ACCIDENT

Aircraft Type and Registration:	Robinson R44 Clipper II, G-CLPR	
No & Type of Engines:	1 Lycoming IO-540-AE1A5 piston engine	
Year of Manufacture:	2009	
Date & Time (UTC):	28 May 2009 at 1120 hrs	
Location:	Goodwood Aerodrome, Chichester	
Type of Flight:	Training	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A Others - 1 (Serious)
Nature of Damage:	Extensive	
Commander's Licence:	Student Pilot	
Commander's Age:	62 years	
Commander's Flying Experience:	302 hours (of which 53 were on type) Last 90 days - 52 hours Last 28 days - 12 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

The student pilot was landing on a concrete apron in front of some hangars. As the helicopter descended from a low hover, it was seen to rock from left to right and then to rotate quickly to the left. It lifted slightly in a nose-low, right skid-low attitude and then rolled over onto its right side. As parts of the rotor blades broke up, a piece of debris was flung across the apron and seriously injured a workman approximately 200 ft away.

History of the flight

After a solo navigation exercise, the student pilot joined the circuit and transitioned to a low hover at 'the triangle', which was within the helicopter training area. The wind was reported as calm, the visibility was more than 10 km and the base of the cloud was reported at 1,800 ft. The pilot hover-taxied to the centre of the concrete apron, "stabilised the hover" and started to lower the helicopter towards the concrete. The helicopter felt "under total control". As the helicopter approached the ground, the pilot felt "some buffeting" and just before the skids touched the concrete the pilot remembered "a sudden swing to the left". He did not remember clearly the order of events but he recalled "lowering the collective at one point and also raising it, immediately realising that was wrong and putting it back down". The helicopter rolled onto its right side and came to rest but the pilot remained

in his seat until the energy from the engine and rotor had dissipated. He released his seat belt, turned off the battery master switch and fuel valve and vacated the helicopter from the left pilot's door.

Damage to the helicopter

The helicopter came to rest on its right side pointing approximately 100° right of its heading before the loss of control. The main rotor stopped in line with the fuselage. The forward rotor blade was broken at a point approximately one third of its length from the rotor mast and most of the blade outboard of this point had become detached or had disintegrated.

The tail rotor blades were intact. A number of fragments of the main rotor blades and tail section were found on the concrete apron and grass nearby. One piece of the rotor blade was found on the airfield approximately 300 m from the accident site.

Injury to a contractor

A workman was standing in the gap between two hangars approximately 200 ft from the helicopter. As the rotor disintegrated, a piece of debris weighing approximately 1.1 kg was flung across the apron towards where he stood. The debris cut through the Heras fencing separating the work area from the apron. It hit and seriously injured the workman's leg. It then penetrated the outer skin and insulation layer of the new hangar sheeting, rebounded and landed approximately four metres away next to the other hangar.

Witness information

A witness estimated that just prior to the accident the helicopter was hovering about two feet above the ground. As the helicopter descended, he saw a "left to right rocking movement". He remembered that the right skid made contact with the ground first, followed by the left. However, as the left skid touched, the right skid lifted off the ground again and "the aircraft bounced slightly from left to right". At this point "it appeared as though the pilot tried to lift the aircraft back up into a hover" but "the aircraft rocking from left to right got more extreme and suddenly the aircraft spun violently to the left while banking to the right and the main rotor blades impacted the ground".

Another witness, who held a Commercial Pilot's Licence (Helicopters), saw the helicopter "spinning quickly" to the left approximately one foot above the ground. "After one complete revolution, the helicopter raised from the ground in a nose-low, right-skid low attitude resulting in dynamic rollover onto the right side of the aircraft. The blades contacted the ground and shrapnel was fired as parts of the blades separated."

Static and dynamic rollover

If a helicopter were to be lifted by its skid on one side, an angle would be reached where a vertical line drawn through its centre of gravity would fall outside the skid on the other side and the helicopter would topple over. This is static rollover and it occurs typically at angles between 30° and 35°[1].

By contrast, dynamic rollover can occur at angles of less than 10° in certain circumstances. If during lift-off one skid were to remain in contact with the ground, it would become a pivot point about which the helicpoter could rotate. Should the helicopter begin to roll about the pivot point, the total rotor thrust would tilt in the direction of the roll and a proportion of that thrust would tend to increase the roll angle. As the roll angle increased, the rotor thrust would tilt further and increase the roll

Footnote

[1] Flight Safety Foundation; Helicopter Safety; Volume 14, Number 1.

rate and angular momentum. Should the pilot raise the collective lever, the overall rotor thrust would increase, the roll would increase still further and the situation would be made worse.

The use of opposite cyclic control inputs to reduce the roll rate might not be successful because the angular momentum could exceed the control authority available. The correct action, should a pilot notice a roll rate building about one skid, is to lower the collective control to reduce the rotor thrust that would otherwise accelerate the roll.

Action by the airfield operator

After the accident, the airfield operator introduced new rules restricting the use of the concrete apron near the hangars to licensed pilots and more experienced students. Less experienced students are required to land on the grass.

Analysis

The first thing the pilot noticed was some buffeting as the helicopter neared the ground which probably coincided with the witness seeing the helicopter rocking left to right. The next event the pilot remembered was the sudden swing to the left although witness information suggested the skids touched the concrete alternately before the swing began. It was possible that the buffeting the pilot felt was caused by the skids coming into contact with the ground but it was not possible to determine this with any certainty. There was also no direct evidence to show why the yaw to the left began but, in the absence of any other obvious cause, it was possible that the left yaw pedal was pushed forward inadvertently.

Witness evidence suggested the helicopter swung through about 360° either on, or nearly on, the concrete which was consistent with the pilot lowering the collective lever slightly. The helicopter then lifted into a nose-low, right skid-low attitude probably caused by the pilot raising the collective again. With the helicopter spinning left in this attitude, if the front part of the right skid touched the ground the helicopter was likely to topple onto its right side. The evidence suggested that this is what happened and, even though the pilot lowered the collective lever again, it was not in time to prevent the dynamic rollover.