FINAL REPORT

AAIU Report No.: 2002/005
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Operator:	21 Century Aviation Ltd, Executive Helicopters
Manufacturer:	Robinson Helicopter Company (USA)
Model:	Robinson R 22 Beta
Nationality:	Irish
Registration:	EI-JWM
Location:	Glenbeigh Strand, Glenbeigh Co Kerry, Ireland.
Date/Time:	9 April 2002 at 19.42 hours (Local)

NOTIFICATION

The Operator notified an Inspector from the Air Accident Investigation Unit (AAIU), at 20.15 hours on the day of the accident, that one of his helicopters had crashed at Glenbeigh, Co Kerry. In phone discussions with the Operator and the Instructor Pilot and mindful of the incoming tide on the helicopter, the AAIU Inspector gave permission for the helicopter to be removed from the crash site, without an Inspector being in attendance.

On the 10 April 2002, the AAIU transmitted formal notification of this accident to the Irish Aviation Authority (IAA), the National Transport Safety Board (NTSB) of the United States of America (USA), and the Robinson Helicopter Company (USA).

Under the provisions of ICAO, Annex 13, (Aircraft Accident and Incident Investigation), the Chief Inspector of Accidents appointed Mr. Jurgen Whyte (Operations) Inspector of Accidents/Investigator-in-Charge, and Mr. John Hughes (Engineering) Inspector of Accidents, to carry out an investigation into the circumstances of this accident and to prepare a Report for publication.

SYNOPSIS.

While carrying out an instructional practice approach and landing onto a beach, the helicopter impacted the ground heavily causing extensive damage to the tail-boom, tail rotor and main rotor blades. There were no injuries.

1. FACTUAL INFORMATION

1.1 History of the Flight.

The student pilot was undergoing a course of instruction with an Irish Aviation Authority (IAA) registered training facility (IRL/RTF/015/01 – Issue 3) at Galway Airport in order to gain his Private Pilot's Licence Helicopters PPL (H). For this particular flight, it was decided to pick up the student at his home in Glenbeigh and conduct the instructional exercise locally.

Up to the time of the accident, the flight was uneventful and consisted mainly of local flying, revision of emergency procedures and some practice approaches without transitioning to hover or landing. After approximately 40 minutes of flying, the instructor requested the student pilot to carry out a practice approach and landing onto a remote location on Rossbeigh Beach. Neither the instructor, nor the student had landed previously on the beach. The beach itself was part of a sand bar stretching north from the mainland for a distance of approximately 4 km. The surface condition of the beach was that of flat compacted sand, with no obstructions. The instructor had estimated the wind at the time to be 270°(M) and light in strength. The student selected a heading of 270°(M) for the approach to the beach. However, during the latter stages of the approach, both the student and the instructor observed that the rate of descent was higher than that normally experienced. Fearful of a heavy impact with the ground, the instructor went on the controls with the student. However, even with the application of "full up collective", the helicopter struck the ground heavily, bounced once and following a loud bang and a second bounce, came to an halt, upright. Both the instructor and the student pilot exited the helicopter to find that the tail rotor had been severed from the tail boom and the main rotor blades had incurred extensive damage. In addition, the instructor observed that the prevailing wind conditions were no longer from the west, but from a direction of 030º and at an approximate strength of between 15 and 20 kt.

1.1.1 Witness Comments

In a frank report following the accident, the instructor stated that in his opinion the cause of the accident was mainly due to an error of judgement in relation to the wind direction and strength. On reflection, he thought that he should have been faster in regaining helicopter control from the student in order to recover the situation. It was the instructor's belief that the late reaction, combined with a possible application of aft cyclic control during the subsequent heavy landing most likely caused the main rotor disc to contact the tail boom.

1.2 Injuries To Persons

There were no injuries.

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor	0	0	0
None	2	0	0

1.3 Damage To Helicopter

1.3.1 Helicopter Recovery

After consultation with the AAIU, the aircraft was recovered from the beach on the evening of the accident. To facilitate the recovery and transportation of the helicopter, the main rotor blades and the tail boom were removed. The helicopter was then transferred by road to the Operator's hangar at Oranmore, Co Galway.

1.3.2 Wreckage Inspection

An Inspector from the AAIU carried out an inspection of the helicopter at the Operator's facility on the 12 April 2002. The tail boom was badly damaged following the strike of the main rotor blade.

The boom was severed in two places between bays 5 and 6. The tail rotor gearbox and part of the tail boom was found approximately 3 metres from the helicopter. The tail rotor blades were destroyed after departing the helicopter with part of the tail boom assembly attached. The tail rotor drive shaft was ripped through the remainder of bay 3 on the tail boom assembly after contact with the main rotor blade.

The red rotor blade was severely wrinkled along the length of the blade and showed evidence of the fuselage colour scheme on the last 500 mm of the blade. The blue blade had one wrinkle approximately two thirds outboard.

The main drive belts jumped one groove due to the impact and also the intermediate flex plate was ripped from its mounting yoke on the back of the clutch assembly. There was no other evident damage to any of the transmission or structure.

The insurance company subsequently assessed the helicopter as damaged beyond economic repair.

1.4 Other damage

Nil

1.5 Personnel Information:

1.5.1 Pilot/Instructor

Personal Details	Male, aged 35 years
Licence	CPL (H), Valid
Last Periodic Check	1 June 2001
Medical Certificate	Class I, Valid

Flying Experience:

Total all types	470 hours
Total all types PI	395 hours
Total on type	420 hours
Total on type PI	380 hours

Last 90 days	105	hours
Last 28 days	65	hours
Last 24 hours	6	hours

1.5.2 Student Pilot

Personal Details	Male, aged 37 years
Licence	SPL (H), Valid
Last Periodic Check	
Medical Certificate	Class II, Valid

Flying Experience:

Total all types	67	hours
Total all types PI	16	hours
Total on type	67	hours
Total on type PI	16	hours
Last 90 days	15	hours
Last 28 days	9	hours
Last 24 hours	0.7	hours

1.6 Aircraft Information

1.6.1 Leading Particulars

Registration:	EI-JWM
Manufacturer:	Robinson Helicopter Company (USA)
Model:	R22 Beta
Serial Number:	1386
Year of manufacture:	1990
Engine:	(1) Lycoming O-320-B2C

1.6.2 Maintenance

The helicopter was registered to its present owner in April 1997 and has a valid Certificate of Airworthiness. Both engine and airframe had accumulated 3677 hours since new. An annual inspection was carried out at 3,429 hours in November 2001, at the operator's JAR 145 approved maintenance base in Galway.

A 50-hour inspection was carried out under JAR-145 on 8/4/02, the day before the accident.

1.6.3 Technical

The instructor pilot advised the investigation that the helicopter was fully serviceable prior to impact with the ground. In addition, he reported that he did not experience any failures or loss of engine power.

1.7 Meteorological Information

1.7.1 Met Éireann, the Irish Meteorological Service, provided the following after-cast for the time of the accident.

General Situation:	An anticyclone of 1028 hPa centred about 51 N 18 W maintained a slack, stable northeasterly airflow over the area.
Wind:	2000 feet: 030/12 kt Surface: 360-020/03-06kt
Weather:	Nil
Visibility:	10+ km
Cloud:	FEW 1200 feet, SCT 20,000 feet
Temperature/Dew-Point:	13º/06º Celsius to 11º/07º Celsius
MSL Pressure:	1026 hPa

1.7.2 Wind Regime

The gradient (geostrophic) wind at 2000 feet was steady in speed and direction. The surface wind was very slack and the direction could have varied substantially. Generally, the surface wind direction should have been between 340 and 070 degrees true. Analysis here suggests that there was not a significant change in wind speed and/or direction at the accident site at the time of impact. There was no convective activity to generate significant downdrafts. In addition, the surface temperature was unlikely to generate a significant sea breeze. There was insufficient gradient wind speed to generate significant low-level turbulence or mountain waves. Any boundary layer turbulence that existed would have been light.

1.7.3 Pilot Meteorological Observation

The instructor estimated the actual weather conditions just after the accident to be:

Visibility:	10+ km
Wind:	030º/15-20kt
Weather:	Nil
Cloud:	Nil

1.8 Aids to Navigation

Not a factor.

1.9 Communications

Not a factor.

1.10 Aerodrome Information

Not a factor

1.11 Flight Recorders

Not fitted and not required to be fitted.

1.12 Wreckage and Impact Information

Nil

1.13 Medical Information

Nil

1.14 Fire

There was no fire

1.15 Survival Aspects

Both pilots were wearing lap and diagonal harnesses.

1.16 Tests and Research

Nil

1.17 Organizational and Management Information

Nil

1.18 Additional Information

Pilot's Operating Handbook – Section 4 - Normal Procedures

Approach and Landing

- Make final approach into wind at the lowest practical rate of descent with an initial airspeed of 60 knots
- Reduce airspeed and altitude smoothly to hover. (Be sure the rate of descent is less than 300 feet per minute (FPM) before airspeed is reduced below 30 knots indicated airspeed (KIAS)

- From hover, reduce collective pitch gradually until ground contact
- After initial ground contact, reduce collective to full down position

2. ANALYSIS

2.1 The investigation is in agreement with the instructor's analysis of this particular accident. The flight path chosen resulted in a near downwind approach, which increased the rate of descent to a higher rate than normal. As the aircraft neared the ground, it most likely settled with power, technically known as the Vortex Ring State[1]. The late reaction by the instructor, combined with the possible on-set of vortex ring state, caused the helicopter to impact heavily with the ground. Subsequent to the heavy landing, the main rotor disc came in contact with the tail boom, and caused extensive damage to both main rotor blades and the tail-boom.

2.2 One of the more common helicopter tail-boom strike conditions is the hard landing of which two scenarios generally exist. The first is where the undercarriage sets down firmly and stops the downward motion of the fuselage, but the rotor blades/disc keep coming down. Low rotor RPM and a quick reduction of collective pitch contribute to the downward flapping and bending of the blades.

The other type of tail-boom strike is likely to occur during a run-on landing when the flare angle is high and the aft part of the undercarriage hits the ground first. This tends to bounce the rear part of the helicopter back up while the front part and the main rotor blades/disc continue to descend. Also, the sudden nose-down pitching motion makes the pilot instinctively pull his cyclic control stick back, causing the rotor to tilt even closer to the tail-boom. Skid-type undercarriage would be considered to be more susceptible to this condition than to that of an undercarriage that has a long energy-absorbing stroke.

2.3 The instructor estimated the prevailing wind conditions just after the accident to be 030º/15-20 kt. The aftercast provided by Met Éireann estimated the surface wind to be 360-020º/03-06 kt and should have been varying 340 - 070º (True).

[1]Vortex Ring State:- In basic terms, this is a condition where a helicopter is descending into its own downwash. This can happen when the helicopter is making a vertical or near vertical descent with low forward speed. A downwind component will also contribute to this phenomenon. As airflow descends through the rotor system, the maximum downward velocity is at the blade tips where the blade airspeed is the highest and decreases nearer the rotor shaft. As the helicopter descends, it is acted upon by an upward relative wind which counteracts the induced flow. In addition, under conditions of a downwind component and low airspeed, there is a tendency for the rotor downwash to be blown ahead of the helicopter or the helicopter catches up with its own downwash. The helicopter is therefore entering an area of disturbed air, which further affects the induced flow. With upward and downward airflows in opposite directions through the rotor system, there is no lift on the helicopter and it is a free falling body. The normal tendency to increase collective pitch while applying power is wrong. In fact, this action can aggravate the power settling. The corrective action for Vortex Ring State is to reduce collective, increase forward airspeed and fly out of the condition.

The investigation recognizes the difficulty of providing accurate aftercasts, specific to actual accident sites that are not co-located with weather/observation stations. Coastal area's can be affected by localized conditions. It is therefore considered that the instructor's estimate of the prevailing wind conditions is the more probable. The investigation is satisfied that the approach to hover was flown with a downwind component of between 7 – 10 kt.

2.4 The flight characteristics, sensitivity to flight control inputs and high rotor RPM decay rate are inherent to the R 22 because of its low gross weight and low rotor inertia. Out-of-wind approaches to hover, in particular, those that have a tailwind component, have a significant and adverse effect on the helicopter performance. The normal procedures for approach and landing in the Pilot's Operating Handbook, recommends that the approach be made into wind and to reduce airspeed and altitude smoothly to hover. Be sure the rate of descent is less than 300 feet per minute (FPM) before airspeed is reduced below 30 knots indicated airspeed (KIAS).

2.5 The importance of carrying out an over-fly reconnaissance (Recce) of the landing zone (LZ), prior to conducting an approach and landing, cannot be over emphasised. The Recce provides the pilot with the opportunity to:

- Confirm the actual wind direction at the LZ;
- Assess the LZ conditions, including surface type, slope, obstructions and possibility for foreign object damage (FOD);
- Assess the approach path for obstacles and an emergency break-off route.

The significance of such a Recce becomes far greater when operating to and from a remote or unfamiliar LZ.

3. CONCLUSIONS

3.1 Findings

3.1.1 The aircraft had a valid certificate of Airworthiness and had been maintained in accordance with an approved schedule.

3.1.2 Both pilot's were medically fit and licensed in accordance with the Irish Aviation Authority Regulations to undertake this flight.

3.1.3 Neither pilot confirmed the true prevailing wind conditions for the approach.

3.1.4 The rate of descent became excessive in the latter stages of the approach due to the unrecognised downwind condition.

3.1.5 The time at which the instructor intervened on the excessive rate of descent was insufficient to ensure a successful go-around or a gentle recovery landing.

3.1.6 The heavy landing and subsequent bounce was sufficient to deflect the main rotor blades/disc from their normal safe plane of rotation, to a plane of rotation that was sufficient to allow the blades to make contact with the tail-boom.

3.2 Causes

Following an unrecognised out of wind approach, the rate of descent was allowed to become excessive to such a degree that the instructor had insufficient time, height and/or power to effect a safe recovery.

The helicopter probably entered the on-set of vortex ring state and following a heavy landing, the main rotor blades struck the tail-boom, most likely as a result of some slight rotor decay, downward deflection of the main rotor retreating blade/disc and the aft application of cyclic control.

4. SAFETY RECOMMENDATIONS

This report supports no safety recommendations.