

Helicopter Control: What is Dynamic Rollover?

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An increasing percentage of helicopter accidents are being attributed to a phenomenon known as dynamic rollover, which may occur during normal or sloped take-offs and landings. All types of helicopters are affected, regardless of rigid, semi-rigid or fully articulated rotor systems and regardless of skid or wheel equipped gear. Helicopters with a high centre of gravity and/or narrow skid tracks are more prone to dynamic rollover than machines with low centre of gravity and/or wide skids. Many experienced pilots have fallen victim to this mishap and a firmer understanding of this issue would prove beneficial to prevent future occurrences. This article will explore some of the causes of helicopter dynamic rollover and measures that may prevent such occurrences.

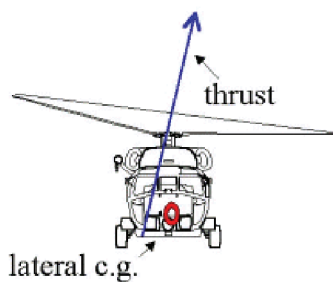


Figure 1

In a nutshell, dynamic rollover occurs when the helicopter pivots (rolls) around one of its skids or wheels whilst still in contact with the ground. For instance, imagine hovering a helicopter in a whiteout or brownout situation attempting to land. Owing to loss of visual cues the pilot starts a lateral drift and one of the skids makes contact with the ground. The centre of gravity of the helicopter now rotates about the skid causing an undesirable rolling motion. With the collective not in a fully down position, the main rotor thrust vector accelerates this motion and the helicopter rolls over.

When operating a helicopter with one skid or wheel on the ground, the pilot should ensure that the cyclic control is properly trimmed. Should the pilot not trim the helicopter to account for the translating tendency of the tail rotor during a slow take-

off, the critical recovery angle may be exceeded in less than two seconds and dynamic rollover may occur. Factors that may cause dynamic rollover includes the landing gear possibly stuck in soft sand or mud during normal take-off or one of the skids striking a fixed object on the ground whilst hovering sideways. Sloped landings or take-offs with some degree of bank angle is especially dangerous.

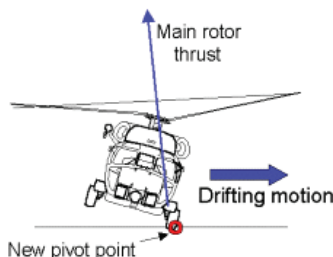


Figure 2

Should any of the above occur, the critical rollover angle (laterally) of the helicopter is thus reached and beyond this point the main rotor thrust vector and its moment continues with the roll. The pilot's control authority to arrest the angular velocity that develops laterally on the pivot (rolling) point is thus exceeded and the machine falls over. This rollover angle may be as little as seven degrees but may vary depending on a helicopter's roll rate, gross weight or main rotor thrust.

The rolling motion induced can not be corrected by applying full lateral cyclic input in the opposite direction.

The critical rollover angle is further reduced by some of the following conditions (for helicopters with counter-clockwise rotating blades):

- Left Yaw Inputs
- Main Rotor Thrust almost equal to helicopter weight
- Crosswinds from the left
- Right Side Skid Down Condition
- Right Lateral Centre of Gravity offset

Should the pilot not apply the proper corrective technique immediately, recovery becomes impossible. However, there is an additional angle that provides some measure of hope for recovery of a dynamic rollover

situation. This angle is known as the static rollover angle and occurs when the helicopter's lateral centre of gravity (c.o.g) is directly over one of its wheels or skids. Translated, if one could balance the helicopter on its side by lifting on skid until the c.o.g. is directly over the opposite skid; this would be known as the static rollover angle. See figure 2.

What to do when dynamic roll over is about to occur:

Without any measure of doubt, the pilot should attempt to cancel out the rolling motion the moment it occurs by smoothly lowering the collective at a rate of approximately two seconds (40 per cent) for full travel. This action allows the weight of the helicopter to counter the lateral rolling motion owing to the main rotor thrust being reduced and is more effective than using the cyclic. See figure 3.

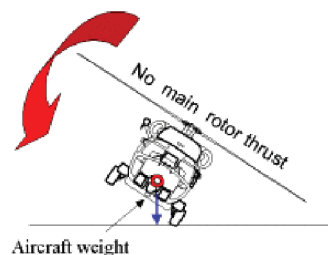


Figure 3

Care should be taken by the pilot not to 'dump' the collective too fast, as the main rotor blades may strike the fuselage of the helicopter.

Another factor to consider is if the helicopter was on a sloped surface and the rollover started towards the upslope side, dumping the collective too quickly may create a high roll rate in the opposite direction. When the uphill slope skid makes contact with the ground, the dynamics of the motion may cause the helicopter to bounce off the upslope skid and this inertia may cause the helicopter to roll about the downslope ground contact point and rollover on its side.

Care should be taken by a helicopter pilot not to suddenly pull the collective to become