Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Schweizerische Unfalluntersuchungsstelle SUST
Service d'enquête suisse sur les accidents SESA
Servizio d'inchiesta svizzero sugli infortuni SISI
Swiss Accident Investigation Board SAIB

Aviation Division

Final Report No. 2178 by the Swiss Accident Investigation Board SAIB

concerning the accident involving the Schweizer 269C helicopter, registration HB-XYI

on 11 November 2010

Lanzenhäusern, Obereichi, municipality of Wahlern/BE

Aéropôle 1, CH-1530 Payerne
Tel. +41 26 662 33 00, Fax +41 26 662 33 01
www.saib.admin.ch

Ursachen

Der Unfall ist darauf zurückzuführen, dass der Helikopter nach einer misslungenen Autorotationsübung mit dem Gelände kollidierte.

General information on this report

This report contains the Swiss Accident Investigation Board's (SAIB) conclusions on the circumstances and causes of this accident.

In accordance with Art. 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 of the Convention on International Civil Aviation (ICAO) of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident investigation. It is therefore not the purpose of this report to determine blame or clarify questions of liability.

If this report is used for purposes other than accident prevention, this may give rise to erroneous interpretations.

The definitive version of this report is the original in the German language.

All times in this report, unless otherwise indicated, are stated in local time (LT). At the time of the accident, Central European Time (CET) applied as local time in Switzerland. The relation between LT, CET and coordinated universal time (UTC) is: LT = CET = UTC + 1 hour.

Final Report

Aircraft type	Schweizer 269C	HB-XYI
Operator	Heliswiss Schweizerische Helikopter AG, CH-3123 Belp, Switzerland	
Owner	Heliswiss Schweizerische Helikopter AG, CH-3123 Belp, Switzerland	

Pilot (flight instructor)	Swiss citizen, born 1966			
Licence	Commercial pilot licence helicopter (CPL(H)) JAR, first issued by the Federal Office of Civil Aviation (FOCA) on 22 February 1990			
Essential ratings	HU269, valid till 21 February 2011 Flight instructor helicopter (FI(H)), valid till 4 June 2011			
Medical fitness certificate	Class 1 with the following restriction VDL: shall wear corrective lenses, valid from 12 July 2010 to 14 February 2011			
Flying hours	**total**	8039:37 hours	**during the last 90 days**	140:59 hours
	on the accident type	2773:32 hours	**during the last 90 days**	21:45 hours
Instruction	**total**	6321:00 hours	**during the last 90 days**	97:08 hours
	on the accident type	1768:00 hours	**during the last 90 days**	21:45 hours

Pilot (trainee pilot)	Swiss citizen, born 1968			
Licence	Private pilot licence helicopter (PPL(H)) JAR, first issued by the Federal Office of Civil Aviation (FOCA) on 22 October 2010			
Essential ratings	HU269, valid till 15 October 2011			
Medical fitness certificate	Class 2, no restrictions, valid from 5 August 2008 to 5 August 2011			
Flying hours	**total**	55:49 hours	**during the last 90 days**	11:25 hours
	on the accident type	54:34 hours	**during the last 90 days**	10:10 hours

Location	Lanzenhäusern, Obereichi, municipality of Wahlern/BE		
Coordinates	593 613 / 188 003	**Elevation**	750 m AMSL
	E7°21`17.65`` N46°50`35.29``		
Date and time	11 November 2010, 09:43		

Type of operation	VFR / training flight
Flight phase	Approach
Type of accident	Loss of control during autorotation training

Injuries to persons

Injuries	Crew	Passengers	Total number of occupants	Others
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	2	0	2	Not applicable
Total	2	0	2	0

Damage to aircraft Severely damaged

Other damage Minor field damage

1 Factual information

1.1 History of the flight

1.1.1 General

For the following description of the pre-flight information and history of the flight, the recordings of the radiotelephony traffic, the helicopter's GPS data, radar recordings and the statements of the crew were used. The flight was conducted according to visual flight rules (VFR). The flight was a training flight.

1.1.2 Pre-history

From 17 July 2009 to 15 October 2010 the pilot, who was a trainee pilot on the accident flight, concluded the practical training as a private helicopter pilot, which he completed successfully on 15 October 2010 when he passed the examination. The examination was considered as passed, but the pilot was encouraged to attend additional training at the flight school with a flight instructor. The aim of this training was to improve the system for off-field landings, as well as the initiation and procedure for autorotation.

Subsequently, a first training flight took place on 3 November 2010 with the instructor involved in the accident. During this flight, six aerodrome circuits with subsequent autorotations were flown.

The accident flight on 11 November 2010 was the second training flight in this sequence. The crew met at 07:45 at the Heliswiss AG helicopter base in Bern-Belp for preparation and a pre-flight briefing for the planned training flight.

1.1.3 History of the flight

At 08:54 the pilots took off in the Schweizer 269C helicopter, registration HB-XYI, from the Heliswiss AG helicopter base at Bern-Belp airport, in the direction of the reporting point HOTEL-WHISKEY.

The crew signed off with the air traffic controller (ATCO) at 09:00, flying in the direction of Schwarzenburg. Some off-field landings and multiple autorotation exercises were performed in this region. According to the flight instructor, these exercises were completed without any problems.

At 09:42, the crew of HB-XYI resumed contact with the Bern-Belp ATCO in the Wahlern area, reported an altitude of 3300 ft QNH and requested clearance to fly back to base via reporting point HOTEL-WHISKEY. On the basis of the recorded data, the helicopter was at this time at an altitude of approximately 4150 ft AMSL. The crew confirmed the clearance received. This was the last radio contact between helicopter HB-XYI and the ATCO.

Shortly before 09:43 (see Figure 1 - reference point 12) the crew discussed the wind conditions and in the Wagerten area initiated an autorotation exercise with a 180° turn into the wind. According to the flight path recordings, the initiation of this manoeuvre took place at an altitude of approximately 4000 ft AMSL and some 1500 ft above the planned landing site (see Figure 1 - reference point 19). According to GPS recordings, in the subsequent 180° turn, within reference points 19 and 27, the average rate of descent was over 3500 ft per minute.

After coming out of the 180° turn to the left, the flight instructor noticed an airspeed of 50 kt[1]. He then instructed the trainee pilot to adjust the attitude in order

[1] The airspeeds referred to in the report, unless stated otherwise, relate to the indicated air speed (IAS).

to increase the airspeed. At this time the helicopter was at an altitude of approximately 3000 ft AMSL, or approximately 500 ft above the intended landing site (see Figure 1 - reference point 27). According to the flight instructor's statement, the resulting change in attitude was perceptible and in the process the rate of descent increased. During the subsequent flare the rate of descent could not be reduced sufficiently. The airspeed in the final phase, according to the flight instructor's statement, was at least 50 kt and the rotor speed was approximately 460 rpm. His last conscious reactions were to increase throttle, bring the helicopter level and pull back fully on the collective lever.

The helicopter made contact with the slightly uphill terrain, first with its tail and then after approximately 10 m with its landing skid, before a hard impact occurred, approximately 24 m after the first contact with the terrain. In the process, the helicopter was rotated about its vertical axis approximately 30 degrees to the left.

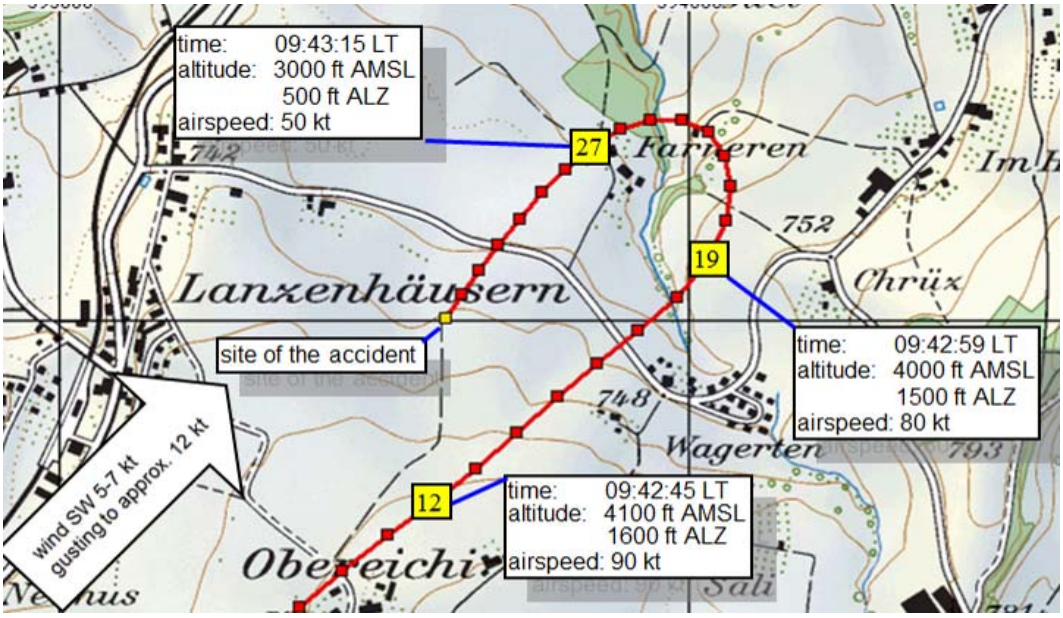


Figure 1: Flight path during the final phase. The data was recorded at two second intervals. ALZ corresponds to the height above the envisaged landing site (above landing zone). The specified speeds correspond to the ground speed.

The crew members wore helmets and were able to exit the wreck unharmed. The helmet of the flight instructor bore the significant trace of an impact on the front, above the helmet visor.

From 09:51, the ATCO attempted several times to make contact with the crew of HB-XYI in order to enquire about their current position. No connection could be established.

1.2 Meteorological information

1.2.1 General

The information in sections 1.2.2 to 1.2.4 was provided by MeteoSwiss.

1.2.2 General meteorological situation

A ridge of high pressure over Central Europe caused a period of generally calm weather. Another area of disturbance was being driven by a storm low from the Atlantic towards Central Europe. However, this did not reach the Jura until the evening.

1.2.3 Weather at the time and location of the accident

The following information on the weather at the time and location of the accident is based on a spatial and chronological interpolation of the observations of different weather stations.

Cloud	1/8 at approx. 5000 ft AMSL
Visibility	Approximately 20 km
Wind	SW at 5-7 kt, gusting to 12 kt
Temperature/dewpoint	5 °C / 1 °C
Atmospheric pressure	QNH LSZB 1013 hPa
Hazards	Locally weak turbulences

1.2.4 Astronomical information

Position of the sun	Azimuth: 141°	Elevation: 17°
Lighting conditions:	Daylight	

1.3 Aircraft information

1.3.1 General information

Characteristics	Single-engine multipurpose helicopter with three seats and skid landing gear. Fully articulated main rotor with three blades, conventional torque compensation with exposed tail rotor.
Manufacturer	Schweizer Aircraft Corp, USA
Year of manufacture	1991
Serial number	S1538
Engine	Four-cylinder piston engine LYC HIO-360-D1A, Serial number L-26415-51A, manufactured by Lycoming Textron Company.
Operating hours	Airframe: 7960:32 hours since manufacture Engine: 1021 hours since last overhaul In the maintenance log, time since new (TSN) was entered as “UNK” [2].
Max. permitted masses	Max. permitted take-off mass: 930 kg.
Mass and centre of gravity	The mass of the helicopter at the time of take-off was 825 kg according to the flight preparations. The mass of the helicopter at the time of the accident was approx. 800 kg (1760 lb). Both the mass and centre of gravity were within the permitted limits according to the pilot's flight manual (PFM).

[2] UNK: unknown

Maintenance	The last 100/300-hour check and annual airframe inspection and the 50/100-hour engine check were certificated on 3 November 2010 by Swiss Helicopter Maintenance AG.
Permitted fuel grade	AVGAS 100LL aviation fuel
Quantity of fuel	According to the information from the crew in the flight plan, the amount of fuel on take-off was approx. 95 l. At the time of the accident, the calculated amount was approx. 60 l.
Registration certificate	Issued by the FOCA on 7 May 2007 / no. 7.
Airworthiness certificate	Issued by the FOCA on 7 May 2007, valid till revoked.
Airworthiness review certificate	Issued on 3 June 2010, valid till 3 June 2011.
Certification	In private use: VFR day / VFR night. In commercial use: VFR day.

According to the statement by the crew, there were no technical faults on the helicopter.

1.3.2 Control of engine power and rotor speed

On the Schweizer 269C helicopter, engine power is transmitted via a belt clutch and a gearbox with a freewheel to the rotor system.

HB-XYI was not fitted with a engine speed regulator (governor). This means that the pilot regulates the engine speed by means of the throttle on the collective, in order to keep the rotor speed within a specific range.

In addition, to reduce the pilot's workload, the engine power can also be adjusted to an extent by raising and lowering the collective. The manufacturer of HB-XYI refers in this context to the correlation between throttle and collective.

This means that the engine speed can change by up to 900 rpm, even though the position of the throttle remains unchanged.

1.3.3 Emergency transmitter

The helicopter was equipped with an emergency transmitter (emergency location beacon aircraft – ELBA) type KANNAD 406AF-H. According to information from air traffic control, on 11 November 2010 no emergency transmitter signal was registered on the 121.500 MHz frequency.

1.4 Wreckage and impact information

1.4.1 Site of the accident and wreckage

As a result of the forceful impact on landing, the landing skid was compressed and deformed. The cabin fractured in front of the two pilot seats and was bent forwards. All the main rotor blades were badly deformed.

Figure 2: Final position of the helicopter.

The tail and the drive shaft running inside it had broken off in the area of the central structure/tail boom mount) and broke into two parts. The tail rotor unit was separated from the tail. The rear section of the tail boom was thrown uphill (Figure 3, position A). The considerable distance from the main wreckage indicates high impact energy.

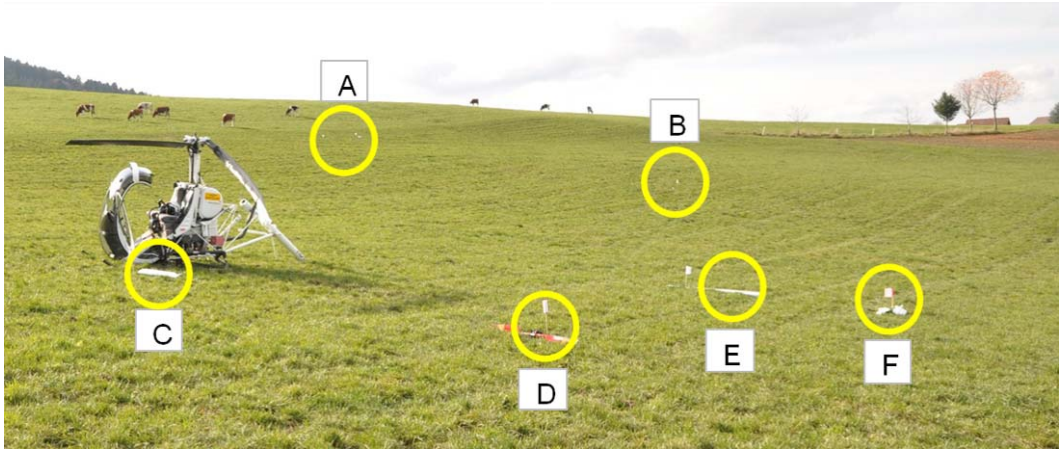


Figure 3: Overview of the location of the wreck.

A: tail boom structure

B: structural element

C: horizontal stabiliser

D: tail rotor and transmission

E: tail rotor drive shaft

F: structural element

The altimeter indicated an altitude of 1520 ft for a set QNH of 978 hPa.

1.5 Organisational and management information

1.5.1 Swiss Helicopter Training

1.5.1.1 General

Swiss Helicopter Training (SHT) is the helicopter flying school of the Swiss Helicopter Group, which was composed of a number of Swiss helicopter companies. Within this approved organisation (Flight Training Organisation - FTO), three flying schools carried out their training activities.

1.5.1.2 Operation Manual

In the Swiss Helicopter Training Operation Manual (OM), dated 28 February 2010, the selection and preparation of the landing site for an off-field landing were described as follows:

" 3.5.3 Selection of Field Landing Sites

Choosing the suitable field landing sites for training purposes is the responsibility of the FI. Every landing outside a published heliport or airport is considered a field landing and has to be carried out taking into consideration Swiss regulations and good airmanship. Landings for training purposes may be made up to altitudes of 2'000 MAMSL or at designated mountain landing sites as published in the Swiss AIP.

The chosen landing site has to be suitable to the student's abilities and training stage. In every case, an air reconnaissance has to be performed before defining the approach path and exact landing spot paying special attention to wind, obstacles, lighting and ecology. Landings near populated areas have to be avoided whenever possible and noise levels during approach, landing and hover exercises should be considered."

There was no explicit information concerning the execution of autorotation exercises.

1.6 Personnel information

1.6.1 Information on the flight instructor's flying experience

The flight instructor officiated as the person responsible for training, the managing director and chief flight instructor of the flying school concerned and was a very experienced instructor with over 6000 hours of instruction. According to his own information, at the time of the accident he had already completed thousands of autorotations on the Schweizer 269C.

1.6.2 Information on the trainee pilot's flying experience

The trainee pilot had passed the flight test to acquire his private pilot's licence on 15 October 2010, and was not very experienced, with 56 hours total flying time.

1.6.3 Medical findings

A breath test was carried out on both pilots. The result was negative, with 0.0 ‰ by weight in both cases.

1.7 Information on autorotation

1.7.1 Airspeed and rotor speed

For the Schweizer 269C helicopter, the autorotation speed is 52 kt according to the PFM.

The autorotation speed is flown in the course of the certification procedure as part of the flight tests. Generally, the definition is at the discretion of the test pilots, taking into account the autorotation performance, with the aim of achieving optimal conditions for a successful autorotation. It is situated between the speed for the lowest rate of descent and the speed for the best glide angle.

In the case of the Schweizer 269C helicopter, the two speeds can be estimated from figure 8-10 (see Annex 1) in the PFM. They are in the range of approximately 45 kt as the speed for the lowest rate of descent and approximately 60 kt as the speed for the best glide angle. At speeds outside this range, the rate of descent increases markedly. The basis for figure 8-10 was a rotor speed during autorotation of 471 rpm.

The green area on the rotor tachometer extends from 390 to 504 rpm according to the PFM 2-6.

1.7.2 Pilot's Flight Manual

Information relevant to this accident in relation to performing an autorotation can be found in the pilot's flight manual (PFM) for the Schweizer 269C helicopter.

1.7.2.1 Section 3: Emergency and Malfunction procedures

„3-1 Engine failure – altitude above 450 feet

- *Lower collective pitch.*
- *Enter normal autorotation.*
- *Establish a steady glide of 52 knots (60 mph) IAS approximately.*
- *At an altitude of 50 feet, begin steadily to apply back cyclic stick to decrease forward speed.*
- *At approximately 10 feet, coordinate collective pitch with forward movement of cyclic stick to level ship and cushion landing. Make ground contact with ship level.*
- *Avoid rapid lowering of collective pitch or the use of aft cyclic stick during initial ground contact or during slide.*
- *(…)"*

1.7.2.2 Section 4: Normal Procedures

„4-10 Practice autorotation

WARNING

DURING POWER RECOVERY FROM PRACTICE AUTOROTATIONS, AVOID AIRSPEED AND ALTITUDE COMBINATIONS THAT ARE INSIDE THE HEIGHT VELOCITY CURVE. HIGH RATES OF DESCENT MAY DEVELOP THAT ARE NOT CONTROLLABLE. ALWAYS PRACTICE IN AN AREA WITH SUITABLE LANDING SITE TO MINIMIZE HAZARDS ASSOCIATED WITH INADVERTENT ENGINE STOPPAGE.

- *Split the needles by lowering the collective while maintaining throttle setting. The throttle correlation will establish a high idle rpm (approximately 2500 rpm) which will aid in preventing the engine from loading up or stalling during recovery. Conversely, when the collective is raised without increasing throttle, the correlation is such that only minor throttle adjustments will be required to perform a smooth recovery without exceeding 3200 rpm."*

1.7.3 Procedure of a training autorotation according to information from the Heliswiss AG flying school

According to the flight instructor, an autorotation with the Schweizer 269C helicopter is taught in the Heliswiss AG flying school as follows:

The autorotation speed is internally defined at 60 kt and this is higher than the recommended speed by the manufacturer in the PFM.

The trainee pilot lowers the collective fully and corrects corresponding deviations about the vertical axis with the pedals. At the same time, because of the characteristics of the helicopter, the cyclic must be pulled back, in order to maintain the attitude or perform a slight flare. The instructor then adjusts the engine speed to approximately 2000 rpm using the throttle twistgrip.

The descent should be stabilised in such a way that a speed of 60 kt can be maintained. At 10 m / GND, the helicopter is levelled out. If the speed under 60 kt this is omitted. At 3 m / GND the flare is initiated; the rate of descent is reduced as is the forward speed. In the flare, the engine speed is increased to 3000 - 3200 rpm and at the end of the flare the collective is pulled (but only slightly). Then with the aid of the helicopter's cyclic control the helicopter is brought level and the height is stabilised by coordinated input at the collective.

2 Analysis

2.1 Technical aspects

2.1.1 General

There are no indications of any pre-existing technical faults which might have caused or influenced the accident.

2.1.2 Autorotation speed

The speed of 52 kt for autorotation defined by the manufacturer in the PFM was low. It does not include an adequate safety margin if negative factors come into play. In addition, the required reading accuracy is not practicable.

The autorotation speed of 60 kt defined internally by the flying school appears appropriate and takes better account of the above-mentioned factors.

2.2 Human and operational aspects

2.2.1 General

The test log shows that the trainee pilot's test as a private helicopter pilot was considered as passed. It was suggested to the newly certified pilot that he should complete additional training with a flight instructor. Evidently the expert was not convinced of the pilot's performance with regard to emergency landing procedures. This approach in relation to a final test is surprising.

2.2.2 Operational aspects

It was not appropriate, after receiving clearance from the ATCO, to carry out a spontaneous autorotation exercise without informing the latter. According to section 3.5.3 of the OM, it is envisaged that a reconnaissance circuit be flown for an off-field landing on the terrain. On the other hand, autorotation training was not explicitly mentioned. After the accident, the flying school made a corresponding amendment to the OM (see section 4.2).

When contacting Bern Tower, an altitude of 3300 ft QNH was reported. At that time, the recordings indicated an altitude of 4100 ft to 4200 ft AMSL. The altimeter was set to a QNH which was 35 hPa too low. This explains the above difference of approximately 1000 ft.

The initiation of the autorotation exercise took place at an altitude of approximately 4000 ft AMSL, and at a ground speed of approximately 80 kt (reference point 19). To reach the landing zone, it was necessary to make a 180° turn. This resulted in an increase in the rate of descent, which in this phase attained an average value of over 3500 ft per minute. Coming out of the turn, a relatively low airspeed of approximately 50 kt was noted by the flight instructor. The subsequent instruction to the pilot to change the attitude to increase speed primarily resulted in the rate of descent increasing in this phase. The indicated rotor speed of 460 rpm was in the middle of the green range.

It would have been advisable to abort the exercise in this phase of the flight – especially because the instructor himself had noted that the internally defined speed of 60 kt had not been attained in the final approach.

The slightly rising terrain at the intended landing area would have necessitated an additional excess of speed in the final approach, in order to take account of the rising vector.

The autorotation was carried out into the wind, but a downwind situation could have arisen on the basis of the prevailing wind and terrain conditions.

In summary, the following factors led to the accident:

- The 180° turn, which led to an increase in the rate of descent due to the bank angle.
- The acceleration following the 180° turn, which further increased the rate of descent and which tended to reduce the rotor speed.
- The rising terrain, which would have required an additional excess of speed.
- The low energy in the rotor, compared to other types.
- The low airspeed before the flare in combination with the high rate of descent.

2.2.3 Safety

Both crew members were wearing helmets. The impact marks on the flight instructor's helmet indicated an impact with the helicopter structure. The wearing of a helmet certainly prevented a head injury.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- There are no indications of any pre-existing technical faults which might have caused or influenced the accident.

3.1.2 Crew

- The pilots were in possession of the necessary licences for the flight.
- There are no indications of the flight instructor or the trainee pilot suffering health problems during the flight.
- Both crew members were wearing helmets.
- The impact marks on the flight instructor's helmet indicated an impact with the helicopter’s structure.

3.1.3 History of the flight

- The autorotation exercise leading to the accident was carried out after receiving clearance to fly into the control area.
- After the initiation of the autorotation, a 180° turn to the left was carried out.
- After the 180° turn, the airspeed was approximately 50 kt and the main rotor speed was approximately 460 rpm. The helicopter was approximately 500 ft above the intended landing area.
- The targeted terrain was sloping uphill.
- The approach was carried out into the wind.
- The autorotation was not aborted.

3.1.4 General conditions

- The altimeter was set to a QNH of 978 hPa. The prevailing QNH at Bern-Belp airport was 1013 hPa.
- The speed for autorotation defined by the manufacturer in the PFM was 52 kt.
- The speed defined within the flying school for autorotation was 60 kt.

3.2 Causes

The accident is due to the fact that the helicopter collided with the terrain after an unsuccessful autorotation exercise.

4 Safety recommendations and measures taken since the accident

4.1 Safety recommendations

None.

4.2 Measures taken since the accident

4.2.1 Flight Training Organisation (FTO)

4.2.1.1 Operation Manual

The FTO's Operation Manual was amended by the flying school as follows for safety reasons (SHT_Part1_Operations Manual_Rev. 05, 30 April 2011).

„3.5.3.2 Autorotation Training

If, during autorotation training, the autorotation is completed to ground level (power recovered or full down), a previous landing shall be executed. If the autorotation is entered during flight and executed into unknown terrain, a go around at a sufficient height, considering obstacles and go around flight path, shall be performed."

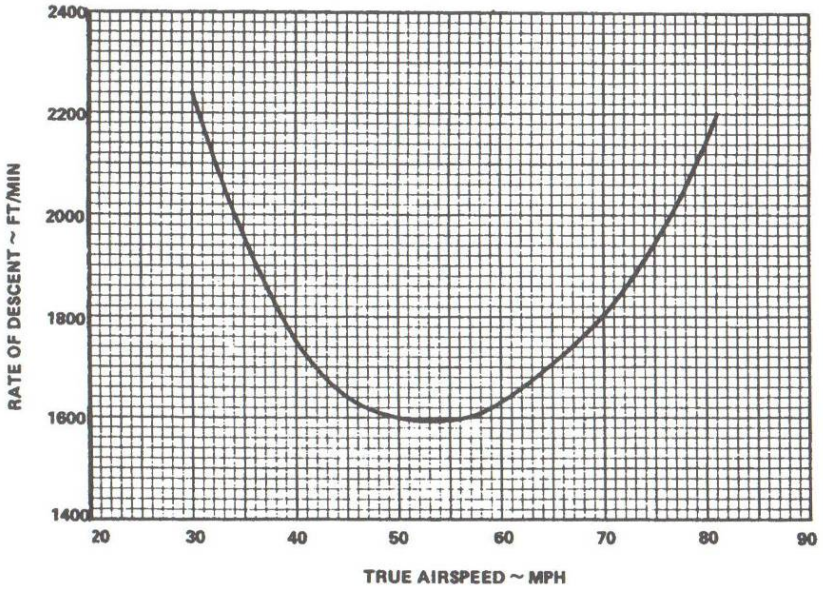
Payerne, 16 May 2013 Swiss Accident Investigation Board

This final report was approved by the management of the Swiss Accident Investigation Board SAIB (Art. 3 para. 4g of the Ordinance on the Organisation of the Swiss Accident Investigation Board of 23 March 2011).

Berne, 4 June 2013

Annex 1: Representation of the rate of descent versus forward airspeed

SCHWEIZER AIRCRAFT CORP. Operations & Performance
Model 269C Helicopter Pilot's Flight Manual



Autorotation, 471 Rotor rpm

Figure 8-10. Rate of Descent

Reissued: 21 September 1988 8-11

The forward speeds in this graph were specified in statute miles per hour (true airspeed – TAS). In the present case this can be roughly equated with the indicated airspeed.(indicated Airspeed - IAS).