CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

OCCURRENCE NUMBER 11/1471

ROBINSON HELICOPTER R22 BETA PLUS

ZK–IXR

DYNAMIC ROLLOVER

MISTAKE CREEK

6 APRIL 2011

(Photograph sourced from: http://nzcivair.blogspot.com/2011/04/robinson-r22-beta-zk-ixr.html)

FOREWORD

As a signatory to the Convention on International Civil Aviation 1944 ("the Chicago Convention") New Zealand has international obligations in respect of the investigation of accidents and incidents. Pursuant to Articles 26 and 37 of the Chicago Convention, the International Civil Aviation Organisation ("ICAO") issued Annex 13 to the Convention setting out International Standards and Recommended Practices in respect of the investigation of aircraft accidents and incidents.

New Zealand's international obligations are reflected in the Civil Aviation Act 1990 ("the Act") and the Transport Accident Investigation Commission Act 1990 ("the TAIC Act").

Section 72B(2)(d) and (e) of the Civil Aviation Act 1990 Act also provides:

> **72B Functions of Authority**
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> (2) The Authority has the following functions:
>
> (d) To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of the Transport Accident Investigation Commission Act 1990:
>
> (e) To notify the Transport Accident Investigation Commission in accordance with section 27 of this Act of accidents and incidents notified to the Authority:

The purpose of an investigation by the Commission is to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future, rather than to ascribe blame to any person.

CAA however investigates aviation accidents and incidents for a range of purposes under the Act. Investigations are primarily conducted for the purpose of preventing future accidents by determining the contributing factors or causes and then implementing appropriate preventive measures - in other words to restore safety margins to provide an acceptable level of risk. The focus of CAA safety investigations is therefore to establish the causes of the accident on the balance of probability.

Accident investigations do not always identify one dominant or 'proximate' cause. Often, an aviation accident is the last event in a chain of several events or factors, each of which may contribute to a greater or lesser degree, to the final outcome.

CAA investigations may also inform other regulatory-safety decision making or enforcement action by the Director.

In the case of a fatal aviation accident, the final CAA investigation report will generally be highly relevant to an inquiry, and in some circumstances, an inquest, conducted by a Coroner. CAA investigations are not however done for, or on behalf of, a Coroner.

Contents

Glossary of abbreviations used in this report

AMSL	above mean sea level
°C	Celsius
E	east
ELT	emergency locator transmitter
ft	foot or feet
GPS	global positioning system
hPa	hectopascal(s)
km	kilometre(s)
mm	millimetre(s)
NZST	New Zealand Standard Time
NW	northwest
PPL(H)	Private Pilot Licence (Helicopter)
PPL(A)	Private Pilot License (Aeroplane)
S	south
s/n	Serial number
UTC	Coordinated Universal Time
WGS 84	World Geodetic System 1984

AIRCRAFT ACCIDENT REPORT

CAA OCCURRENCE No.11/1471

Aircraft type, serial number and registration:	Robinson R22 Beta Plus, s/n 2196, ZK-IXR
Number and type of engines:	1 Lycoming O-360-J2A
Year of manufacture:	1992
Date and time:	6 April 2011, 0938 hours[1]
Location:	Mistake Creek, 62km NW of Methven Latitude[2]: S 43º 10'05.79'' Longitude: E 171º 12'15.16'' Altitude: 3750 feet AMSL
Type of flight:	Private
Persons on board:	Crew: 1 Passenger: 1
Injuries:	Crew: 1 Fatal Passenger: 1 Serious
Nature of damage:	Aircraft destroyed
Pilot's licence:	Private Pilot Licence (Helicopter)
Pilot's age:	59 years
Pilot's total flying experience:	1037 hours Total Time 237 hours Fixed Wing 632 hours on type
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr S J Walker

[1] All times are NZST (UTC + 12 hours).

[2] World Geodetic System (WGS 84) co-ordinates.

Synopsis

The Civil Aviation Authority (CAA) was notified at 1600 hours Wednesday 6 April 2011 that a Robinson R22 Beta Plus helicopter, registered as ZK-IXR, had been involved in a fatal accident at Mistake Creek, a tributary of the Mathias River, south of the Rolleston Range. The pilot was found deceased in the wreckage and the passenger was seriously injured. The Transport Accident Investigation Commission (TAIC) was notified shortly thereafter. The TAIC declined to investigate. A CAA field investigation was commenced the following day.

1. Factual information

1.1 History of the flight

1.1.1 The purpose of the flight was to transport the first of a hunting party of two passengers, both friends of the pilot, from a location close by Mistake Hut into the headwaters of Mistake Creek.

1.1.2 The pilot departed from his Aylesbury home base at 0819 hours, after topping up the fuel tanks, and headed in a westerly direction on the flight of 98 kilometres to Mistake Hut.

1.1.3 The pilot arrived at Mistake Hut at 0857 hours. The pilot left the helicopter running while a briefing was held with the two passengers. The passengers were to be dropped at separate locations and rendezvous later in the day at a predetermined campsite. The pilot intended to return home once both hunters had been dropped off.

1.1.4 At 0912 hours the pilot took off from Mistake Hut with the first passenger on-board and headed north into the Mistake Creek valley.

1.1.5 From data gathered from the pilot's Garmin Pilot III hand held GPS device retrieved from the accident site, it was seen that the helicopter flew into three valleys on the north-east of Mistake Creek on the first flight, achieving approximately 4900ft altitude at 0917 hours. Shortly after this the pilot descended into the headwaters of Mistake Creek, before flying downstream, landing alongside Mistake Creek at 0925 hours.

1.1.6 The helicopter remained on the ground for four minutes so that the passenger could uplift a blue tarpaulin. At 0929 hours, the pilot took off to return to the headwaters of Mistake Creek, less than three kilometres upstream.

1.1.7 The pilot circled above the headwaters for seven minutes. At 0937 hours the pilot attempted to land the helicopter. During the landing the accident occurred. The total flying time from leaving Mistake Hut to arrival at the accident site was 22 minutes, in which a total of approximately 30 kilometres was covered.

1.1.8 When the helicopter didn't return to Mistake Hut within the expected time, the second passenger became concerned and made his way out to the station homestead by vehicle, to raise the alarm.

1.1.9 The homestead was reached by the second passenger at 1400 hours and the Rescue Coordination Centre New Zealand (RCCNZ) was then notified of the missing helicopter. A decision was made to dispatch the station manager into the valley with a radio and if there was still no sign of the helicopter or its occupants by 1500 hours then a full scale search would commence. At 1455 hours the station manager called

RCCNZ to inform of his unsuccessful search. A full scale search was then commenced by RCCNZ.

1.1.10 The rescue helicopter, which had been dispatched from Methven, located the wreckage in the headwaters of Mistake Creek at 1525 hours.

1.1.11 The pilot was found deceased. The passenger was found with serious injuries, lying in a stream, beside the wreckage.

1.1.12 The accident occurred at approximately 0938 hours, at Mistake Creek, 62 kilometres northwest of Methven, at 3750 ft AMSL, Latitude S 43º 10'05.79" and Longitude E 171º 12'15.16".

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0
Serious	0	1	0
Minor/None	0	0	

Table 1: Injuries to Persons

1.3 Damage to aircraft

1.3.1. The helicopter was destroyed.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

1.5.1 The pilot, aged 59, held a Private Pilot Licence PPL(H) and PPL(A). His Medical Certificate (Class 2) was valid until 12 June 2012.

1.5.2 The pilot obtained his PPL(H) on 9 April 1987. The pilot's last logbook entry was made on the 1 September 2010. The records in the logbook, plus the information gathered from the GPS data, showed that the pilot had a total of 1037 hours experience as pilot in command. This consisted of 800.3 hours of helicopter time and 237.8 hours of fixed wing time.

1.5.3 Of the helicopter time, the pilot had flown 632 hours in the Robinson R22. He also held type ratings on the Schweizer 269, Hughes 369, the Aerospatiale AS350 and the Bell 206.

1.6 Aircraft information

1.6.1 The Robinson R22 Beta Plus, ZK-IXR, serial number 2196, was manufactured in the USA in 1992; it had accrued total of 4140.60 flight hours at the time of the accident. The most recent maintenance activity was an Annual Review of Airworthiness carried out on 30 March 2011.

1.6.2 The helicopter had a Standard Category Non-Terminating Airworthiness Certificate issued on 28 November 2007. On the 15 March 2010, ZK-IXR was modified to a Beta Plus specification, where a Lycoming 0-360-J2A engine, s/n L-41015-36E was installed along with associated components. This modification provided the helicopter with increased power and better altitude performance compared to a standard Beta model.

1.6.3 The snow shoes fitted to the landing gear skid tubes were of welded aluminium construction and were attached permanently to the rear of the skid tubes by fillet welds. The maintenance records associated with the installation of the snow shoe on ZK-IXR was not able to be located. However, it was determined that the snow shoe modification was approved by the CAA in 1994, for installation onto the Robinson R22.

1.7 Meteorological information

1.7.1 The METAR[3] for Christchurch issued at 2100 hours UTC on 5 April reported a light west to south-westerly wind, variable in direction between 230 and 290 degrees[4]. The visibility was in excess of 10 kilometres. The cloud was few (1-2 Oktas[5]) at 6000 ft. The temperature was 11ºC and the dewpoint was 3ºC. The sea-level pressure was 1010 hPa.

1.7.2 While waiting to be picked up at Mistake Hut, the second passenger noted that the weather on the morning of the day of the accident was perfectly calm. However he observed that the west south-westerly wind increased in strength as the day progressed.

1.7.3 The search and rescue pilot, who was operating near to the accident site in the morning, and then at the accident site in the afternoon, described the winds as 30 knots and variable on the ridges around midday, and 10 to 15 knots at the accident site and in the area of valley floor.

1.8 Aids to navigation

1.8.1 Nil.

1.9 Communications

1.9.1 No communications were received from ZK-IXR.

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[3] Coded weather report detailing conditions at an aerodrome, predominantly used by pilots for flight planning purposes.

[4] Expressed in degrees from true north.

[5] The fraction of the sky that is obscured by clouds, expressed in eighths.

1.10 Aerodrome information

1.10.1 Not applicable.

1.11 Flight recorders

1.11.1 Not applicable.

1.12 Wreckage and impact information

1.12.1 Parts of the helicopter were scattered for 120 metres down a steep sided spur. The main fuselage, including the cockpit area and engine, had come to rest in a stream downhill from a small depression at the top of the spur, (see Figure 1).

1.12.2 The depression, intended to be used as the landing site, measured approximately three metres by seven metres. Small rocks were scattered within the bounds of the landing site with large tussocks at the northern end. The perimeter of the landing site consisted of a small raised dirt bank. The inside of the banked edge was generally vertical, as if cut with a spade. The banked edge varied in height between 100 mm and 400 mm.

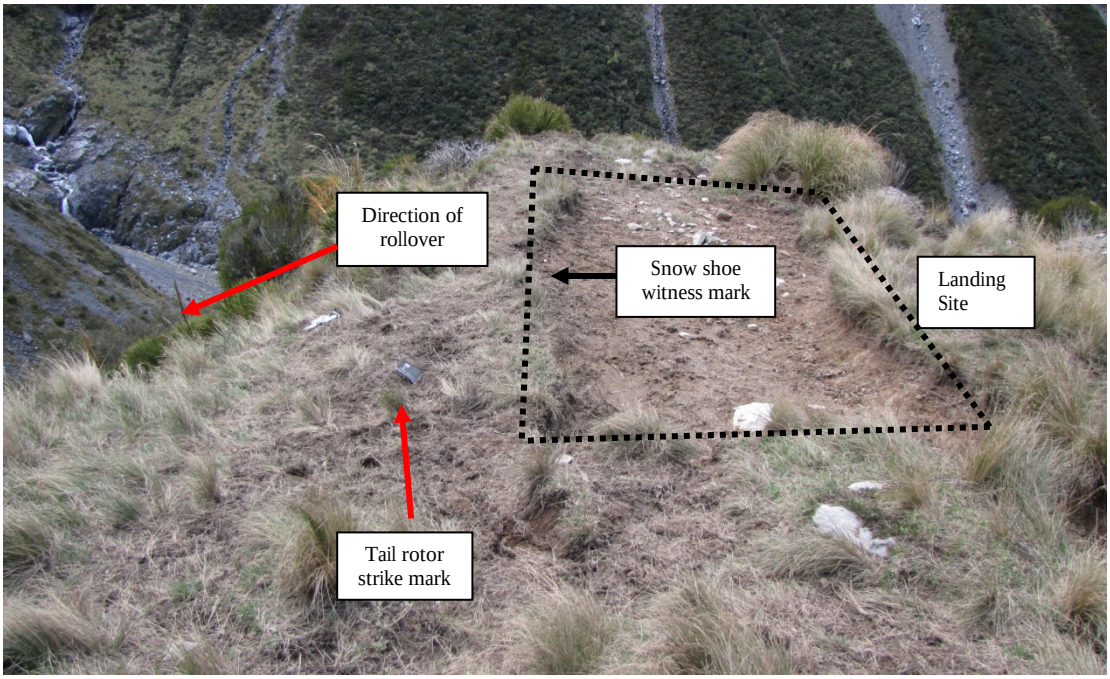

Figure 1. Landing site situated at 3800ft AMSL

1.12.3 A pronounced witness mark was evident in the western edge of the landing site, adjacent to the edge of the steep side of the spur. This witness mark matched the shape of the snow shoe fitted to the rear of both skid tubes, (see Figures 2 and 3).

Figure 2. Witness mark from left hand snow shoe.

Figure 3. Snow shoe, demonstrating contact with edge of landing site.

1.12.4 A significant strike mark was evident approximately four metres aft of the snow shoe witness mark. This strike mark appeared to have been made by the tail rotor blades. The strike mark indicated that the helicopter was banked by approximately 45° when the strike occurred. The depth of the strike, (approximately 200 mm), matched the extent of organic material found on both tail rotor blades.

1.12.5 An arc of cut vegetation, broken shrubs and a significant scar in the ground approximately three metres from the landing site indicated that the main rotor blades had struck the ground during the accident sequence.

1.12.6 Both of the main rotor blades exhibited a degree of sweep back and evidence of significant ground strike while under power. One of the main rotor blades had significant tip damage situated approximately 600 mm inboard from the blade tip after striking a hard object. This strike was seen to correspond with a rock protruding from the hillside.

1.12.7 The cockpit area, helicopter fuselage frame, engine, belly pan, and main fuel tank had come to rest in, or near, the streambed. The cockpit area was severely disrupted during the accident sequence. Closer inspection of the instruments revealed no useful information.

1.12.8 The engine and power transmission system remained attached to the main fuselage frame. Although they were found to be not installed on the sheaves, both drive belts were found to be intact.

1.13 Medical and pathological information

1.13.1 Toxicological tests conducted on the pilot disclosed no evidence of medicinal or recreational drugs.

1.13.2 The Post Mortem Report revealed that the pilot died of injuries consistent with the aircraft accident.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 The pilot was found secured in his seat by his harness and was partially submerged in the stream. The passenger had managed to extricate himself from the wreckage and was lying with the lower half of his body in the water. The passenger's seatbelt was buckled and his seat pan was not in place. The passenger had significant seatbelt bruising and broken ribs which suggested that he remained in the wreckage during the entire rollover and tumbling sequence.

1.15.2 The cockpit design and construction offered little protection in the event of a significant rollover accident, with consequential injuries to the occupants.

1.15.3 The helicopter was fitted with an Artex ME 406 ELT. Only a faint signal was detected from the 121.5 MHz transmitter of the ELT at a distance of approximately 100 metres from the accident site. No 406 MHz signal was detected. The ELT antenna mounted on the airframe had separated from the helicopter during the accident sequence.

1.16 Tests and research

1.16.1 Not applicable

1.17 Organisational and management information

1.17.1 Not applicable.

1.18 Additional information

1.18.1 Helicopters, especially those fitted with fixed skid undercarriage, are susceptible to a hazardous ground handling condition called, *dynamic rollover*. Dynamic rollover requires three elements: (1) a pivot point, (2) lateral directional movement of the helicopter and (3) exceedance of the helicopter's critical roll-over angle. Restraining of the skid causes a pivot or 'anchor point' which, in this case, was at the earth bank alongside the helipad. Subsequent lateral movement toward this point by the helicopter; exacerbated in part by the rotational direction of the main rotors and a component of rotor thrust, causes the helicopter to lean over until it exceeds the critical roll-over angle. Incorrect control inputs by the pilot, i.e. raising of the collective lever, will lead to a more rapid roll-over.

1.18.2 Helicopter pilots are taught the inherent risks of dynamic rollover during training, as it is pertinent at both take-off and landing. In general terms, should a pilot encounter this hazardous situation, the pilot should recover the aircraft by reducing collective input in a controlled manner along with the use of the cyclic and anti-yaw pedals as required.

1.18.3 Because of the frequency of rollover accidents, Robinson Helicopter Company issued Safety Notice 9 in July 1982 and revised it in June 1994. This notice describes in detail the dangers of dynamic rollover and outlines situations to avoid.

Robinson Helicopter Company Safety Notice SN-9 Issued: Jul 82 Rev: Jun 94

MANY ACCIDENTS INVOLVE DYNAMIC ROLLOVER

A dynamic rollover can occur whenever the landing gear contacts a fixed objection, forcing the aircraft to pivot about the object instead of about its centre of gravity. The fixed object can be obstacle or surface which prevents the skid moving sideways. Once started, the dynamic rollover cannot be stopped by application of opposite cyclic alone. For example, assume the right skid contacts an object and becomes the pivot point while the helicopter starts rolling to the right. Even with full left cyclic applied; the main rotor thrust vector will still pass on the left side of the pivot point and produce a rolling moment to the right instead of to the left. The thrust vector and its moment will the follow the aircraft as it continues to rolling to the right. Quickly applying down collective is the most effective way to stop a dynamic rollover.

To avoid dynamic rollover:

1) Always practice hovering autorotations into the wind and never when the wind is gusty or over 10 knots.

2) Never hover close to fences, sprinklers, bushes, runway lights or other obstacles a skid could catch on.

3) *Always use a two-step lift-off. Pull in just enough collective to be light on the skids and feel for equilibrium, then gently lift the helicopter into the air.*

4) *Do not practice hovering manoeuvres close to the ground. Keep the skids at least five feet above the ground when practicing sideward or rearward flight.*

1.19 Useful or effective investigation techniques

1.19.1 Nil.

2. Analysis

2.1 At the time of the accident the aircraft had sufficient fuel onboard for the pilot to complete his flight and return home with more than the required fuel remaining in reserve, at the end of the flight.

2.2 Calculations carried out to establish the all-up weight of the helicopter at the time of the accident identified that it was close to the maximum permitted weight. Using the Manufacturer's Operating Handbook it was established that, at the calculated weight and altitude, the helicopter had sufficient performance available to the pilot to maintain control and hover out of ground effect.

2.3 The landing site was a roughly prepared surface with numerous rocks and irregular shaped small boulders scattered within its boundary. This uneven surface would have required the pilot to carefully select a suitable place to land in order to maintain the stability of the helicopter during landing.

2.4 It is evident that, during the landing, the left snow shoe penetrated the vertical banked edge of the landing site. The shape of the penetration revealed that the snow shoe did not penetrate vertically from above the edge of the landing site, but arrived there horizontally, from within the boundary of the landing site.

2.5 The horizontal penetration could be explained as a result of the pilot attempting to reset the position of the helicopter on the landing site. The pilot's seating position being on the right hand side would have prevented him from seeing the proximity of the snow shoe in relation to the banked edge of the landing site.

2.6 Having penetrated the edge of the landing site, the snow shoe became a pivot point, a factor in the onset of dynamic rollover.

3. Conclusions

3.1 The helicopter was on a private flight operating in mountainous terrain. The pilot was appropriately qualified, and held the appropriate licence and medical certificate to conduct the flight.

3.2 The helicopter had a valid Airworthiness Certificate and had been maintained in accordance with the CAA rules.

3.3 There was no evidence to suggest that a mechanical malfunction of the helicopter contributed to the accident.

3.4 The accident was caused from the onset of dynamic rollover which remained uncorrected by the pilot. This occurred possibly while the pilot was repositioning the helicopter to due to the uneven surface of the landing site.

3.5 Once the critical rolling point was reached, the pilot was not able to recover control of the helicopter.

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Authorised by:

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