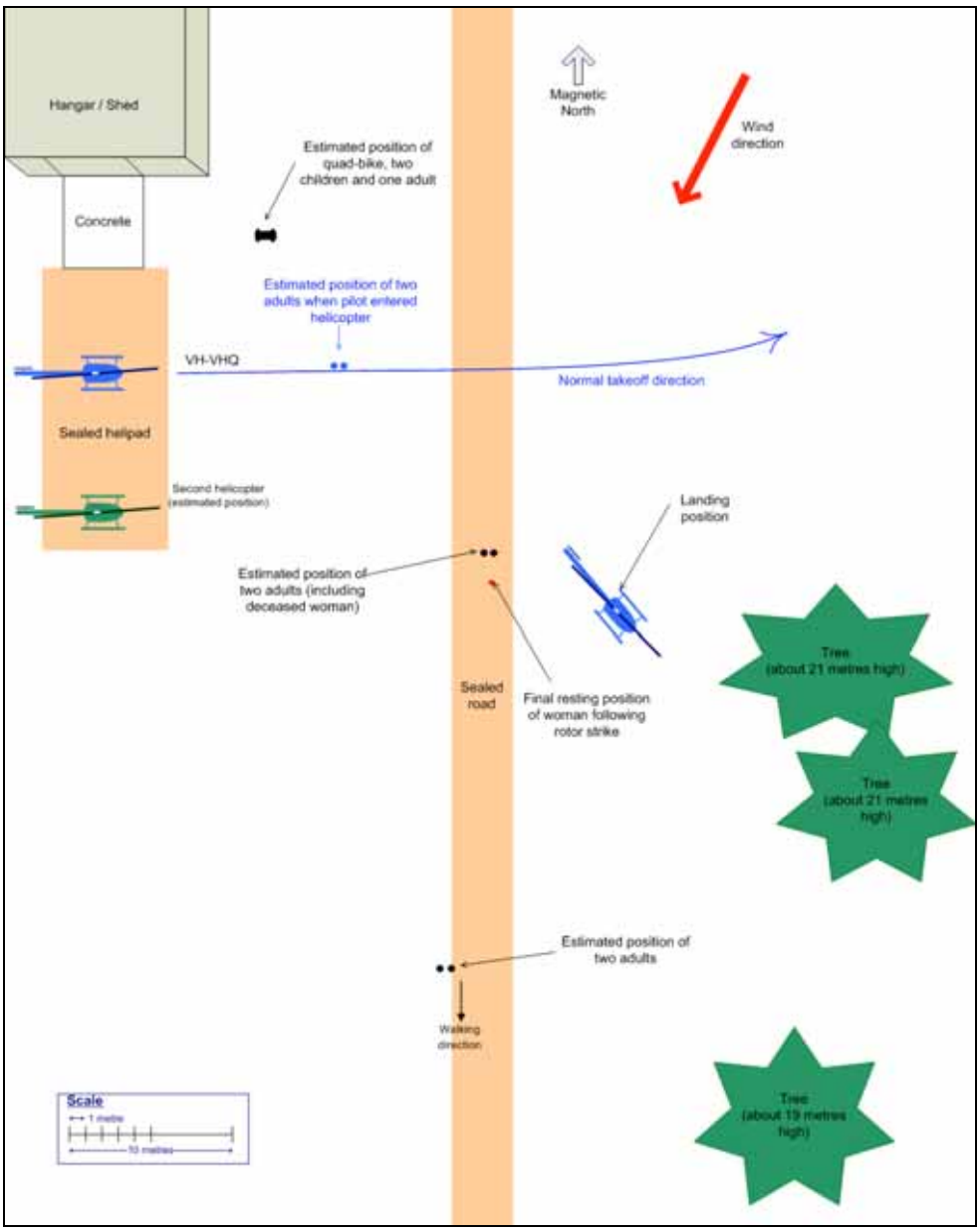
4 The RPM governor maintains engine RPM, and therefore rotor RPM, within the normal operating range (see the *Aircraft performance* section at page 7 for further detail).

5 Lowering the collective lever reduces the pitch of the main rotor blades, reducing drag and facilitating increased rotor RPM. The action of lowering the collective lever also reduces the main rotor thrust (effectively lift) produced by the main rotor blades.

6 Pushing forward on the cyclic stick tilts the main rotor disk forward and lowers the nose of the helicopter.

Figure 3: Scale diagram of the helipad, take-off area and accident site at the time of the rotor strike.



Aircraft information

Aircraft specifications

The aircraft was an R22 Beta helicopter, serial number 1890, and was manufactured in 1991 in the US by the Robinson Helicopter Company. The helicopter was registered to the current owner on 5 May 2003.

The helicopter had one main rotor, comprising two main rotor blades, and a tail rotor. It was fitted with a Textron Lycoming 0-320-B2C engine, serial number L-16873-39A. There were two seats, one on the right for the pilot and another on the left for a passenger. There was one set of flight controls fitted on the pilot's side of the cockpit.

The helicopter had a maintenance release issued in the private operational category that was valid until 4 June 2008 or 2,904.3 hours in service. At the time of the accident, the helicopter had accumulated a total of 2,833.9 hours service since new.

Recent maintenance history

The helicopter completed its 2,200 hour servicing on 5 June 2007. That servicing included the replacement of significant flight control and main and tail rotor drive components, and the non-destructive inspection of flight control and structural components.

The main rotor blades were replaced on 19 December 2006 and the new blades had accumulated 321.4 hours since that time.

The engine had been fitted on 21 December 2004 and had accumulated 517.8 hours since that time.

The pilot reported that, before the scenic flights, he had changed six of the helicopter engine's eight spark plugs. That was due to a spark plug problem that was encountered during the previous flight. After they were changed, the second pilot conducted a short flight in the helicopter and found that the apparent problem had been rectified.

On-site examination

The helicopter was intact and capable of landing after the main rotor struck the woman. An on-site examination of its structure, engine and flight control systems found nothing that would have contributed to the accident.

The investigation ran the engine using the fuel that was remaining in the helicopter at the time of the accident. During that engine run, the engine and engine control system operated normally and in accordance with the manufacturer's specifications.

The remaining fuel was examined and found to be free of any obvious water or contamination. The helicopter had sufficient fuel for flight.

Damage to one of the main rotor blades, including tip distortion and skin indentation (Figure 4), was consistent with that blade having contacted the woman during operation.

Figure 4: Damage to main rotor blade

Aircraft performance

Aircraft weight and performance

Weight and balance calculations indicated that the helicopter was operating below its maximum allowable gross weight and within the centre of gravity limits at the time of the accident.

The manufacturer's performance data also indicated that the helicopter was capable of hovering out of ground effect[7] in zero wind conditions.

Take-off procedure

The Normal Procedures section of the *Robinson R22 Pilot's Operating Handbook* (POH) stated the following take-off procedure:

1. Verify governor on, RPM stabilized at 102-104%.
2. Clear area. Slowly raise collective until aircraft is light on skids. Reposition cyclic as required for equilibrium, then gently lift aircraft into a hover.

7 Helicopters require less power to hover close to the ground due to a cushioning effect created by the main rotor downwash striking the ground. Under these conditions, the helicopter is operating 'in ground effect'. The United States Federal Aviation Administration's *Rotorcraft Flying Handbook*[9] states that this effect usually occurs at less than one rotor diameter above the surface (25 feet for an R22 helicopter), above which point the helicopter is operating 'out of ground effect'.

3. Check that gages are in the green, lower nose and accelerate to climb speed following profile shown by the height-velocity diagram in Section 5[8]. If RPM drops below 102%, lower collective.

The POH stated that the climb airspeed for safe operation was 60 kts indicated airspeed. The height-velocity diagram indicated that the helicopter should not be climbed above 10 ft above ground level (AGL) until it had reached about 30 kts (see Appendix A).

Gaining additional height before accelerating to the recommended climb speed is possible when there is sufficient power to hover out of ground effect. However, doing so will increase operational risk in the event of a loss of engine power.[9]

Low RPM

The normal engine and rotor RPM operating range for the helicopter was between 101% and 104%.[10] An RPM governor sensed engine RPM changes and applied corrective inputs to open or close the throttle to ensure that the RPM remained within that operating range.

The POH noted that, although the RPM governor was designed to assist the pilot in controlling the RPM in the normal operating range, it may not be able to maintain the rotor RPM within that range in all circumstances. If the rotor RPM reduced to 97% or below, then the 'low RPM' horn would sound through the pilot's headphones and an associated cockpit caution light would illuminate.

An immediate pilot response is required to restore rotor RPM to within the published safe limits, otherwise it is probable that the helicopter will lose aerodynamic performance. The POH stated that:

> To restore RPM, immediately roll throttle on, lower collective and, in forward flight, apply aft cyclic.

Pilot information

Flight training

The pilot had worked at the station for about 12 years and, at the time of the accident, was employed as the station manager. He was awarded his commercial pilot (helicopter) licence in 2003, including with an endorsement on the R22 helicopter and an aerial stock mustering approval. In addition, the pilot had completed low flying training. At the time of the accident he had accrued 1,100.4 hours flight time, of which 1,032.8 hours was in R22 helicopters. Nearly all of his R22 hours were flown in the accident helicopter.

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8 See Appendix A for the height-velocity diagram from Section 5 of the R22 POH.

9 Federal Aviation Administration (2000). *Rotorcraft Flying Handbook.* (Report no. FAA-H-8083-21). Washington, DC: Federal Aviation Administration.

10 The helicopter was installed with a later model tachometer.

The pilot's most recent flight review was conducted on 15 March 2007. He had no previous experience in tourist or scenic flight operations.

The pilot held a valid medical certificate without restrictions.

Recent history

The station commenced the season's mustering operations 5 days prior to the accident. According to the maintenance release that was completed by the pilot at the end of each day's flying and the engine hour meter, the pilot's flight hours in the days prior to the accident were as follows:

Date	Flight hours	Comments
20 July 2007	8.0	
21 July 2007	Nil	Day off
22 July 2007	5.9	
23 July 2007	Nil	
24 July 2007	6.5	Date of the accident

The pilot reported that he had no known health or medical issues that would have affected him on the day of the accident. He did not wear, nor was he required to wear, corrective lenses.

Usual take-off procedure

The helicopter was parked in its usual position on the helipad prior to the accident flight. The pilot stated that he normally took off tracking and climbing virtually due east and/or turning slightly left towards east-north-east (see Figure 3). An alternative but less commonly used take-off profile involved turning left after becoming airborne and tracking north, along the road that was adjacent to the hangar.

Weather conditions

Bureau of Meteorology observations

The Bureau of Meteorology made instantaneous observations at Daly Waters (about 48 km south of Maryfield Station) and Larrimah (about 35 km north-north-west of Maryfield Station) at 1500. Those observations included:

- at Daly Waters, the air temperature was 30.9 °C, with a wind of 5.1 kts from 063 degrees magnetic (north-east);
- at Larrimah, the air temperature was 29.9 °C, with a wind of 5.1 kts from 050 degrees magnetic (north-east).

Observations at Maryfield station

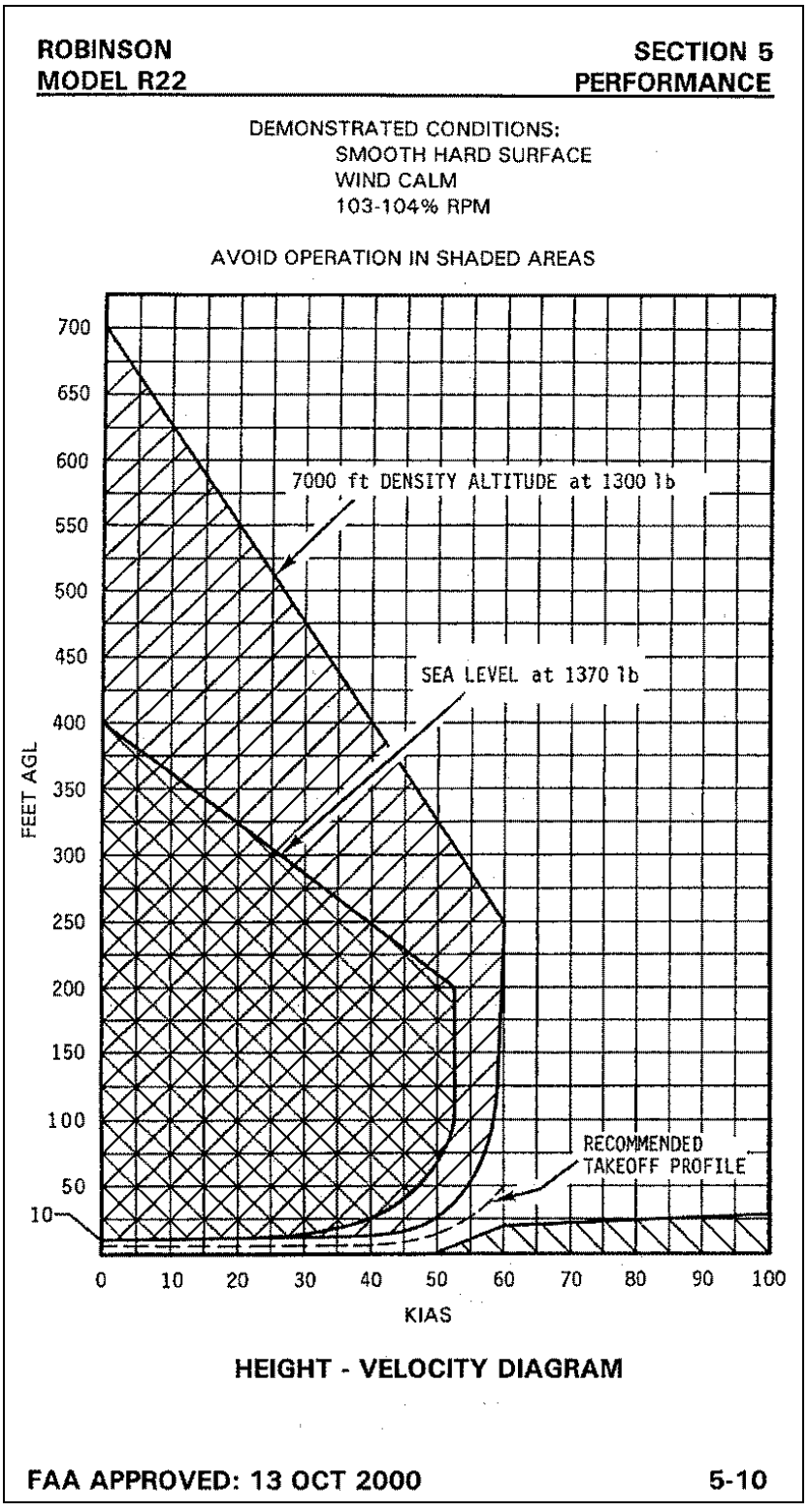
The two pilots that were operating at the station reported that following a still and foggy early morning, there was some wind during that morning's mustering, with varying wind gusts from the south-east. There was no wind-sock at the station, so the pilots estimated wind strength and direction by the movement in the trees.

Further investigation

The investigation is continuing and will include the examination of:

- aircraft performance issues
- take-off and obstacle clearance issues
- the weather
- pilot performance and training.

APPENDIX A: HEIGHT-VELOCITY DIAGRAM FROM SECTION 5 OF THE R22 PILOT OPERATING HANDBOOK



Note: KIAS refers to 'knots indicated airspeed'.