

## AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Ref No.	CA18/2/3/8480	
<b>Aircraft Registration</b>	<b>ZS-RYR</b>	<b>Date of Accident</b>	19 April 2008		<b>Time of Accident</b>	0900Z
<b>Type of Aircraft</b>	Robinson R44 Raven II		<b>Type of Operation</b>		Commercial charter flight	
<b>Pilot-in-command Licence Type</b>		Commercial (helicopter)	<b>Age</b>	28	<b>Licence Valid</b>	Yes
<b>Pilot-in-command Flying Experience</b>		Total Flying Hours	895.0		Hours on Type	490.8
<b>Last point of departure</b>		Dragon Peaks Park, KwaZulu-Natal				
<b>Next point of intended landing</b>		Dragon Peaks Park, KwaZulu-Natal				
<b>Location of the accident site with reference to easily defined geographical points (GPS readings if possible)</b>						
Crystal Beds, Drakensberg (GPS position: South 28°58.373" East 029°15.871")						
<b>Meteorological Information</b>		Surface wind: northerly 5-8 kts; Temperature: 17°C; CAVOK				
<b>Number of people on board</b>	1 + 3	<b>No. of people injured</b>	0	<b>No. of people killed</b>	0	
<b>Synopsis</b>						
<p>The pilot stated that on 19 April 2008 at 0900Z, he took off with two passengers on board from Dragon Peaks on a scenic flight and landed at the normal landing spot at Crystal Beds in the Drakensberg (6 620ft AMSL).</p> <p>After picking up a third passenger from another helicopter that had also landed at Crystal Beds, the pilot commenced the takeoff into the wind in a northerly direction at approximately 0945Z. During the takeoff, the low rotor warning sounded and the pilot immediately lowered the collective in an attempt to regain RPM. This caused the helicopter to drop but its height over the ground remained approximately the same as the ground sloped away in the direction of the takeoff. As the helicopter had not yet gone through transition, it descended. The pilot pulled the power to stop the descent, which caused a further decay in rotor RPM. At the same time, he applied aft cyclic to slow the forward speed in case the helicopter impacted with the terrain. The aircraft nevertheless struck the ground fairly hard and then swung through 180°, coming to rest facing in the direction of the flight path. Due to the fact that the cyclic was in the aft position, the helicopter slid for approximately one metre before stopping.</p> <p>None of those on board sustained any injuries as a result of the accident.</p>						
<b>Probable Cause</b>						
<p>The pilot over-pitched the helicopter on takeoff and it was not possible to sustain flight following a decay in rotor RPM. The out-of-ground effect (OGE) performance graph indicated that the aircraft's weight exceeded the OGE calculated limit by 126 lbs.</p>						
<b>IARC Date</b>				<b>Release Date</b>		



## AIRCRAFT ACCIDENT REPORT

**Name of Owner/Operator** : Dragon Peaks Park Pty (Ltd)  
**Manufacturer** : Robinson Helicopter Company  
**Model** : R44 Raven II  
**Nationality** : South African  
**Registration Marks** : ZS-RYR  
**Place** : Crystal Beds, Drakensberg, KwaZulu-Natal.  
**Date** : 19 April 2008  
**Time** : 0945Z

*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 (1997), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to establish legal liability**.*

### Disclaimer

*This report is given without prejudice to the rights of the CAA, which are reserved.*

## 1. FACTUAL INFORMATION

### 1.1 History of Flight:

- 1.1.2 The pilot stated that on 19 April 2008 at 0900Z, he took off with two passengers on board from Dragon Peaks on a commercial scenic flight and landed at the normal landing spot at Crystal Beds in the Drakensberg (6 620ft AMSL).
- 1.1.3 After picking up a third passenger from another helicopter that had also landed at Crystal Beds, the pilot commenced the takeoff into the wind in a northerly direction at approximately 0945Z. During the takeoff, the low rotor warning sounded and the pilot immediately lowered the collective in an attempt to regain RPM. This caused the helicopter to drop but its height over the ground remained approximately the same as the ground sloped away in the direction of the takeoff. As the helicopter had not yet gone through transition, it descended. The pilot pulled the power to stop the descent, which caused a further decay in rotor RPM. At the same time, he applied aft cyclic to slow the forward speed in case the helicopter impacted with the terrain. The aircraft nevertheless struck the ground fairly hard and then swung through 180°, coming to rest facing in the direction of the flight path. Due to the fact that the cyclic was in the aft position, the helicopter slid for about one metre before stopping.

## 1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	1	-	3	-

1.2.1 There were no injuries and the other helicopter ferried the passengers back to Dragon Peaks Park.



**Figure 1.** Aerial view of helicopter near Crystal Beds after the accident.



**Figure 2.** The tail boom that separated from the helicopter on impact.



**Figure 3.** Aft fuselage of helicopter showing where tail boom separated.

### 1.3 Damage to Aircraft

1.3.1 The tail boom was severed from the helicopter during the accident sequence.

### 1.4 Other Damage

1.4.1 Minor damage was caused to vegetation.

### 1.5 Personnel Information

1.5.1 Pilot-in-command

Nationality	South African	Gender	Male	Age	28
Licence Number	-----	Licence Type	Commercial		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Night Rating; Instrument Rating; Under-sling/Winching				
Medical Expiry Date	28 November 2008				
Restrictions	None				
Previous Accidents	None				

#### Flying Experience

Total Hours	895.0
Total Past 90 Days	108.0
Total on Type Past 90 Days	108.0
Total on Type	706.0

## 1.6 Aircraft Information

### 1.6.1 Airframe

Type	Robinson R-44 Raven II	
Serial Number	10218	
Manufacturer	Robinson Helicopter Company	
Year of Manufacture	2003	
Total Airframe Hours (at time of accident)	1 510.5	
Last MPI (Hours & Date)	1 477.6	17 March 2008
Hours since Last MPI	32.9	
C of A (Issue Date)	3 October 2008	
C of A (Expiry Date)	2 October 2009	
C of R (Issue Date) (Present Owner)	24 July 2007	
Operating Categories	Standard	

### 1.6.2 Engine

Type	Lycoming IO-540-AE1A5
Serial Number	L-29015-48A
Hours since New	1 510.5
Hours since Overhaul	TBO not yet reached

### 1.6.3 Weight and balance calculation

	Weight (lbs)	Arm (inches)	Moment (in.lb)
A/C empty weight	1 518.95	105.9	160 845.00
Pilot (88.4 kg)	195.0	49.5	9 652.50
Fwd passenger (101 kg)	223.00	49.5	11 038.50
Aft passenger (72.59 kg)	160.00	79.5	12 720.00
Aft passenger (92.10 kg)	203.00	79.5	16 138.50
Baggage (0 kg)	0	44.0	0
Fuel main tank (15 US gal)	90.00	106.0	9 540.00
Fuel aux tank (6 US gal)	36.00	102.0	3 672.00
<b>Total T/O Weight</b>	<b>2 425.95</b>	<b>93.57</b>	<b>226 996.14</b>

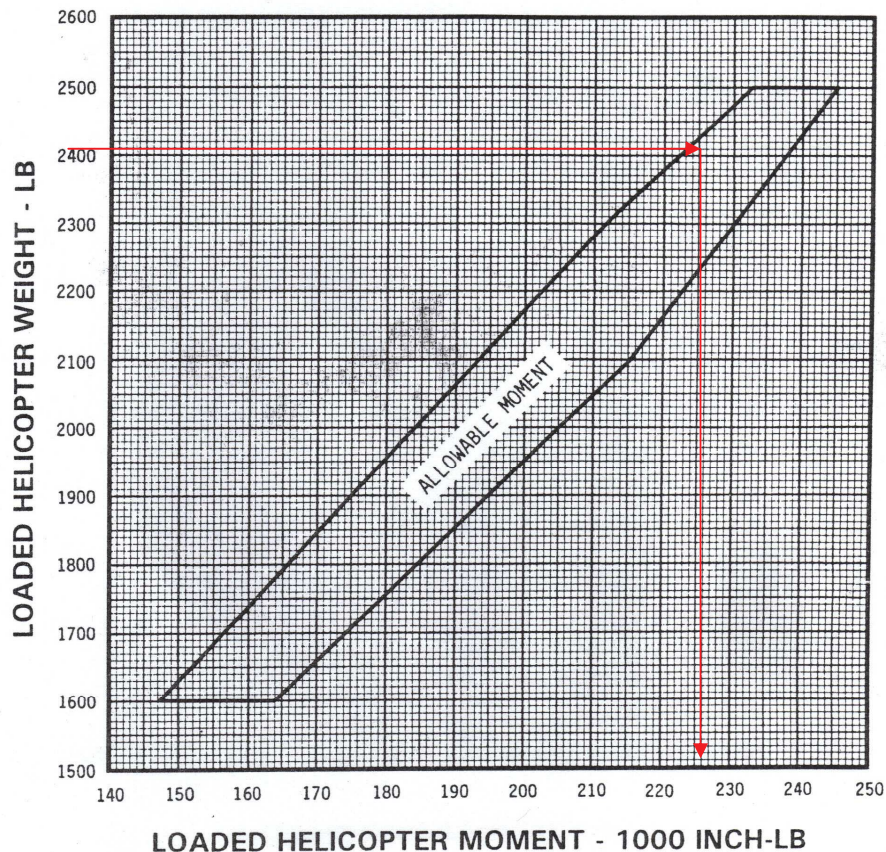
The maximum certificated takeoff mass for the helicopter as stipulated in Section 2, pages 2-3 of the POH (pilot's operating handbook) is given as 2 500 pounds (1 134 kg).

$$\begin{aligned}\text{Centre of Gravity (CG)} &= \text{Total Moment} \div \text{Weight} \\ &= 226\,996.14 \div 2\,425.95 \\ &= 93.57 \text{ inches}\end{aligned}$$

- (i) The fuel conversion factor that was used to calculate the fuel was:  
1 US gallon = 6 pounds.
- (ii) The helicopter was being operated within its allowable centre of gravity envelope (CG) as indicated by the graph on the next page.



LOADING INSTRUCTIONS (cont'd)

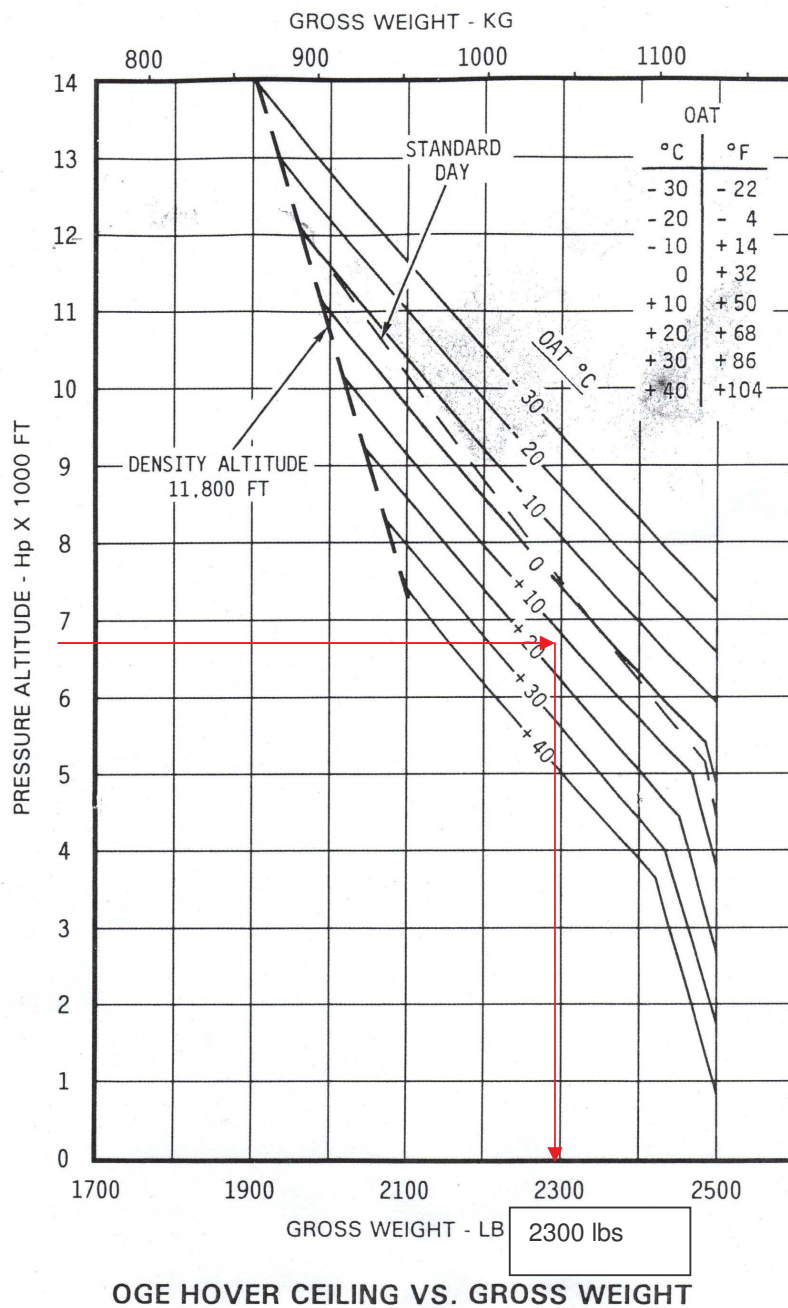


R44 II

ALLOWABLE LOADED MOMENT VS. GROSS WEIGHT  
ENVELOPE

- (iii) The in-ground effect (IGE) hover graph, as described in the POH, Section 5, pages 5-4, was used. This indicated that an IGE hover at 6 620 feet with pressure altitude at 17°C and a gross weight of 2 426 lbs would have been possible. The pilot was able to attain an in-ground effect hover over the terrain.
- (iv) However, the performance figures on the out-of-ground effect (OGE) hover graph indicate that the maximum out-of-ground hover gross weight at 6 620 feet pressure altitude and 17°C should not exceed 2 300 lbs. The gross weight of the helicopter on takeoff was 2 426 lbs, which exceeded the OGE calculated limit by 126 lbs, as shown in the OGE graph below.

OUT OF GROUND EFFECT  
TAKEOFF POWER OR FULL THROTTLE  
ZERO WIND



## 1.7 Meteorological Information

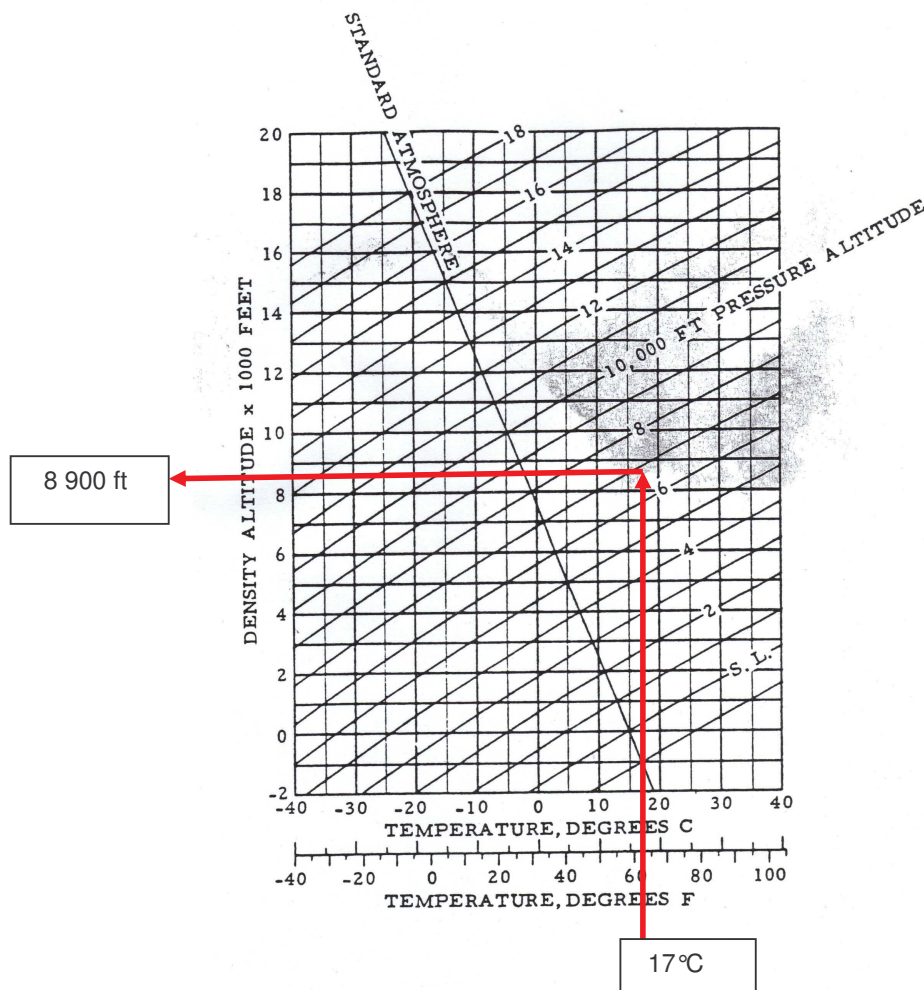
1.7.1 The following weather information was obtained from the pilot's questionnaire:

Wind direction	Northerly	Wind speed	5-8 knots	Visibility	Good
Temperature	17°C	Cloud cover	None	Cloud base	None
Dew point	N/A				

- 1.7.2 According to the density altitude chart tabled in Section 5 of the POH, at 6 620 feet pressure altitude and a temperature of 17°C, the density altitude would be about 8 900 feet.

ROBINSON  
MODEL R44 II

SECTION 5  
PERFORMANCE



DENSITY ALTITUDE CHART

## 1.8 Aids to Navigation

- 1.8.1 The aircraft was equipped with the standard navigational equipment as per the minimum equipment list approved by the regulator. No defects were reported prior to the accident.

## 1.9 Communications

- 1.9.1 The aircraft was equipped with one VHF (very high frequency) radio that was approved by the regulator
- 1.9.2 Dragon Peaks Park was located outside a control zone (CTR) area.



## **1.10 Aerodrome Information**

- 1.10.1 The pilot took off with two passengers from the Dragon Peaks Park in KwaZulu-Natal, which is located at GPS position S29°00.904" E029°26.132".
- 1.10.2 He then landed at Crystal Beds in the Drakensberg at S28°58.373" E029°20.871", and took aboard a third passenger prior to the accident.

## **1.11 Flight Recorders**

- 1.11.1 The aircraft was not fitted with a cockpit voice recorder (CVR) or a flight data recorder (FDR). Neither was required to be fitted to this type of helicopter.

## **1.12 Wreckage and Impact Information**

- 1.12.1 The helicopter struck the sloping ground, causing it to swing through 180°. During the impact sequence, the tail boom was severed from the fuselage and the helicopter slid backwards for some metres before coming to rest.
- 1.12.2 The tail boom and rotor assembly were found approximately 17 metres from the main wreckage.

## **1.13 Medical and Pathological Information**

- 1.13.1 Not applicable.

## **1.14 Fire**

- 1.14.1 There was no pre-or post-impact fire.

## **1.15 Survival Aspects**

- 1.15.1 The accident was survivable, and there were no injuries. The helicopter was only a short distance above the ground, resulting in low impact forces. In addition, the occupants were properly restrained with three-point safety harnesses.

## **1.16 Tests and Research**

- 1.16.1 None were considered necessary.

## **1.17 Organisational and Management Information**

- 1.17.1 This was a domestic charter flight operated by Westline Aviation CC. The operator was in possession of a valid Class II & III Air Service Licence – No. G869D / N235D – issued in terms of Section 17(1) of Act No. 115 of 1990. The operator had been

authorised by the Air Service Licensing Council to operate the type of air service with categories of aircraft specified under G10 and H2.

1.17.2 The passengers were issued with ticket numbers 3112, 3113 and 3116 on 19 April 2008 for the flight operating from Dragon Peaks Park..

1.17.3 The last maintenance carried out on the aircraft prior to the accident was certified by Aircraft Maintenance Organisation (AMO) No. 237 at 1 477.6 airframe hours on 17 March 2008 and the Certificate of Release to Service No. 00570 issued. The AMO was in possession of a valid AMO Approval Certificate with an expiry date of 31 March 2009.

## **1.17 Additional Information**

1.17.1 Annexure 'A': Air Density and Flight : Meteorology for Pilots

1.17.2 Annexure 'B': The Effect of Gross Weight on Helicopter Performance:

1.17.3 Annexure 'C': Maximum Performance Takeoff

1.17.4 Annexure 'D': Over-Pitching: Principles of Helicopter Flight.

## **1.19 Useful or Effective Investigation Techniques**

1.19.1 None considered necessary.

## **2. ANALYSIS**

2.1 This was a domestic charter flight that was initiated from Dragon Peaks Park with two passengers on board. Dragon Peaks Park is in the Drakensberg at GPS position S29° 00.904" E029° 26.132". The helicopter landed safely at Crystal Beds at GPS position S28° 58.373 " E029° 20.871" at an elevation of 6 620ft AMSL.

2.2 The pilot of another helicopter at Crystal Beds then requested the pilot of ZS-RYR to uplift a third passenger from his helicopter as he was slightly heavy for the flight. After the third passenger had climbed aboard, the pilot commenced with the takeoff into the wind in a northerly direction at approximately 0945Z. During the takeoff, the low rotor warning sounded and the pilot immediately lowered the collective in an attempt to regain RPM which caused a decrease in altitude. However, the height over the ground remained the same due to the downslope. As the helicopter has not yet gone through transition, it descended. The pilot pulled the power to stop the descent, which caused a further decay in rotor RPM. At the same time, he applied aft cyclic to slow the forward speed in case the helicopter impacted with the terrain. The helicopter nevertheless struck the ground fairly hard and swung through 180°, causing the tail boom to separate from the fuselage.

2.3 "If rotor RPM decreases during these phases (for whatever reason), total rotor thrust reduces and an unwary pilot might attempt to restore the rotor thrust by pulling up the collective. This action invariably tilts the total reaction away from the axis of rotation, worsening the total rotor thrust/rotor drag ratio. Thus, up collective

will only result in further decay in rotor rpm.” This was the case in the accident in question.

- 2.4 The performance of an aircraft, and particularly for helicopters, is often disputed against the term “Density Altitude”. This is the height in the ISA (International Standard Atmosphere), which has a density corresponding to the actual ambient density at a specific location. Alternatively it can be considered as the pressure altitude corrected for temperature.”
- 2.5 It appears that the pilot did not consult the POH to ensure that the helicopter configuration at the time of takeoff was within the performance capabilities for the given environmental conditions. The density altitude at the time was calculated to be 8 900 feet AMSL (above mean sea level), which had a direct effect on the performance capabilities of the helicopter.
- 2.6 All the parameters were found to be within limits whilst the helicopter was within ground effect. As soon as the aircraft began moving forward over the down-slope, however, the ground effect dissipated and the low main rotor warning sounded. The pilot then aggravated the condition by lowering the collective in an attempt to regain rotor RPM. He was unable to restore the low rotor RPM condition, as the power required exceeded the power available and he had limited height available to unload the rotor system. The pilot thus over-pitched the rotor system, rendering ground impact inevitable.

### **3. CONCLUSION**

#### **3.1 Findings**

- 3.1.1 The pilot was the holder of a valid commercial helicopter pilot’s licence and the helicopter type was endorsed in his logbook.
- 3.1.2 The last MPI prior to the accident was certified on 17 March 2008 by AMO No. 237 at 1 477.6 airframe hours.
- 3.1.3 The helicopter had flown a further 32.9 hours since the last MPI was certified.
- 3.1.4 According to the South African Weather Service, the weather conditions were fine to partly cloudy. The temperature at the site area was reported to be 17°C with the surface wind northerly 5-8kt.
- 3.1.5 The density altitude during takeoff from Crystal Beds was calculated as 8 900 feet AMSL (above mean sea level).
- 3.1.6 The takeoff weight of the helicopter from Dragon Peaks Park was within its maximum certified takeoff limit of 2 500 pounds.
- 3.1.7 The helicopter was capable of performing an in-ground effect (IGE) hover, according to the IGE performance graph.
- 3.1.8 The out-of-ground effect (OGE) performance graph indicated that the aircraft weight should not have exceeded 2 300 lbs. The aircraft weight exceeded the OGE calculated limit by 126 lbs.

- 3.1.9 It can reasonably be assumed that the pilot did not perform a weight-and-balance calculation after a third passenger boarded the helicopter when he landed at Crystal Beds.
- 3.1.10 This was a commercial charter flight and the passengers had been issued with authorised passenger tickets.

### **3.2 Probable Cause/s**

- 3.2.1 The pilot over-pitched the helicopter on takeoff and it was not possible to sustain flight following decay in main rotor rpm. The out-of-ground effect (OGE) performance graph indicated that the aircraft weight exceeded the OGE calculated limit by 126 lbs.

### **3.3 Contributory factor/s**

- 3.3.1 The density altitude of 8 900 feet had a significant effect on the helicopter's performance during takeoff.
- 3.3.2 The pilot did not perform a proper weight-and-balance calculation after a third passenger boarded at the second landing site.
- 3.3.3 The pilot obviously did not consult the IGE and OGE hover charts for the helicopter in the POH.

## **4. SAFETY RECOMMENDATIONS**

- 4.1 None

## **5. APPENDICES**

- 5.1 Annexure 'A'  
Annexure 'B'  
Annexure 'C'  
Annexure 'D'



## Annexure 'A'

### Air Density and Flight:

Reference: *Meteorology for Pilots*, by K.M. Wickson, pp 19-21

*Low air density can considerably reduce the performance of engines and airframes because of the reduction in the mass of air entering the engine. For airframes, the amount of lift from a wing is directly proportional to the density. For these reasons, for both takeoff and landing, when density is very low, the pilot must either use a longer takeoff and landing run or, alternatively, reduce the aircraft weight (either fuel or payload). Cruising at height in a jet aircraft, the lower density gives reduced thrust. However, the aircraft's drag is also reduced because of the lower density and the lower thrust produced by the engine means it will have a lower fuel consumption. As a consequence, fuel consumption can be expected to reduce as height increases.*

*For helicopters, the engine effects are as for fixed wing aircraft. The equivalent to lift from a wing is lift from the rotor blades. In low-density conditions, the rotor blades have to be set at a higher angle of attack, and this makes the retreating blade more liable to stall. A lower density can also significantly reduce the hovering ceiling. Lastly, in extreme cases of low density, vertical takeoff or landing may not be possible, necessitating a 'running' take-off and landing.*

*Low-density conditions are most likely to occur where:*

- *Airfield elevation is 'High' (hence low pressure)*
- *Temperature is "High", and*
- *Humidity is 'High'.*

*Each of these will produce low density. An airfield with a high elevation near the equator in the rainy season will therefore suffer from all low-density effects. A good example of the above is Nairobi airport at latitude 01°19'S, which has an elevation of some 5 500 ft (1.7 km). It is a frequent occurrence that aircraft have to operate with a reduced payload when taking off in the early afternoon. Another, somewhat less of a low-density regime, concerns Bahrain in the Arabian Gulf. In summer, in the afternoon, temperatures are high and humidity is high. Despite the fact that the airfield is virtually at sea level, when a Concorde service operated from Bahrain its passenger load had to be reduced for takeoffs during summer. It is for this reason that the Concorde service to Bahrain was terminated. Singapore at latitude 01°21' N is widely used a refuelling stop for aircraft flying to Japan and Australasia. These stops are usually scheduled for night-time or the early morning hours when temperatures are cooler and thus density is greater.*

*Density Altitude:*

*Performance of an aircraft, and particularly for helicopters, is often argued against the term Density Altitude. This is the height in the ISA (International Standard Atmosphere), which has a density corresponding to the actual ambient density at a specific location. Alternatively it can be considered as the pressure altitude corrected for temperature. Hence if reference is made to a high Density Altitude it means that the air density, as such, must be low.*

Annexure 'B' :

The Effect of Gross Weight on Helicopter Performance:

Reference: *Basic Helicopter Handbook, US Department of Transportation*

*We learned earlier that the total weight of a helicopter is the first force that must be overcome before flight is possible. Lift is the force that is needed to overcome or balance this total weight. It is easily seen that the greater the gross weight of the helicopter, the more lift is required to hover. The amount of lift available is dependent upon the angle of attack at which the rotor blades can operate and still maintain required rotor RPM. The angle of attack at which the blades can operate at required rotor RPM is dependent upon the amount of power available. Therefore, the heavier the gross weight, the greater the power required to hover and for flight in general, and the poorer the performance of the helicopter since less reserve power is available, or to state it another way, the heavier the gross weight, the lower the hover ceiling.*

*A study of the hovering ceiling chart reveals the following interesting information for one helicopter, and this is fairly typical for all helicopters (with un-supercharged engines). At 60 °F in dry air, the hovering ceiling for gross weights of 1 300, 1 400, 1 500 and 1 600 pounds are 9 400 feet, 7 400 feet, 5 900 feet, and 4 300 feet, respectively. An increase of 300 pounds in gross weight decreases the hovering ceiling by more than half. At gross weight of 1300, 1 400, 1 500, and 1 600 pounds at a temperature of 100 °F (37.8 °C) in air with a relative humidity of 80% the hovering ceilings are 6 100 feet, 4 400 feet, 2900 feet, and 1 300 feet, respectively. In the latter case, an increase of 300 pounds in gross weight reduces the hovering ceiling by almost 80%. **A comparison of the two examples illustrates vividly the reduction in performance brought about by a combination of heavy gross weight and high-density altitudes.***

*Of the three major factors affecting the performance of a helicopter at high elevations (density altitude, wind, and gross weight), the pilot can control only the gross weight. It should be obvious that the gross weight carried on any flight must be considered – not only for takeoff under the existing density altitude, wind conditions, and power available at point of departure, but also under the expected density altitude, wind conditions, and power available at the landing destination. Smaller amounts of fuel may be carried to improve performance or to increase useful load. It must be remembered, however, that this necessitates a sacrifice in range.*

Annexure 'C'

## Maximum Performance Takeoff

Reference: *Flying the Helicopter*, by John J. McDonald, pp 100-102)

*When such a takeoff is required, the pilot must be thoroughly familiar with the capabilities and limitations of his aircraft. The pilot's best friend is his flight manual for that particular aircraft and is an invaluable tool, as it is under many conditions. Besides the capabilities and limitations of the aircraft, the pilot will have to know about, and take into consideration: wind velocity, air density, temperature, CG, and gross weight. These, and other factors affecting technique and performance, are **absolutely essential** before attempting a maximum performance takeoff. The procedures for this type of takeoff are critical and must be followed explicitly, along with certain required observations, if the manoeuvre is to be safely and successfully accomplished.*

*Increase collective pitch and throttle while watching the tachometer. Continue increasing both until the maximum redline engine RPM is indicated on the tachometer and the aircraft becomes light on its landing gear. As the aircraft becomes airborne, increase the pitch and apply full throttle. When the helicopter becomes airborne it should be climbing and going forward at the same time in a very steep ascent angle. When climbing airspeed is achieved, come back on the cyclic stick slightly to prevent too much forward speed from decreasing the required angle of ascent. Continue with full power until the aircraft is safely clear of all obstacles, then power may be reduced and a normal or standard rate of climb established. The goal of this type of takeoff is to obtain a maximum altitude in a minimum amount of forward distance. The result will depend not only on the pilot's skill, but also to a great extent on the performance and conditions outlined earlier. The less favourable these conditions, the shallower the angle of ascent will be. **Extreme** caution must be employed when climbing very steeply, for if airspeed is permitted to get too low, there is the ever-present danger that the helicopter may settle back to the ground. What could be even **more** dangerous is the possibility of a power failure at low altitude and airspeed, which would place the craft into a very dangerous situation – one that would require a very high degree of skill to make a safe autorotation landing. Considerable caution and anticipatory judgement of any changing conditions and circumstances cannot be over-emphasised.*

Annexure 'D': Over-Pitching; Reference: *Principles of Helicopter Flight*, by W.J. Wagtendonk, pp 81-82

*Over-pitching is different from recirculation even though the symptoms have similarity. While over-pitching can occur at any altitude and at various stages of flight, it is more likely to occur when approaching a hover or during hover.*

*If the rotor rpm decreases during those phases (for whatever reason), total rotor thrust reduces and an unwary pilot might attempt to restore the rotor thrust by pulling up the collective. This action invariably tilts the total reaction away from the axis of rotation, worsening the total rotor thrust / rotor drag ratio. Thus, up collective will only result in further decay in rotor rpm.*

*Decaying rotor rpm also causes the helicopter blades' coning angles to increase. The consequence of this is that, firstly, the disc becomes smaller so that rotor thrust falls off. Secondly, large coning angles cause rotor thrust to point inward so that smaller vertical components become available to overcome the helicopter's weight.*

*There comes a stage where the rotor rpm is so low that even full power can no longer restore it; this is the beginning of over-pitching. Any further raising of collective creates more rotor drag and rotor rpm decays even further. The only recovery action from over-pitching is to lower the collective lever to increase rotor rpm. This will cause the helicopter to lose some height.*

*Over-pitching may occur when approaching a high altitude landing site if the power required to hover is not available. As airspeed decreases and the need for power increases, the helicopter descend rate builds when the engine cannot supply the power required. Pilots who then instinctively pull up the collective to arrest the sink rate are in trouble. The high inflow angles and associated rotor drag quickly decay the rotor rpm and the stage is set for over-pitching. The best scenario ends in hard landing, while the worst-case scenario ends in full rotor stall, at which point the helicopter virtually falls out of the sky.*

Report reviewed and amended by the Advisory Safety Panel 30 October 2009

-END-