AIRCRAFT ACCIDENT

FINAL REPORT

A 07/18

Air Accident Investigation Bureau (AAIB)

Ministry of Transport, Malaysia

Accident involving Rotorcraft Helicopter Robinson R66

Registration 9M-RML

at Sultan Abdul Aziz Shah Airport,

Subang, Kuala Lumpur

on the 15th August 2018

AIR ACCIDENT INVESTIGATION BUREAU (AAIB)

MALAYSIA

ACCIDENT REPORT NO. : A 07/18

OPERATOR	**:**	**PRIVATE**
AIRCRAFT TYPE	**:**	**ROBINSON R66**
NATIONALITY	**:**	**MALAYSIA**
REGISTRATION	**:**	**9M-RML**
PLACE OF OCCURRENCE	**:**	**SULTAN ABDUL AZIZ SHAH AIRPORT, SUBANG, KUALA LUMPUR**
DATE AND TIME	**:**	**15th AUGUST 2018 AT 0758LT**

This report contains a statement of facts which have been determined up to the time of issue. It must be regarded as tentative, and is subjected to alteration or correction if additional evidence becomes available.

This investigation is carried out to determine the circumstances and causes of the accident with a view to the preservation of life and the avoidance of accident in the future: It is not the purpose to apportion blame or liability (Annex 13 to the Chicago Convention and Civil Aviation Regulations 2016).

INTRODUCTION

The Air Accident Investigation Bureau of Malaysia

The Air Accident Investigation Bureau (AAIB) is the air accident and serious incident investigation authority in Malaysia and is responsible to the Minister of Transport. Its mission is to promote aviation safety through the conduct of independent and objective investigations into air accidents and serious incidents.

The AAIB conducts the investigations in accordance with Annex 13 to the Chicago Convention and Civil Aviation Regulations of Malaysia 2016.

In carrying out the investigations, the AAIB will adhere to ICAO's stated objective, which is as follows:

"The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability".

Accordingly, it is inappropriate that AAIB reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

AIRCRAFT ACCIDENT/SERIOUS INCIDENT REPORT

Aircraft Type	**:**	**Robinson**
Model	**:**	**R66**
Owner	**:**	**Leopad Aviation Sdn. Bhd.**
Nationality	**:**	**Malaysia**
Year of Manufacture	**:**	**2013**
Aircraft Registration	**:**	**9M-RML**
Serial Number	**:**	**0375**
State of Registration	**:**	**Malaysia**
Place and State of Occurrence	**:**	**Sultan Abdul Aziz Shah, Subang (WMSA)**
Date and Time of Occurrence	**:**	**15th August 2018 (0758LT)**

All times in this report are Local Time (LT) (UTC +8 hours)

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SYNOPSIS

On 15th August 2018 at approximately 0725 LT (local time), a Robinson R66 helicopter bearing registration 9M-RML was on a demonstration flight at Sultan Abdul Aziz Shah Airport, Subang (WMSA).

During the sloping ground exercise at the grass area, after completed the landing with left skid upslope, the helicopter attempted take-off procedure from the sloping ground. Upon lift-off, the helicopter drifted to the right and the PIC (Pilot in command) performed immediate corrective action which caused the helicopter to bank to the left. As the helicopter banked to the left excessively, the main rotor blades struck on the upslope and caused the fuselage to spin uncontrollably clockwise direction and impacted to the ground at approximately 90 degrees from its original heading.

Both of the occupants escaped the helicopter safely with the PIC suffered minor injury and the helicopter sustained substantial damage.

1.0 FACTUAL INFORMATION

1.1 History of the flight

A helicopter Robinson 66, bearing registration 9M-RML, owned by a private company was conducting a familiarisation flight at Sultan Abdul Aziz Shah Airport, Subang (WMSA) on the 15th August 2018.

At approximately 0645 LT, a rotary Private Pilot License (PPL) holder arrived at SAS hangar in the airport. He assisted the ground technical crew to push the helicopter out of the hangar in preparation for the flight.

At approximately 0715 LT, the PIC who was also the Flight Instructor arrived at the hangar and made several phone calls to Subang Tower for a flight clearance. Upon getting the clearance he boarded the helicopter occupying the Left Hand Seat. The Right Hand Seat then was occupied by the PPL holder who has been waiting at the hangar. There was no pre-flight briefing done prior to the flight.

Upon interview with the PPL holder, he claimed that he was flying in a capacity of a passenger. His Licence Proficiency Check (PPL) has lapsed and has not been renewed. The PIC for the flight was also qualified as a flying instructor.

Both of them did the pre-start check in accordance to the checklist available in the helicopter cockpit. They were ready for take-off, after getting Subang air traffic control clearance at 0725 LT.

It departed SAS hangar by air taxy to taxiway Oscar which is not far from the hangar. From taxiway Oscar they performed two circuits work. The circuit pattern was, departing on taxiway Oscar on runway 15 heading and back on taxiway Sierra terminating at the bridge beside Sapura hangar. Both circuit works were successfully carried out.

On completion of the circuits work they flew the helicopter back to taxiway Oscar for a quick stop exercise. The quick stop was carried out on taxiway Oscar in the direction of 150 heading (runway 15 heading) Subsequently they carried out another quick stop exercise on the opposite direction terminated back to the original position at taxiway Oscar. The exercise was uneventful and satisfactory. They were happy with the performance of the helicopter and there was no anomaly felt on the helicopter.

They decided to continue the flight for a sloping ground exercise. From taxiway Oscar they positioned the helicopter to the grass adjacent to taxiway Oscar and taxiway Sierra (see Diagram 1).

At the grass area there was a favourite location for sloping ground take-off and landing exercise. It should be emphasised here that this grass area is not a special or dedicated area provided for training but it is consider a suitable area and has been used for sloping ground training unofficially. They were exactly at that location facing the Sapura hangar approximately Easterly direction. The helicopter performed the landing and take-off with the right skid on the upslope position. Both the landing and take-off from the sloping ground was carried out uneventfully.

While hovering they executed a 180 degrees spot turn to position the helicopter nose facing the runway. (Easterly heading) for sloping landing with left skid upslope.

This exercise is considerably difficult as compared to landing with right skid upslope. R 66 is inherently hovering with left skid lower than right skid. The landing and also take-off has to be done with extra care and very gentle on the controls. The situational awareness on the main rotor disc attitude has to be monitored at all time.

The landing with left skid upslope was done successfully and uneventful. The collective lever was then lowered fully and both skids were firmly on ground. Normally the main rotor blade disc attitude should be brought back to level attitude after collective lever fully down. On this flight both occupants were not certain of the disc attitude position.

The PIC did not notice any abnormality on the helicopter following the landing and decided to attempt the take-off from the sloping ground. With the PPL holder on the controls, he initiated the take-off by applying collective power gently. As the right skid break contact with the ground, suddenly the helicopter got airborne and drifted to the right at a fast rate. Realising that something was not right during the lift-off, the PIC made a quick correction by applying cyclic stick to the left.

The quick reaction of the PIC causing excessive movement of the cyclic to the left subsequently tilt the main rotor blades downwards on the upslope area. Upon inspection of the area, there were two strike marks (Figure 11) found on the ground indicating the blade tips had struck the ground at high speed.

The PIC admitted that he was trying to correct the situation when the helicopter started to drift to the right vertically, however his corrective

action was rather abrupt and excessive causing the main rotor blade to tilt and bend downwards towards the ground on the upslope and strike the ground with extensive impact.

The subsequent effect of the main rotor strike, causing an exorbitant feedback on the main gearbox and the fuselage. Since the main rotor turning anti-clockwise direction the reaction on the fuselage was clockwise movement.

The fuselage spin uncontrollably clockwise direction and impacted to the ground at approximately 90 degrees from its original heading. It rested on the left side with the PIC at the bottom. Both of them escaped from the wreckage with the PIC suffered minor injury.

There was no fire or any excessive fuel leak. The engine shut by itself and the PIC managed to pull the fuel cut-off and shut off the battery switch.

The PIC was sent to nearby hospital for further treatment. Meanwhile the helicopter sustained substantial damage especially to the main rotors, main gear box assembly, fuselage and most probably the engine that need further examination.

1.2 Injuries to persons

Injuries	Crew	Passenger
Fatal	-	-
Serious	-	-
Minor/None	1	1

1.3 Damage to aircraft

Main Rotor Blade - Damaged and detached	

Figure 1: Main Rotor Blade

Main Rotor Head - Damaged **Linkages and Pitch Link** - Broken **Swash Plate** - Twisted	

Figure 2: Main Rotor Head**,** linkages and pitch links and swash plate

Main Gearbox Attachment - Broken and tilted forward	

Figure 3: Main Gearbox Attachment

Rotor Drive Shaft - Twisted and damaged	

Figure 4: Rotor Drive Shaft

Main Gearbox Compartment - Broken	

Figure 5: Main Gearbox Compartment

Canopy (Left Hand) - Shattered and severely damaged **Airframe Door** - Deformed and fully damaged	

Figure 6: Canopy and airframe door

Tail Rotor Blade - Twisted **Vertical Stabiliser** - Broken and dented **Tail Boom** - Deformed	

Figure 7: Tail rotor blade, vertical stabiliser and tail boom

Engine Drive Shaft - Detached and twisted **Engine Input Shaft** - Deformed **Engine Firewall** - Torn off	

Figure 8: Engine drive shaft, engine input shaft and engine firewall

Instrument Panel - Dented	

Figure 9: Instrument panel

Main Gearbox and Engine Cowling - Deformed and torn off	

Figure 10: Main gearbox and engine cowling

1.4 Other damage

Figure 11: Damage to the ground area due to the blade strike

1.5 Personal Information

Pilot in command

Status	Commander
Nationality	Malaysian
Age	70 years old
Gender	Male
License Type	ATPL/H
License Validity	31st October 2018
Medical Examination	31st October 2018
Aircraft Rating	EC135, R66 & MD600N
Instructor Rating	EC135, R66 & MD600N
Certificate of Test	31st May 2019 (R66)
Flying Hours	Total hours : 12,000hrs (approx.) Total on Type : 600hrs (approx.)

1.6 Aircraft Information

Aircraft	Robinson R66
Owner	Leopad Aviation Sdn. Bhd.
Registration	9M-RML
Serial No.	0375
CofA No.	M.1916
CofA Expiry	29th November 2018
CofR No.	AR/17/136
CofR Expiry	26th April 2020
Year of Manufacture	2013

1.7 Meteorological Information

Not relevant.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Not applicable.

1.10 Aerodrome information

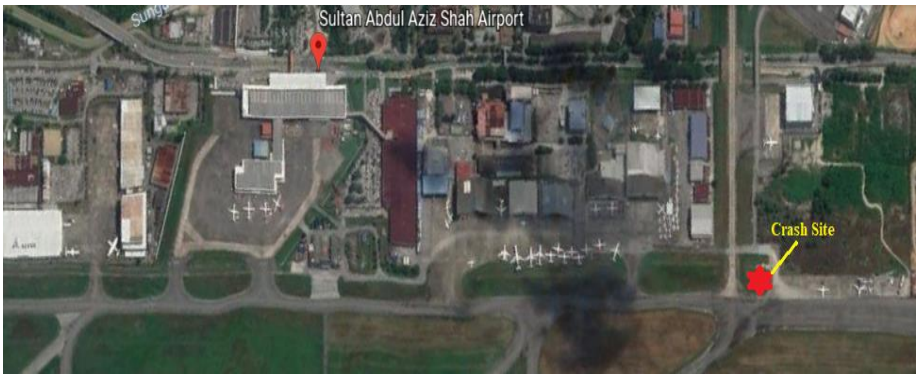

Diagram 1: Location of the crash site

Training area

There is an open area adjacent to taxiway Oscar and taxiway Sierra where it has been known as a location for regular sloping ground take-off and landing activities. This grass area is not a designated area provided for training but it is considered as a suitable area and has been used for sloping ground training by helicopter pilots.

This place was accepted by trainers due to its nature of uneven surface with sloping angles varies from 8˚ to 12˚ as per shown below.

Figure 12: Investigator is measuring the slope angle

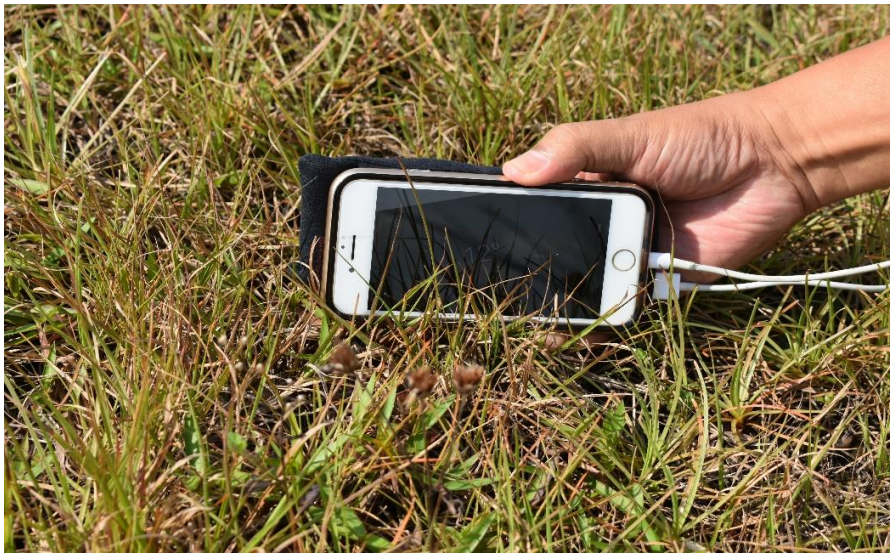

Figure 13: The measurement showing the angle of the slope (12°)

1.11 Flight Recorders

There's no flight recorders installed in the helicopter.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

There was no fire before, during and after the accident.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Organisational and management information

Not applicable.

1.18 Additional information

Not applicable.

1.19 Useful or effective investigation techniques

Not applicable.

2.0 ANALYSIS

2.1 Pre-flight preparation

As mentioned earlier in the history of flight section, at approximately 0645 LT, the rotary PPL holder arrived at SAS hangar in the airport and he helped the ground technical crew to push the helicopter out of the hangar in preparation for the flight. It was a planned sortie and they were supposed to take-off at 0700 LT.

However, at approximately 0715 LT, the PIC who was also the Flight Instructor for some reasons arrived late at the hangar and made several phone calls to Subang Tower for a flight clearance. Upon getting the clearance he boarded the helicopter occupying the Left Hand Seat. The Right Hand Seat then was occupied by the PPL holder who has been waiting at the hangar. The PIC admitted that there was no briefing carried out for the flight.

There was no pre-flight briefing conducted prior to the sortie which is required to be done by the operating procedure before commencing every flight. The flight departed at approximately 0725 LT or 0730 LT.

2.2 Sloping ground (take-off techniques and dynamic roll over)

Sloping ground is a manoeuvre that is used to transition the helicopter from hover to a landing on a slope and take-off from slope. A parallel sloping ground approach will be described below:

2.2.1 Take-off techniques - With the RPM within the normal operating range, the pilot displaces the cyclic toward the slope. Depending on the circumstances, he might put just the amount he thinks is required, or on a steeper slope he may elect to put all available cyclic into the slope to start with. The intent is not to tip the rotor toward the slope, but to have the main rotor disk level with the horizon, or tipped just slightly into the slope.

As power is increased, the downhill skid will eventually lift up. During this phase of the manoeuvre, collective is controlling the height of the skid, and cyclic is simply trying to maintain the rotor system level with the horizon. As the fuselage rolls uphill, the swashplate and therefore the rotor system tip with it, and the pilot has to take out some of his upslope cyclic in order to maintain the rotor level with the horizon.

The collective should be slowly raised until the downhill skid is level with the uphill skid. Cyclic should continue to be manipulated to maintain a level rotor system. It is critical that the downhill skid does not get raised above the uphill skid. Doing so starts biasing the equation toward dynamic rollover. This is

because not only may some main rotor thrust be trying to roll us uphill, but the CG is shifting toward the uphill skid, and thus any restoring force preventing dynamic rollover is being reduced.

Once the skids are level, remove any remaining upslope rotor thrust by moving the cyclic away from the slope. It is normally very apparent when there is no main rotor thrust into the slope, because the helicopter will suddenly become much less stable on the slope side. Continue to center the cyclic, and increase power to cause the helicopter to lift straight up. Continue up to your desired hover height.

2.2.2 Dynamic roll over – Dynamic roll-over will occur if there is an excessive application of collective while the cyclic is displaced literally. When this occurs, one side of the undercarriage becomes a lateral pivot point and the helicopter rolls rapidly as it is forced to pivot around that side of the undercarriage instead of rolling around its C of G. Diagram below illustrates the dynamic roll over.

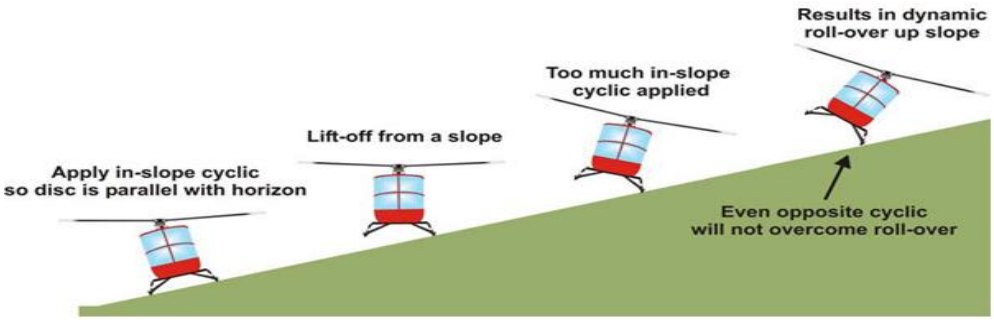

Diagram 2: Dynamic roll over
(source: http://www.myaviationschool.com/aviation-articles/becker-helicopters/dynamic-roll-over.html)

2.3 What happened during this flight

Based on the interview statement given by the PIC, it was a familiarity flight to a PPL pilot with lapsed LPC whom was on the controls at that time following through by the PIC while demonstrating landing and take-off on sloping ground. The landing was done normally with the left skid upslope. When they commenced the take-off with right skid up sloped, the downhill skid needs to be raised without moving the uphill skid. To achieve this, the vertical component of total rotor thrust (VTRT) must be enough to lift on side of the helicopter. Whilst applying sufficient lateral force to the rotor mast to roll the helicopter to a level altitude around the upslope skid, as the right skid break contact with the ground, the helicopter started to drift to the right. The PIC who is also Instructor pilot (occupying LHS), without calling *'I have control'* grabs the control and tries to correct the situation. Instead of bringing the helicopter to normal hover, it excessively bank to the left and subsequently

the main rotor blades strike the ground. This was believed due to the startled effect from the PIC.

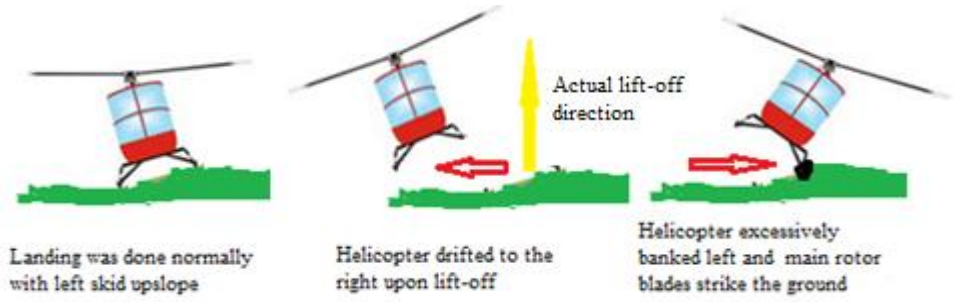

Diagram 3: Sequence of event during the lift-off until blades strike the ground

Instructor procedure on taking over control when the flying pilot could not take-off properly from the sloping ground is that the instructor should call '*I have control'* and take control in a smooth and timely manner. Without clear *'I have control'* instructions there is a possibility of both pilots fighting over control of the helicopter, which can cause large and aggressive control inputs. The instructor should then bring the helicopter to a stable hover and instruct a good landing with the student following through, followed by a take-off, again with the student following through. The student then should attempt the landing with the instructor following through and again without the instructor following the controls *(when we say 'following through' the instructor or the student will follow the control movements without actually putting any input into the controls).*

Sloping ground take-offs, in fact every take-off taught, should be a *two stage take-off*; raise the collective lever whilst observing the RPM is in the green until the helicopter becomes light on the skids, '*pause'*, feel and correct any movement, then carry on with level take-off.

It should also be emphasized here that the maximum recommended rate of angle for sloping ground exercise is 5˚, while the actual angle of slope for the surface used during the occurrence is approximately from 8˚ to 12˚which is on the high side. However, the angle of the slope couldn't be accurately determined by the pilot while flying the helicopter during hover.

2.3.1 Non-conventional cyclic controls – Robinson 66 is being installed with a tee type of cyclic controls. When the RHS pilot is on the control, the handle will be tilted at an angle and his hand placed on RHS pilot's thigh. For the Instructor Pilot to follow on the controls, he has to place his hand high freely without any datum. In the event he has to take full control especially when the helicopter is banking to the right, he could have difficulty to maintain cyclic movement at the right displacement. He could have overdoing the

correction easily. Upon engaging with Robinson manufacturer, Instructor pilot has the options to use the controls handle or the centre stick whichever is most comfortable and work the best to him.

3.0 CONCLUSIONS

3.1 Findings

3.1.1 The helicopter was properly maintained and airworthy for the flight.

3.1.2 The PIC was properly licensed and experienced to conduct the familiarisation flight and he was occupying the left hand seat. He was also a qualified flying instructor on Robinson 66.

3.1.3 The helicopter did not show any abnormality in its performance during the flight and the engine as well as the main rotors were with power when the accident happened.

3.1.4 The person occupying the right hand seat is a holder of rotary PPL but the license validity has lapsed and has not been renewed.

3.1.5 There was no proper pre-flight briefing conducted by the PIC prior to the flight.

3.1.6 The person occupying the right hand seat claimed that he was only a passenger and the flight was a familiarisation flight. He was only following through on the controls.

3.1.7 The grass area where they performed the exercise was not properly designated as sloping ground exercise area. The pilot could not determine the actual slope angle visually from the hovering height.

3.1.8 The approximate angle of the slope area for the sloping ground exercise is from 8° to 12°, whereby the maximum recommended angle for sloping exercise is 5°.

3.2 Cause

The cause of the accident is due to a ‘loss of lateral control’ during lift-off leading to dynamic roll over.

4.0 SAFETY RECOMMENDATIONS

It is recommended that:

4.1 The aircraft commander to ensure a proper pre-flight briefing to be conducted prior to any flight and to include an understanding on the exercise that going to be carried out together with safety precaution.

4.2 The airport operator (MAHB) is to designate a suitable place for helicopter sloping ground exercise and a hovering area for precision flying preferably a slope of 5 degree with a trimmed grass.

4.4 The Civil Aviation Authority of Malaysia (CAAM) is to supervise the instructional techniques for Robinson 66 especially on the use of non-conventional cyclic stick control.

CHIEF INSPECTOR
Air Accident Investigation Bureau
Ministry of Transport
MALAYSIA
18th March 2019