AIRCRAFT ACCIDENT SHORT REPORT

CA18/2/3/9743, ZS-RHY, Unsuccessful forced landing on mountainous terrain following a decay in main rotor RPM.

Date and time	**:** 3 November 2018, 0955Z
Occurrence category	**:** Accident
Aircraft registration	**:** ZS-RHY
Aircraft manufacturer and model	**:** Robinson Helicopter Company, R44 Astro
Last point of departure	**:** Private farm near Witbank
Next point of intended landing	**:** Private farm near Witbank
Location of accident site with reference to easily defined geographical points (GPS: readings if possible)	**:** Private farm near Witbank 25°47.718' South 029°20.174' East
Meteorological information	**:** Surface wind: 340°/15 kt, temperature: 20°C, visibility: +10 km, CAVOK
Type of operation	**:** Private (Part 91)
Persons on board	**:** 1 + 3
Injuries	**:** None
Damage to aircraft	**:** Substantial

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011) this report was compiled in the interests of the promotion of aviation safety and the reduction of the risk of aviation incidents or accidents and ***not to apportion blame or liability****.*

Disclaimer:

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1. SYNOPSIS

1.1 On Saturday 3 November 2018 at approximately 0950Z, the pilot accompanied by three passengers took off from a private farm with the intention to conduct a local private flight in the area.

1.2 The pilot stated that this was his third flight of the day and each time he took off from the same open area on the farm. He further indicated that he changed his route slightly on the third flight (the accident flight) and was flying to some high ground but remained to the south of it on the leeward side. As he completed a right turn, the low main rotor revolutions per minute (RPM) horn sounded. He lowered the collective pitch lever and tried to fly out of the condition but the RPM continued to decay. He decided to do a run-on landing and due to the low rotor RPM the helicopter touched down hard on rocky terrain. The skid gear broke off and the helicopter continued to skid on its lower fuselage for several meters before coming to rest and rolling over onto its left-hand side. The pilot stated that the wind was north north-easterly (NNE) at approximately 15 to 20 kt.

1.3 None of the occupants on-board the helicopter sustained any injuries. The helicopter sustained substantial damage during the accident sequence.

1.4 The investigation revealed that the accident attributed to a decay in main rotor RPM which was induced by a down-draft on the leeward side of mountainous resulting on an unsuccessful forced landing onto rocky terrain.

2. FACTUAL INFORMATION

2.1 History of flight

2.1.1 On Saturday 3 November 2018, the pilot took off from Witbank Aerodrome (FAWI), where the helicopter was hangared, after he had uplifted 78 L of Avgas. The pilot then flew to a private farm where a friend of his was building a house and constructing a dam.

2.1.2 The pilot landed with the helicopter on the farm in an open, clear area. There were several people on the farm at the time, and the pilot decided that he would give them a short pleasure flight over the farm. The people were divided into three groups of three people each. He gave them altogether a safety briefing, which included the operation of the doors, how to use the safety harnesses, and that they needed to approach the helicopter from the front (the pilot's 12 o'clock when seated in the pilot's seat) and keep their heads down as they approached the helicopter while the main rotor blades are turning.

2.1.3 After the first two groups had concluded their respective pleasure flights, it was the chance of the last group, which comprised of two adult males – one of the passengers was seated next to the pilot in the front left seat and the other behind the pilot – and a young child (aged 4 years) seated in the left aft seat. The two adult passengers wanted to see the building/construction from the air and the pilot flew over the area. The pilot then decided to fly a different route with this group and they then proceeded in a southerly direction, remaining on the leeward side of some high ground. The pilot stated during an interview with him that the wind at the time was north north-easterly (NNE) at 15 to 20 knots.

2.1.4 After being airborne for a few minutes, the pilot executed a 180º turn to the right with the intention to return to the landing area. After the helicopter had completed the turn, the low main rotor RPM audio warning sounded. The pilot mentioned to the passengers, who were each wearing a headset that he would get it under control. According to one of the passengers, a few seconds later the pilot told them to hold on, and the passenger could see how they were descending towards the ground. The pilot indicated that he attempted to restore the main rotor RPM by going down on the collective pitch lever, but he did not have enough altitude available even though the terrain was sloping downwards. He then decided to execute a skid-on landing on an open area he had identified straight ahead. The helicopter touched down hard on the rocky terrain and the skid gear broke off. The helicopter then skidded for a further 6 m on its lower fuselage before it came to rest and rolled over to the left.

2.1.5 Once the main rotor blades had come to a stop, the pilot instructed the passengers to unbuckle their safety harnesses and get out of the wreckage, and move some distance away in case the helicopter caught alight. The passenger seated next to the young child in the back stated that he was lying on the child; he unbuckled the child first and handed him through the door before he unbuckled himself and

disembarked from the wreckage. The other people that had flown before the last group had heard the crash and rushed to the scene with their vehicles. The parents of the young child took him to hospital for a medical check-up. None of the three adult occupants had any serious injuries that required medical treatment.

2.1.6 The pilot was requested to submit a detailed weight and balance (WB) calculation for the accident flight. The information in Figures 1 to 3 was obtained from the pilot. The maximum take-off weight for this helicopter, according to the pilot's operating handbook (POH), section 2, was not allowed to exceed 2 400 lb (1 089 kg). According to the WB calculation, the helicopter was operated at 36 lb (16 kg) below its maximum gross weight.

Sample R44 (Robinson R44)

Item	Entered Load	Weight lb	Long Arm "	Long Moment in-lbs	Lat Arm "	Lat Moment in-lbs
Basic Empty Weight		1510.0	106.50	160815	0.50	755
Pilot P1	88.0 kg	194.0	49.50	9603	12.20	2367
Fwd Left Pax	105.0 kg	231.5	49.50	11459	-10.40	-2407
Right Aft Pax	87.0 kg	191.8	79.50	15248	12.20	2340
Left Aft Pax	12.0 kg	26.5	79.50	2103	-12.20	-323
Removable Controls	yes	0.0	40.29	0	-16.22	-0
Right Front Door	yes	0.0	49.40	0	24.00	0
Left Front Door	yes	0.0	49.40	0	-24.00	-0
Right Rear Door	yes	0.0	75.40	0	23.00	0
Left Rear Door	yes	0.0	75.40	0	-23.00	-0
Left Pod Type None	0.0 kg	0.0	0.00	0	0.00	0
Right Pod Type None	0.0 kg	0.0	0.00	0	0.00	0
Zero Fuel		2153.7	92.50	199228	1.27	2732
	Weight and CG OK (Long limits Fwd:92.00" Aft:100.77")					
Zero Fuel		2153.7	92.50	199228	1.27	2732
Main Fuel Tank	25.0 usg	150.2	106.00	15923	-13.50	-2028
Aux Fuel Tank	10.0 usg	60.1	102.00	6129	13.00	781
All Up		2364.1	93.60	221280	0.63	1485
	Weight and CG OK (Long limits Fwd:92.82" Aft:98.40")					

Aircraft config	Unlocked
Loaded Fuel Weight	210.3
Total Pax Weight	643.7

Computed by iBal Rotary 1.67 (build 1104): 2018-11-06 07:12:40 +0000

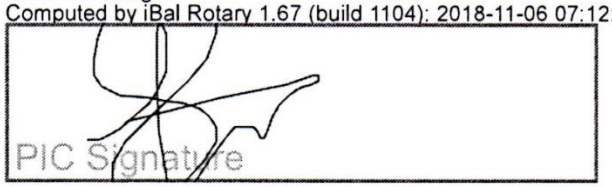

Figure 1: WB calculation

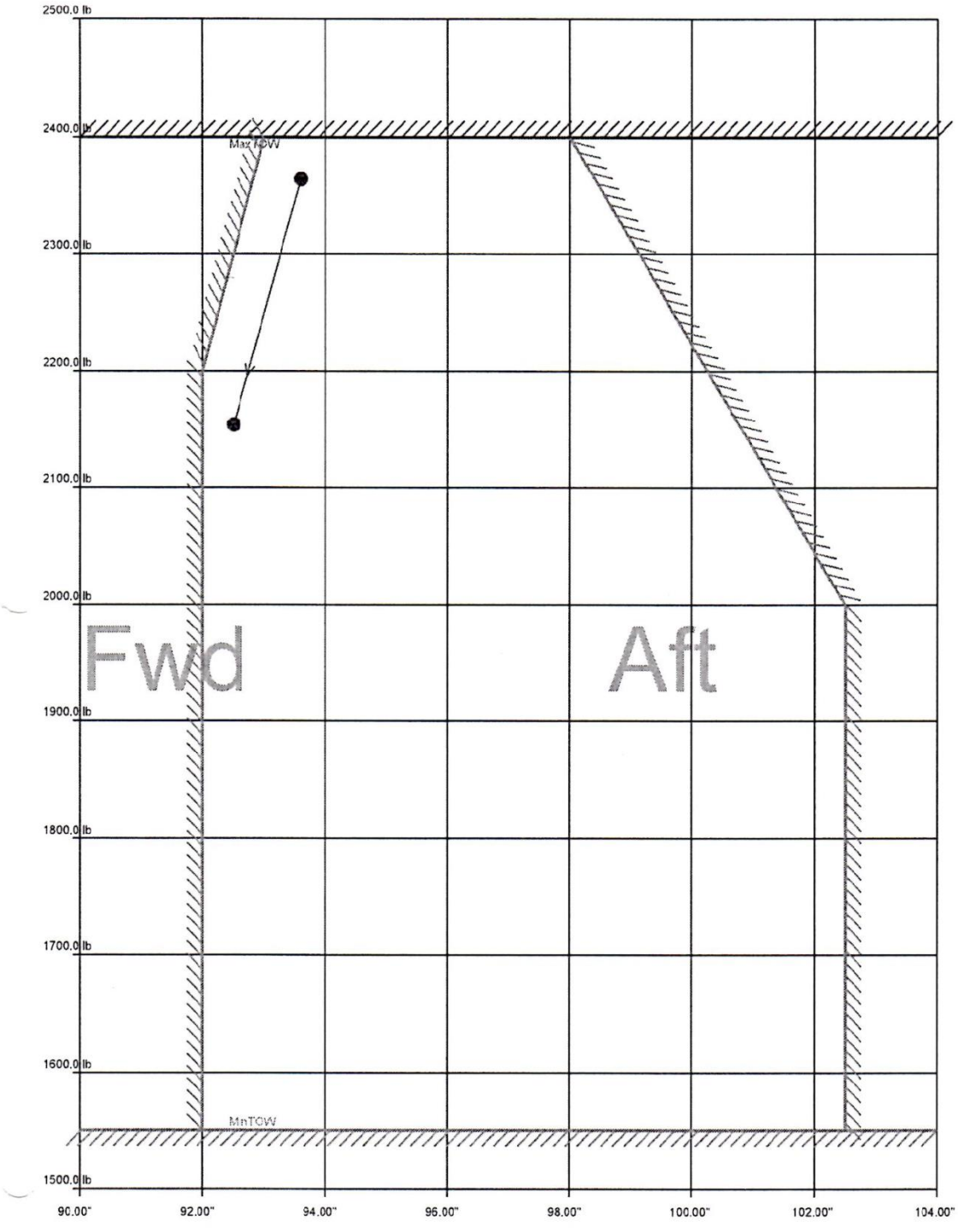

Figure 2: Centre of gravity (CG) chart (1)

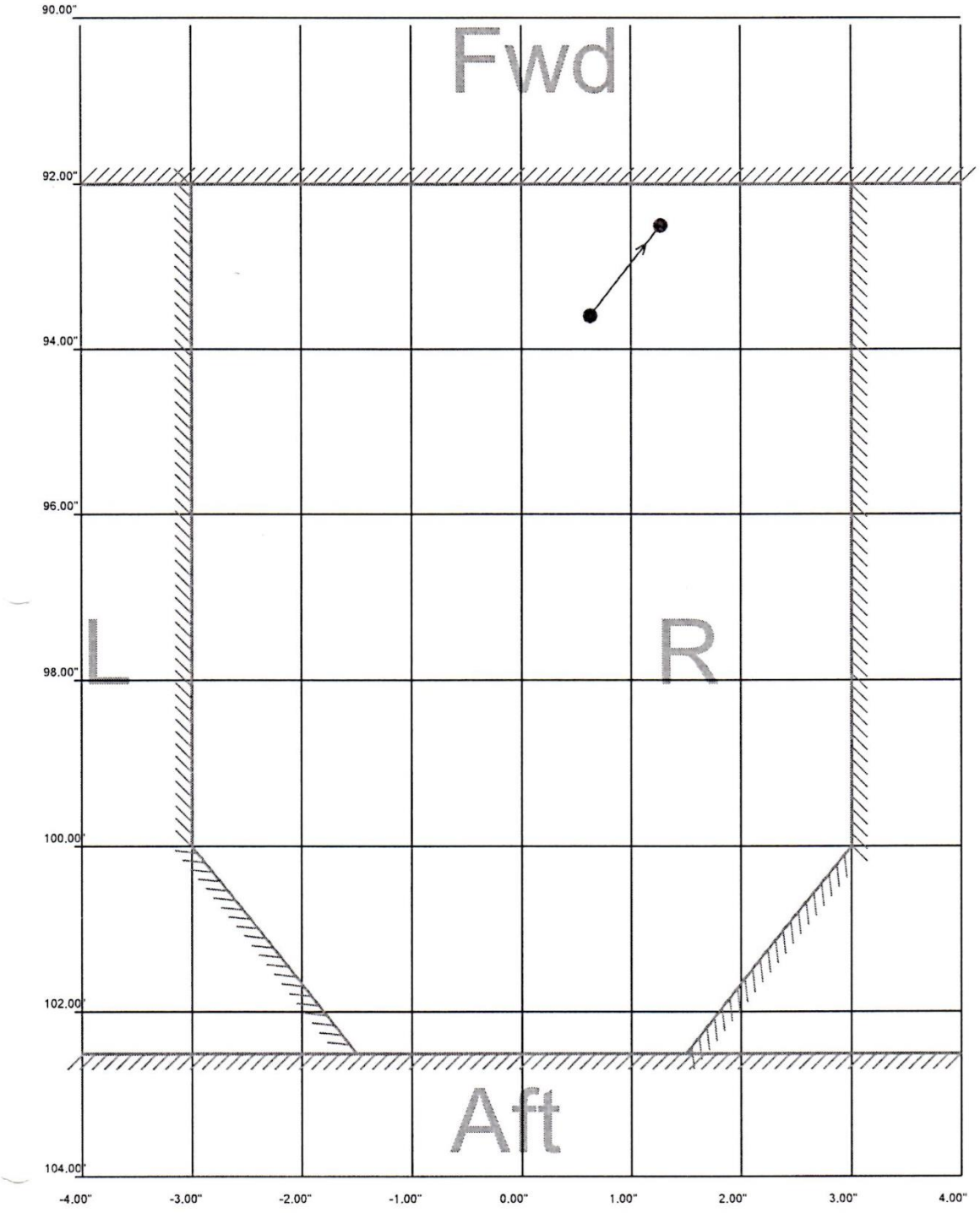

Figure 3: CG chart (2)

2.1.7 The pilot indicated that the temperature at the time was 20ºC, with the prevailing wind north north-easterly (NNE) at 15 to 20 kt. Taking the elevation as 4 913 ft at the point of take-off, the density altitude was calculated to be approximately 6 228 ft.

2.1.8 The accident occurred during daylight conditions at a geographical position determined to be 25º 47.718' South 029º 20.174' East at an elevation of 4 895 ft above mean sea level (AMSL).

2.1.9 Wreckage and impact information:

The pilot opted to execute a skid-on landing on open rocky terrain. The aircraft touched down on a heading of 110ºM. Evidence from the impact sequence was that the skids touched down on the rocks and due to the excessive forces associated with hard ground contact, the skid gear broke off (Figure 4). The helicopter then remained in an upright position and skidded for a distance of approximately 6 m on its lower fuselage before it turned to the right and rolled over to the left after the main rotor blades had severed the tail boom. The tail boom assembly and the tail rotor drive system (comprising the tail rotor hub assembly, which was still attached to the tail rotor gearbox, and some deformed sections of both tail rotor blades) were found lying on the right-hand side of the fuselage. The collective pitch lever was found to be in the full-up position and the fuel shut-off valve was found to be in the closed position. The pilot stated that he and the other two adult passengers turned the fuselage upright after disembarking from it. The main fuel tank was approximately ¾ full and the auxiliary tank approximately ½ full. The fuel levels of the two fuel tanks were measured using the dipstick method, with the helicopter in the attitude as seen in Figures 4 to 6.

Figure 4: The helicopter as it came to rest and after it was picked up and placed in an upright position

Figure 5: Showing the forward and aft skid gear cross tube assemblies

Figure 6: An aft view of the main wreckage, facing in a southerly direction

Figure 7: A view of the terrain (high ground)

3 FINDINGS

3.1 The pilot held a valid private pilot's licence and he had the helicopter type endorsed on it.

3.2 The pilot held a valid aviation medical certificate that had been issued by a designated aviation medical examiner, which was due to expire on 31 July 2019.

3.3 The pilot had accumulated a total of 416.9 flying hours, all of which were on the helicopter type. He had flown 45.0 hours on type during the past 90 days prior to the accident.

3.4 The pilot had given all the passengers a safety briefing before he commenced with the pleasure flights, and all the occupants were properly restrained during the flight.

3.5 The helicopter was 36 lb (16 kg) below its maximum take-off weight of 2 400 lb (1 089 kg) during take-off on the accident flight.

3.6 According to the CG graphs in Figures 2 and 3 of this report, the helicopter was loaded within the allowable limits as per the POH.

3.7 The helicopter was in possession of a valid Certificate of Airworthiness, which was due to expire on 31 March 2019.

3.8 The Certificate of Release to service for this helicopter had been issued on 7 August 2018 and would have lapsed on 6 August 2019 or at 6 094.6 airframe hours.

3.9 The last maintenance inspection that was carried out on the helicopter prior to the accident flight had been certified on 7 August 2018 at 5 996.4 airframe hours by an approved aircraft maintenance organisation (AMO). Following the inspection, a further 46.5 hours had been flown with the helicopter.

3.10 The helicopter sustained substantial damage during the accident sequence.

3.11 The accident was survivable, as the cockpit/cabin area remained intact and all four occupants were properly restrained; none of them were seriously injured.

3.12 The density altitude at the time and place of the accident was calculated to be 6 228 ft.

3.13 The pilot indicated that the prevailing wind was from the north north-east at 15 to 20 kt. This information correlates with the METAR data obtained for FAOR at 1000Z, which indicated the wind to be variable between 350° and 050° at 13 kt.

4 PROBABLE CAUSE

4.1 A decay in main rotor RPM which was induced by a down-draft on the leeward side of mountainous terrain resulting in an unsuccessful forced landing onto rocky terrain.

5 CONTRIBUTING FACTORS

5.1 The helicopter was operated very close to its maximum take-off weight limit, which increased the risk for any possible error substantially (e.g. low rotor RPM).

5.2 The prevailing wind conditions and flying on the leeward side of the high ground had a direct effect on the flight characteristics of the helicopter, as a down-draught was encountered.

5.3 The power available from the engine is directly proportional to the RPM. In this accident, the engine power required to fly out of the situation exceeded the engine power available even after the pilot rolled on the throttle and lowered the collective pitch lever.

5.4 Even though the terrain was sloping downwards, the pilot was unable to recover from the low main rotor RPM condition with the altitude that was available to him.

5.5 The density altitude had a substantial influence on the engine power, as the helicopter was equipped with a normal aspirated engine.

6 REFERENCES USED IN THE REPORT

6.1 Pilot's Operating Handbook, section 2, pages 2-5 (weight limits)

6.2 http://www.pilotfriend.com/pilot_resources/density.htm

Elevation	4 913 ft
Temperature	20°C
*Dew point	10°C
*Altimeter setting	1 030 mb
Density altitude	**6 228 ft**

*Note: The barometric pressure (altimeter setting) entered in the table above was obtained from the aircraft's instrument during the on-site investigation. The dew point was obtained from the METAR that was issued for FAOR.

7 SAFETY RECOMMENDATION

7.1 None.

8 ORGANISATION

8.1 This was a private flight, which was operated under the provisions of Part 91 of the Civil Aviation Regulations of 2011 as amended.

9 SAFETY ACTION

9.1 None.

This report is issued by:

Accident and Incident Investigation Division
South African Civil Aviation Authority
Republic of South Africa