FINAL REPORT

AAIU Synoptic Report No: 2005-002
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In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Accidents, on 23 February 2004, appointed Graham Liddy as the Investigator-in-Charge to carry out a Field Investigation into this occurrence. Jurgen Whyte assisted the investigation and prepared a Synoptic Report.

Aircraft Type and Registration:	Schweizer 269 (300 CBi), EI-FUN	
No. and Type of Engines:	1 x Lycoming HIO-360-G1A	
Aircraft Serial Number:	0155	
Year of Manufacture:	2003	
Date and Time (UTC):	21 February 2004 @ 15.40 hrs	
Location:	South of Runway (RWY) 07/25 Weston Aerodrome (EIWT)	
Type of Flight:	Flight Instruction	
Persons on Board:	Instructor - 1	Student - 1
Injuries:	Instructor - Minor	Student - Nil
Nature of Damage:	Beyond economic repair	
Commander's Licence:	UK CPL (H)	
Commander's Details:	Male, aged 41 years	
Commander's Flying Experience:	2,932 hours of which 565 were on type	
Information Source:	AAIU Accident Report Form submitted by the Instructor Pilot. AAIU Field Investigation.	

SYNOPSIS

The instructor was conducting a revision exercise with the student/owner of the helicopter in preparation for a pending Licensing Standards Test (LST). During a downwind turn and flare Quick Stop manoeuvre, the main rotor blades struck the ground and the helicopter cart-wheeled for approximately 30 metres before coming to rest in an upright position. Both pilot's evacuated the wreckage unaided with only minor bruising being sustained by the Instructor. There was no fire. The Report makes one safety recommendation.

NOTIFICATION

The Aerodrome Flight Information Service Officer (AFISO) at EIWT reported this accident to the AAIU Inspector-on-Call (IOC) at 15.52 hrs on the day of the accident. The IOC arrived at the accident site a short time later and initiated the investigation.

FINAL REPORT

1. FACTUAL INFORMATION

1.1 History of the Flight

The Instructor was carrying out a revision exercise with the student pilot/owner in preparation for a LST. Part of this revision included a test requirement to perform into-wind and downwind Quick Stops[1]. The helicopter was positioned to operate in an area of levelled grassland south of the main runway RWY 07/25.

To the southwest of this area is a substantial aircraft parking area and numerous aviation related buildings/facilities, including the control tower, ramp area, refuelling pumps, hangars and a car park. The southern side of the manoeuvring area is made of up of a perimeter tree lined hedgerow running in a southwest to northeast direction.

Prior to the student taking control, the Instructor demonstrated two Quick Stops. The first was completed directly into-wind and the second consisted of a downwind turn and flare to an into-wind hover. The student then commenced the manoeuvre from a north easterly direction running downwind and parallel to RWY 07/25. The height of the helicopter was between 20 - 30 feet above ground level (AGL) and the indicated airspeed was approximately 55 kt (approx 70 - 75 kts ground speed) as the student pilot entered the left turn. Passing through 90º of the left turn, the main rotor blades and then the front portion of the left skid struck the ground and the helicopter cart-wheeled for approximately 30 metres before coming to rest in an upright position. The helicopter was damaged beyond economic repair. Both pilot's evacuated the wreckage unaided with only minor bruising being sustained by the Instructor. There was no fire.

In his submitted Accident Report Form, the Instructor recalled that, *"The angle of bank was much too steep. As the aircraft (*helicopter*) was banking left, the student pulled back on the cyclic to start the flare part of the manoeuvre. The helicopter was unable to hold altitude and the main rotor blades struck the ground. The front skid struck the ground and the helicopter rolled, coming to a stop in an upright condition* (**See Fig 1**)*. The engine had stopped. I turned the switches and fuel off and we both exited the helicopter".*

In his assessment of the cause of the accident the Instructor considered that, *"In my opinion the cause of the accident was mainly low altitude. This gave me insufficient time to recover the aircraft (*helicopter*). However, other factors were involved. My student had always been uncomfortable with this particular manoeuvre and I was unaware that he was particularly uncomfortable with the high ground speed due to the tail wind on the day of the accident. My student was booked in to do his LST three days later and as he also owned the helicopter, I may have let him stay on the controls too long before attempting a recovery."*

[1] A Quick Stop is a handling manoeuvre that requires the helicopter to be flown low level (a) into wind followed by an into-wind flare to hover or (b) flown downwind/crosswind followed by a flare and turn or turn and flare, which terminates to an into-wind hover.

1.2 Meteorological Information

1.2.1 After-cast

The following after-cast for the Weston area was provided to the Investigation by Met Éireann, the Irish Meteorological Service (Aviation Services Division, Shannon Airport)

Weather Situation:	An anticyclone in Mid-Atlantic and a depression over the Iberian Peninsula maintained a fresh easterly gradient over the area.
Wind:	2000 ft - 080 degrees 32 kt Surface - 050 degrees 15 gusting 26 kt
Visibility:	10+ km
Weather:	Nil
Cloud:	FEW 2200 ft
Temperature/ DewPoint	05/02 degrees Celsius
Pressure:	1020hPa
Comment:	The wind at the time was relatively gusty and the wind could easily have gusted to 32 kt. However, gusts of that magnitude would have been relatively infrequent. The wind direction could have varied between 030 and 060 degrees true.

1.2.2 Pilot Weather Report

The Instructor considered the actual weather conditions at the time of the accident as:

Wind:	060 varying 090 degrees 15 - 20 kt
Visibility:	10+ km
Weather:	Nil

1.3 Additional Information

1.3.1 Registered Training Facility (RTF)

The instructional flight was being conducted within an Irish Aviation Authority (IAA) approved Registered Training Facility (RTF) for Private Pilot Licence (PPL) Helicopters. The RTF is limited to giving training on single-engined helicopters with a maximum certificated seating capacity of not more than four persons. The accident helicopter was the only helicopter being used at the RTF.

1.3.2 Instructor Pilot

The Instructor was the designated Chief Flying Instructor (CFI) for the RTF. He was rated to conduct the instructional detail and was certified medically fit to fly.

1.3.3 Student Pilot

At the time of the accident the student pilot had approximately 70 hours on type, which included 10 hours solo. The CFI had completed the majority of the 60 hours instruction with the student. Three days after the accident the student pilot completed and passed his LST on type.

1.3.4 Joint Aviation Requirements (JAR's)

The Joint Aviation Authorities (JAA) Joint Aviation Requirements - Flight Crew Licensing (JAR-FCL) requires at JAR-FCL 2.125 (*Training Course*), that an applicant for a PPL(H) shall complete, at a Flight Training Organization (FTO) or an accepted Registered Training Facility (RTF), the required instruction in accordance with the syllabus as set out in Appendix 1 to JAR-FCL 2.125. Appendix 1 to JAR-FCL 2.125 requires at Para 3, that the PPL(H) flight instruction syllabus shall cover at sub-part (j) *Transitions, Quick Stops, out of wind manoeuvres, sloping ground landings and take-off's;*

Under JAR-FCL 2.135 (*Skill*) an applicant for a PPL(H) shall have demonstrated the ability to perform as Pilot-in-Command of a helicopter the relevant procedures and manoeuvres described in Appendix 1 to JAR-FCL 2.130 and 2.135 (*Theoretical knowledge examination and skill test for the PPL(H)*) and Appendix 2 to JAR-FCL 2.135 (*Contents of the skill test for the issue of a PPL(H)*) with a degree of competency appropriate to the privileges granted to holder of a PPL(H). Appendix 2 to JAR-FCL 2.135, Section 2 (Hover manoeuvres, advanced handling and confined areas) requires, under sub-part (g), *Quick Stops into and downwind*[2]*;*

1.3.5 Federal Aviation Administration (FAA) Rotorcraft Flying Handbook

A review of the FAA Rotorcraft Flying Handbook, which is a technical manual and training aid for applicants who are preparing for their private, commercial or flight instructor pilot certificates for helicopter or gyroplane class rating, determined that the Rapid Deceleration (Quick Stop) is considered an advanced flight manoeuvre that is performed into-wind only.

1.3.6 Schweizer Aircraft Flight Manual (AFM)

In consultation with the Schweizer Company it was determined that, they do not publish any information pertaining to Quick Stop manoeuvres in their Aircraft Flight Manual. Schweizer also referred to the caution provided in the FAA Rotor Flying Handbook (See 1.3.5).

1.3.7 Turning Flight

In forward flight, the rotor disc is tilted forward, which also tilts the total lift-thrust force of the rotor disc forward. When the helicopter is banked, the rotor disc is tilted sideways resulting in lift being separated into two components. Lift acting upwards and the opposing weight is called the vertical component of lift. Lift acting horizontally and opposing inertia (centrifugal force) is the horizontal component of lift. As the angle of bank increases, the total lift force is tilted more towards the horizontal, thus causing the rate of turn to increase because more lift is acting horizontally.

[2] The downwind element refers to a flare and turn or turn and flare terminating back into an into-wind hover

Since the resultant lifting force acts more horizontally, the effect of lift acting vertically is decreased. To compensate for this decreased vertical lift, the angle of attack of the rotor blades must be increased in order to maintain height. Thus, with an increase in bank and a greater angle of attack, the resultant lifting force increases and the rate of turn is faster.

1.4 Discussion

1.4.1 General

The Quick Stop manoeuvre is normally used to slow the helicopter rapidly and bring it to a stationary hover. For an into-wind Quick Stop, the entry height should be such to allow a safe clearance between the tail rotor and the surface throughout the manoeuvre, especially at the point where the pitch angle (flare) is highest.

For a turn and flare or flare and turn Quick Stop manoeuvre there is an additional factor relating to the safe clearance between the main rotor blade tips and the surface, especially at the point where the angle of roll (bank) is highest. The entry height to be chosen should be high enough to avoid danger to the tail rotor during the flare and the main rotor blades during banking, but low enough to stay out of the crosshatched or shaded areas of the height/velocity diagram (contained in the Flight Manual) throughout the manoeuvre. In addition, this height should be low enough that you can bring the helicopter to a safe hover during the recovery. An example of the Height Velocity Chart for a Schweizer 296C helicopter is presented as **Appendix A** to this report.

The LST requires, under JAR FCL, that the student can perform Quick Stops into-wind and downwind. The Rapid Deceleration (Quick Stop) is considered by the FAA as an advanced flight manoeuvre that should be performed into-wind only.

The merits of the requirements to perform Quick Stops into-wind can be justified on the basis that, from time to time, a pilot may have to carry out an emergency stop or rapid deceleration, while manoeuvring into-wind close to the ground. The merits of the requirements to perform downwind Quick Stops initially appear less compelling. However, the capabilities of helicopters are such that it is particularly versatile in operating outside of the normal runway environment. While it is preferable to perform take-off's and approach/landings into-wind, the reality is that this may not always be possible. In particular, approaches/departures to/from confined and remote sites may have segments where the helicopter is out-of-wind. Therefore, some schools of thought consider that an appreciation of manoeuvring into-wind and the risks associated with manoeuvring out-of-wind, particularly at low height and low speed, must be engrained into a student pilot from the outset.

The Quick stop manoeuvres form part of the out-of-wind manoeuvres contained in the JAR FCL training syllabus. As an advanced, dynamic, high-energy manoeuvre, it does require a high degree of coordination of the controls and generally serves as a good confidence builder for the student pilot. It also provides an examiner/instructor with a good opportunity to assess the student pilot's overall controllability of the helicopter. However, given the fact that the helicopter is being operated at times in a low level, downwind flaring and turning environment, the exposure to risk, like many emergency exercises, is unquestionably heightened.

Therefore, the quality of instruction must be high, the dynamics of the manoeuvre must be fully understood by the instructor/student pilot and it is important that the instructor or examiner satisfy themselves, through pre-flight exercise briefing, on how the student intends to perform the particular manoeuvre. In particular, the instructor or examiner must heighten his/her awareness to the risk of student control error during such manoeuvres.

1.4.2 The Training Area

The selection of a training area to perform such dynamic manoeuvres as into-wind and downwind Quick Stops need to take into account a number of factors, including:

- The overall size of the helicopter;
- The expected ground speed of the helicopter during the manoeuvre;
- The intended flight path of the helicopter during the manoeuvre;
- Possible exceedence of the intended flight path during the manoeuvre;
- The proximity of aviation and other related facilities and obstructions to the intended flight path;
- Conflicting aviation and non-aviation traffic; and
- The need for emergency run-off areas throughout the intended flight path.

For the accident flight, the downwind segment of the run, terminated just short of an aircraft parking area and other aviation related facilities. If a helicopter were to experience an engine or control failure on the downwind segment, the pilot would have no clear run-off area to attempt a recovery. In addition, the selected training area is flanked on the north side by the main runway and to the south by a tree-lined hedgerow. The relatively confined nature of the selected operating area, coupled with the high ground speed experienced on the downwind segment of the manoeuvre, may have caused the student pilot to become tense on the controls, and ultimately this would have affected his sensitivity to control inputs.

Recognizing that Weston Aerodrome is presently undergoing extensive re-modelling, the Investigation does however, consider that the practice of conducting low level dynamic manoeuvres within such a restricted area is unsafe. The Investigation therefore makes a safety recommendation to this effect.

1.4.3 Survivability

The combination of the wearing of a four-piece shoulder harness, and the fact that the integrity of the cockpit area remained intact after the event, contributed greatly to both occupants evacuating the wreckage with only one minor injury.

1.5 Reporting

This report was complied on foot of an AAIU Field Investigation and information provided by the Instructor Pilot. The handling student pilot did not respond to two requests by the AAIU to provide a Pilot Report into this accident.

2. Safety Recommendation

2.1 The Irish Aviation Authority (IAA) should review the suitability of the designated helicopter training area's for dynamic low-level manoeuvres at Weston Aerodrome. (**SR 01 of 2005**)

Fig 1.

This photograph shows where the helicopter came to rest, following the blade and skid contact with the ground, having completed 90º of the 180º turn and flare. The aircraft parking area and related aviation facilities as mentioned at 1.4.2 of the Report can be seen in the right-hand background. The boundary hedgerow can be seen on the left-hand side of the photograph.

Appendix A

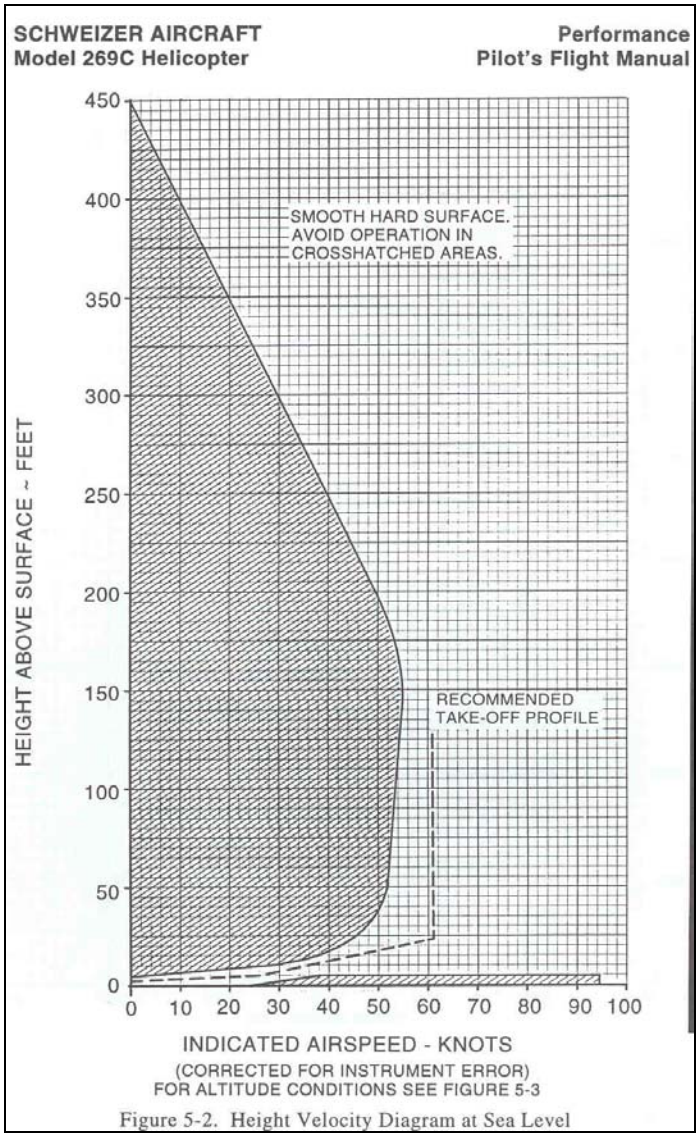

Figure 5-2. Height Velocity Diagram at Sea Level

This graph assumes a zero wind condition