

HELICOPTER ACCIDENT REPORT AND EXECUTIVE SUMMARY

					Reference:	CA18/2/3/9675	
Aircraft Registration	ZS-HLI	Date of Accident	21 December 2017		Time of Accident	1100Z	
Type of Aircraft	UH-1H		Type of Operation	Private (Part 91)			
Pilot-in-command Licence Type		Commercial Pilot Licence		Age	57	Licence Valid	Yes
Pilot-in-command Flying Experience		Total Flying Hours	3599		Hours on Type	1005	
Last Point of Departure		Bredasdorp Fire Station, Bredasdorp, Western Cape Province					
Next Point of Intended Landing		Bredasdorp Fire Station, Bredasdorp, Western Cape Province					
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Bredasdorp is 79.2nm south-east of Cape Town at GPS co-ordinates 34° 32' 11.10" S; 20°2' 55.31" E; elevation 157ft							
Meteorological Information		Wind: 130°/15kts gusting 25kts, Temperature: 20°C Clouds: BKN 2000ft AGL					
Number of people on-board	1+0	No. of People Injured	0	No. of People Killed	0		
Synopsis		<p>On 21 December 2017, the helicopter with registration marks ZS-HLI took off on a demonstration flight from Bredasdorp Fire Station (BFS) with the intention to land back at BFS, in Bredasdorp. Following the demonstration flight, the helicopter landed at BFS at approximately 1030Z. After landing, it was noted that the helicopter's right-hand skid was resting on the strop of the Bambi bucket used for fire-fighting. To free the strop, the helicopter had to be repositioned slightly to the right. The pilot requested the marshal to stand in front of the helicopter and direct him using hand signals to ensure that the helicopter was repositioned correctly off the strop.</p> <p>The pilot reported that once the helicopter was hovering in-ground effect, it began to oscillate. The oscillation progressed uncontrollably and the helicopter began to yaw to the right before the pilot lost control. The helicopter rotated along its vertical axis approximately 270 degrees to the right; the tail and main rotor blades impacted a fence before the helicopter impacted the ground hard on its skids. The skids broke off and the helicopter came to rest on its belly.</p> <p>The helicopter's engine failed to shut down in spite of the pilot switching off the fuel supply and pulling all the circuit breakers. The pilot requested the fire department to spray water into the engine intake to force an engine shut down. The fire department building and vehicles in the vicinity sustained minor damages caused by flying debris.</p> <p>The marshal was seriously injured while the pilot was unharmed.</p> <p>The investigation revealed that the pilot's loss of control was likely caused by the pilot's induced vertical oscillation due to incorrect tightening of the collective friction which was less than the required 7 pounds (hand tight), subsequently leading to the crash.</p>					
SRP Date				Publication Date			

Reference Number : CA18/2/3/9675
Name of Owner : FFA Aviation
Name of Operator : Kishugu Aviation
Manufacturer : Richards Heavy Lift Helo Inc
Model : UH-1H
Nationality : South African
Registration Marks : ZS-HLI
Place : Bredasdorp, Western Cape Province
Date : 21 December 2017
Time : 1100Z

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 (CAR) 2011, 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 apportion blame or liability.***

Investigations process:

The accident was notified to the Accident and Incident Investigations Division (AIID) on 21 December 2017 at about 1300Z. The Investigator/s went to Bredasdorp on 22 December 2017. The Investigator/s co-ordinated with all authorities on-site and initiated the accident investigation process according to CAR Part 12 as amended and investigation procedures. The AIID of the Republic of South Africa (RSA) is leading the investigation as the RSA is the State of Occurrence.

Notes:

1. Whenever the following words are mentioned in this report, they shall mean the following:

- Accident – this investigated accident
- Helicopter – the UH-1H involved in this accident
- Investigation – the investigation into the circumstances of this accident
- Pilot – the pilot involved in this accident
- Report – this accident report

2. Photos and figures used in this report are taken from different sources and may be adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.

Disclaimer:

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1. FACTUAL INFORMATION

1.1 History of Flight

- 1.1.1 On 10 December 2017, 11 days before this accident, the helicopter was on a post-maintenance flight when the pilot reported that the helicopter had oscillated at low speed whilst on approach for landing. However, he was able to increase power and make a go-around, and thus, recovered from the oscillation.
- 1.1.2 On 21 December 2017 at approximately 1030Z, the helicopter took off from Bredasdorp Fire Station (BFS) helipad for a fire fighting demonstration flight in the area with the underslung Bambi bucket fitted to it. The pilot demonstrated two pick-up and release of water before returning to the helipad at BSF. The flight duration took approximately 15 minutes.
- 1.1.3 On arrival at BFS, the pilot opted to land the helicopter at the wash bay helipad located closer to the fire station. The radius of the wash bay is 18 metres (m) from the perimeter fence. After landing, it was discovered that the helicopter had inadvertently landed with the right skid on the Bambi bucket's strop. The pilot switched off the engine and waited for the aircraft marshal to return from the demonstration area before re-starting the helicopter to reposition it so that the marshal can unhook the strop. The marshal was standing in front of the helicopter guiding the pilot using hand signals. The helicopter hovered in-ground effect at approximately 5 inches above ground level (AGL); it then started moving to the right of the wash bay.
- 1.1.4 In his statement, the pilot stated that once established in hover, the helicopter began to oscillate uncontrollably. He attempted to land the helicopter back on the helipad, but the oscillation increased rapidly. He then pulled up the collective to lift off the ground, attempting a forward flight. As the helicopter gained height, the oscillation became very severe, making it impossible to control the helicopter. At this point, it started to yaw to the right. The severity of the oscillation continued to an extent that it became hard for the pilot to keep his hands and feet on the controls.
- 1.1.5 At approximately 10 to 20 feet AGL, the pilot decided to push down the collective to force the helicopter to land. The helicopter landed hard resulting on its skids braking off and the helicopter resting on its belly. The main rotor blades impacted the ground and separated from the rotor mast; the tail boom and tail rotor also impacted the perimeter fence. Around this time, the marshal had run towards the building to the right of the helipad to escape injury, however, a piece of the rotor blade struck him, seriously injuring him.

1.1.6 Furthermore, the pilot stated that he was unable to shut down the engine despite switching off the fuel master and pulling all circuit breakers. He then requested the fire fighters to spray water into the engine intakes to force the engine to shut down. The pilot was not injured in the accident sequence; the marshal was seriously injured and was taken to the hospital. The helicopter damaged the concrete perimeter fence, a large metal gate, windows of vehicles parked outside the fire station and windows of the fire station building.

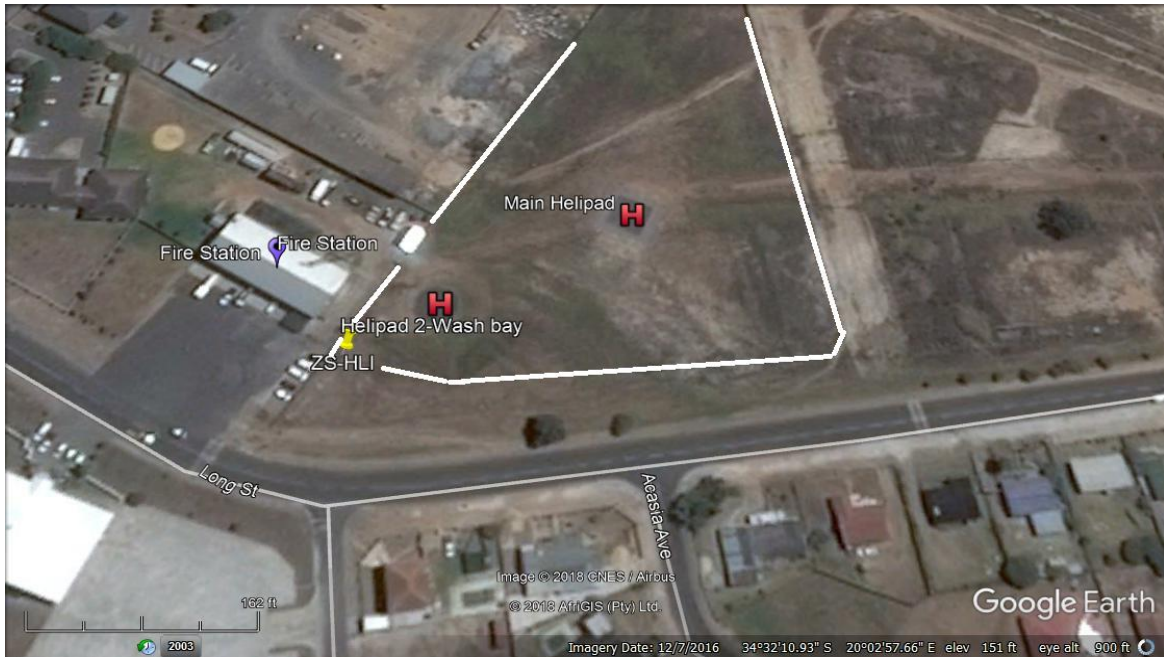


Figure 1: Overlay of the location of the two helipads and the wreckage on Google Earth

1.1.7 The accident occurred during daytime at Bredasdorp, which is 79.2 nautical miles (nm) south-east of Cape Town at the following Global Positioning System (GPS) coordinates: S 34° 32' 11.10" E 20°2' 55.31" and at an elevation of 157 feet (ft).

1.2 Injuries to Persons

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

1.3 Damage to Helicopter

1.3.1 The helicopter was substantially damaged.



Figure 2: The helicopter at the accident site.

1.4 Other Damage

1.4.1 The concrete perimeter fence, wire fence and a large metal gate were damaged. There was also damage to several vehicles that were parked near the helipad and several windows of the fire station building were shattered.



Figure 3: Damage to the concrete perimeter fence, wire fence and gate.

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	57
Licence Type	Commercial Pilot Licence				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Cull, Test Pilot, Undersling Winching				
Medical Expiry Date	31 May 2018				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	3599
Total Past 90 Days	12.6
Total on Type Past 90 Days	12.6
Total on Type	1005

1.5.1 The Marshal

The marshal who was assisting the pilot is a trained fire fighter with multiple certificates, one of which is Helicopter Secure Leader which he completed on 6 December 2010. His function involves attaching and removing the Bambi bucket and serves as an assistant to the pilot during fire-fighting operations.

1.6 Helicopter Information

Airframe:

Type	UH-1H	
Serial Number	66-00789	
Manufacturer	Richards Heavy Lift Helo Inc	
Date of Manufacture	1970	
Total Airframe Hours (At time of Accident)	8240.4	
Last MPI (Date & Hours)	18 December 2017	8235.3
Hours since Last MPI	5.1	
C of A (Issue Date)	7 November 2017	
C of R (Issue Date) (Present owner)	9 July 2012	
Operating Categories	Restricted	

Engine:

Type	Honeywell Lycoming
Serial Number	LE-23660 B
Hours since New	6590
Hours since Overhaul	748

Main Rotor Transmission Gearbox and Blades:

Gearbox Type	Bell	Blade Type	Bell	
Serial Number	A12-2148	Serial Number	A-8122	A-7937
Installation Date	6 October 2015	Installation Date	30 November 2015	
Hours since New	6295.9	Hours since New	2441.3 and 2471.2	
Hours since Overhaul	263.0			

Tail Rotor Transmission Gearbox and Blades:

Gearbox Type	Bell	Blade Type	Van Horn	
Serial Number	B13-4260	Serial Number	A188	A186
Installation Date	23 July 2015	Installation Date	31 January 2013	
Hours since New	4358.3	Hours since New	721.2	
Hours since Overhaul	713.3			

1.7 Meteorological Information

1.7.1 The weather information below was obtained from the South African Weather Service (SAWS).

Wind direction	130°	Wind speed	15G25	Visibility	10km
Temperature	20°C	Cloud cover	Broken	Cloud base	2000ft
Dew point	Unknown				

1.8 Aids to Navigation

1.8.1 The helicopter was equipped with standard navigational equipment as approved by the Regulator (SACAA) for the helicopter type. There were no recorded defects with the navigational equipment prior to the flight.

1.9 Communication

1.9.1 The helicopter was equipped with standard communication equipment as approved by the Regulator for the helicopter type. There were no recorded defects with the navigational equipment prior to the flight.

1.10 Aerodrome Information

1.10.1 The accident occurred during daytime at Bredasdorp Fire Station's unlicensed helipad, which is 79.2nm south-east of Cape Town at the following GPS coordinates: 34° 32' 11.10" S; 20°2' 55.31" E and at an elevation 157ft.

1.10.2 The helicopter, which was based at BFS in the Western Cape, was operated from an open area with two gravel helipads adjacent to the fire station.

1.11 Flight Recorders

1.11.1 The helicopter was not fitted with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the helicopter type.

1.12 Wreckage and Impact Information

1.12.1 After the helicopter was established on a hover approximately 5 inches above the helipad, it moved to the right when it started to oscillate. The pilot attempted to correct the oscillation by pulling on the collective, however, that exacerbated the oscillation. The pilot had a hard time keeping his hands and feet on the controls, and thus, pushed the collective down to force the helicopter to land. The helicopter landed hard and broke the skids.

1.12.2 The helicopter came to rest on its belly facing south; the fuselage of the helicopter remained intact. The main gearbox separated from the mounting attachments, slanting to the left. The main rotor blades were destroyed; and the main rotor hub was separated from the rotor mast. A portion of the main rotor spar, approximately 1.2m, penetrated the roof tiles of a neighbouring house, landing inside the house and no one was inside the house. The house was approximately 145m to the south-easterly direction from where the wreckage was located.

1.12.3 The tail boom was bent near the airframe and showed signs of right yaw caused by impact with the ground. The tail rotor blades were destroyed during impact with the fence. The tail rotor gearbox was ripped out of its mounts; it had cracked vertically and was leaning to the left of its normal position.

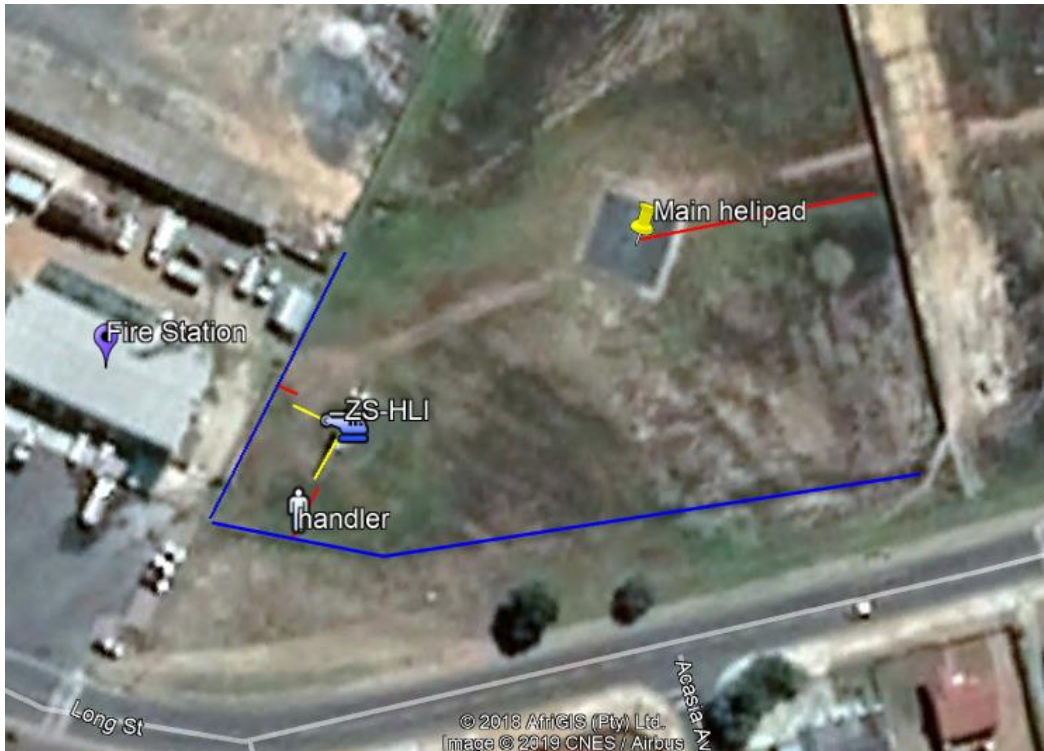


Figure 4: Yellow lines depict rotor blades which have a radius of 7.5m. The marshal stands approximately 11m from the helicopter. The space to the right of the helicopter was approximately 4m long from the blade tip. On the main helipad, the shortest distance to any object or obstacle is approximately 43m.



Figure 5: The substantially damaged helicopter at the accident site.

1.13 Medical and Pathological Information

1.13.1 None.

1.14 Fire

1.14.1 There was no evidence of a pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was considered survivable as the cockpit area had no damage which could have caused serious injury to the pilot.

1.16 Tests and Research

1.16.1 Collective Bounce: Source: UH-1H POH. See Appendix A.

Collective bounce is a pilot induced vertical oscillation of the collective control system when an absolute friction (either pilot applied, or control rigged) is less than seven pounds. It may be encountered in any flight by a rapid build-up of vertical bounce at approximately three cycles per second. The severity of the oscillation is such that effective control of the helicopter may become difficult to maintain. The pilot should apply and maintain adequate collective friction in all flights.

1.16.2 The collective friction on accident aircraft was close to the limit as indicated on Figure 6 with the inset showing a fully open collective friction.

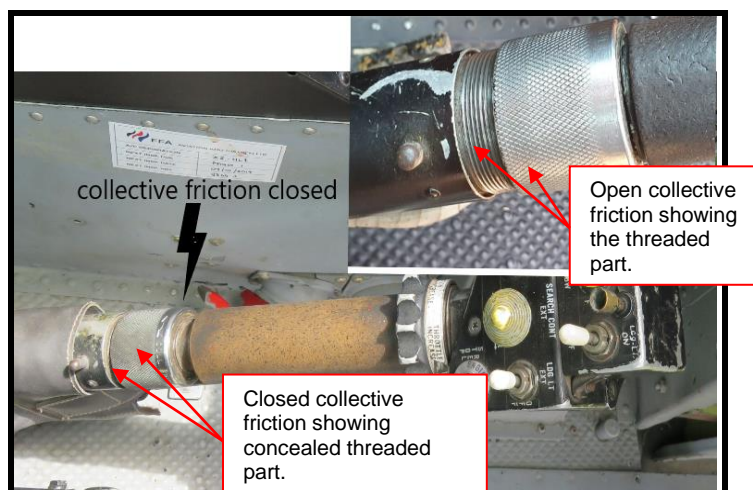


Figure 6: The main photo shows the closed collective friction. The inset shows an open collective friction.

1.16.3 Recommended recovery techniques: Source: UH-1H POH. See Appendix B

- *Relax pressure on collective. (Do not 'stiff arm' the collective)*
- *Make a significant collective application either up or down*
- *Increase collective friction*

1.17 Organisational and Management Information

1.17.1 The helicopter was privately operated in line with the requirements of Part 91 of the CAR 2011 as amended.

1.17.2 Kishugu Aviation had a valid Air Operating Certificate (AOC) issued on 7 February 2017 with an expiry date of 22 December 2017. The AOC no was CAA/G921D and ZS-HLI was listed as one of the helicopters on the fleet.

1.18 Additional Information

1.18.1 None.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

From the available evidence, the following analysis was made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

2.2 Analysis

2.2.1 The pilot was issued a Commercial Pilot Licence (CPL) on 23 May 2017 with an expiry date of 31 May 2018. His medical certificate was issued on 17 May 2017 with

an expiry date of 31 May 2018 with no restrictions. The helicopter type was endorsed on his licence.

2.2.2 The helicopter's last maintenance inspection was carried out on 18 December 2017 at 8235.3 hours. The certificate of release to service was issued on the same day (18 December 2017) with an expiry date of 17 December 2018 or at 82435.3 hours, whichever occurs first.

2.2.3 Collective bounce is a pilot-induced vertical oscillation of the collective control system when an absolute friction is less than seven pounds. It may be encountered in any flight by a rapid build-up of vertical bounce at approximately three cycles per second. The severity of the oscillation is such that effective control of the helicopter may become difficult to maintain. The pilot should apply and maintain adequate collective friction in all flights.

2.2.4 The investigation revealed that the pilot's loss of control was likely caused by the pilot's induced vertical oscillation due to incorrect tightening of the collective friction which was less than the required 7 pounds (hand tight), subsequently leading to the crash.

3. CONCLUSION

3.1. General

From the available evidence, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual

To serve the objective of this investigation, the following sections are included in the conclusions heading:

- **Findings** - are statements of all significant conditions, events or circumstances in this accident. The findings are significant steps in this accident sequence but they are not always causal or indicate deficiencies.
- **Causes** - are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **Contributing factors** - are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2. Findings

- 3.2.1 The pilot was issued a CPL on 23 May 2017 with an expiry date of 31 May 2018, and the helicopter type was endorsed on his licence. His last proficiency check was done on 31 August 2017.
- 3.2.2 The pilot was issued a medical certificate on 17 May 2017 with expiry date of 31 May 2018 with no restrictions.
- 3.2.3 The pilot had indicated that on 10 December 2017, 11 days before this accident, the helicopter oscillate, but he was able to recover by increasing power.
- 3.2.4 The helicopter was issued a certificate of airworthiness (C of A) on 7 November 2017 with an expiry date of 31 December 2018. It was also issued a certificate of registration (C of R) on 9 July 2012.
- 3.2.5 The marshal was struck by a piece of the main rotor blade, sustaining a serious injury. He was taken to hospital. The pilot was not injured in the accident.
- 3.2.6 The fire department was requested to flood the engine and to force it to shut down after the pilot was unable to shut it down.
- 3.2.7 The investigation revealed that the pilot's loss of control was likely caused by the pilot's induced vertical oscillation due to incorrect tightening of the collective friction which was less than the required 7 pounds (hand tight), subsequently leading to the crash.

3.3. Probable Cause/s

- 3.3.1 The pilot's loss of control was likely caused by the pilot's induced vertical oscillation due to incorrect tightening of the collective friction which was less than the required 7 pounds (hand tight), subsequently leading to the crash.

4. SAFETY RECOMMENDATIONS

4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report; the AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

- 4.1.1 None.

5. APPENDICES

- 5.1 Appendix A: Definition of Collective Bounce. Source: UH-1H Pilot Operating Handbook.
- 5.2 Appendix B: Recovery Techniques. Source: UH-1H Pilot Operating Handbook.

This Report is issued by:

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

3-31. Collective Bounce.

Collective bounce is a pilot Induced vertical oscillation of the collective control system when an absolute friction (either pilot applied or control rigged) is less than seven pounds It may be encountered in any flight condition by a rapid buildup of vertical bounce at approximately three cycles per second. The severity of the oscillation is such that effective control of the helicopter may become difficult to maintain. The pilot should apply and maintain adequate collective friction In all flight conditions.

6-27. Collective Bounce.

If collective bounce occurs:

1. Relax pressure on collective. (Do not 'stiff arm' the collective.)
2. Make a significant collective application either up or down.
3. Increase collective friction.