ACCIDENTS WAITING TO HAPPEN

TYING THE HELICOPTER DOWN

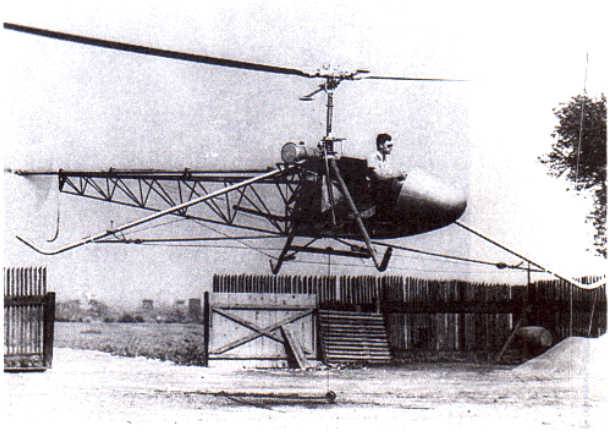
Helicopters are designed to fly, and they don't like to be tied down except for their own safety. For those times when helicopter and rope come together, operators should know how to handle the helicopter properly.

Learning to fly

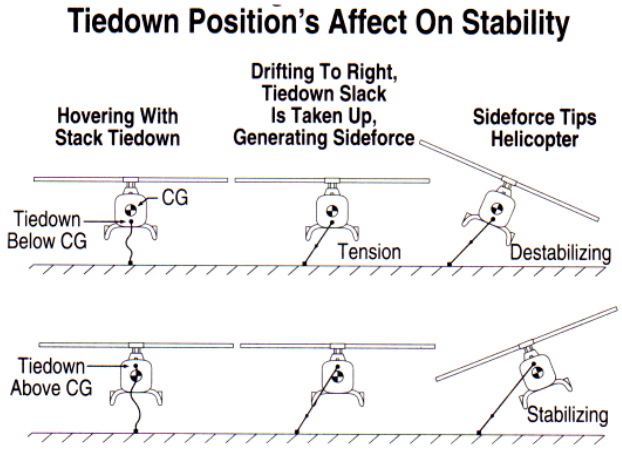
The early helicopter pioneers relied on a tiedown for various reasons. For one, they had to learn to fly by themselves. As a matter of prudence, they generally fastened the helicopter down with a short tether so that if it did go up it wouldn't be very high. One obvious tiedown point was the bottom of the fuselage just under the rotor.

The photograph below shows how Igor Sikorsky used this method on his prototype VS-300 with four cables going down from the framework to a large weight. This arrangement may have caused a turnover accident that was recorded on film.

Art Young in developing the Bell Model 30 did it slightly differently. His restraint cable went up to a trapeze arrangement that was fastened to outriggers near the fuel tank--that is above the aircraft's center of gravity and then went down to a pulley fastened in the ground and then to a solid anchor.



The next figure illustrates what happens if a helicopter which is tied down below the center of gravity drifts so that the tiedown cable is tightened up.



The bottom of the fuselage stops but the center of gravity keeps going. The resultant sideward component of the cable tension makes the helicopter roll away from the anchor in an unstable way resulting in a crash as the rotor tilts enough to strike the ground. On the other hand, if the attachment is above the center of gravity as on the Bell arrangement, drifting to the limit of the cable is stabilizing as the helicopter is rolled to bring it back over the anchor in the ground.

Snagging a sling load

The same geometry applies to the helicopter that finds itself attached to the ground because a sling load has snagged something immovable. Except for helicopters like the Sikorsky Skycrane that is designed especially for sling work, most helicopters have the attachment for external loads well below the center of gravity. Thus they can be inadvertently driven into the ground if the pilot tries to free he load by doing anything but pulling vertically.

Sikorsky Skycrane Cable-Attachment Point

The wind tunnel dilemma

Tying the helicopter down to the balance system of a wind tunnel is also to put it into a dangerous situation that must be treated with caution. When being subjected to different environmental conditions such as changes in speed or shaft angle of attack, a rotor produces moments about the center of gravity by flapping.

In flight the pilot either cancels the flapping out with his control system or uses the moments to maneuver by accelerating the fuselage in the direction he wants. While maneuvering, the fuselage keeps out of the way of the rotor blades (if it doesn't, we have a tail-boom or canopy strike).

If flapping occurs in a wind tunnel, however, the moments cannot accelerate the fuselage because it is solidly tied down. As a result, moments caused by flapping are not relieved unless the tunnel operator can uses cyclic pitch just as the pilot would.

The trouble is that whereas the pilot is well trained to use the good clues from the motion of the horizon, the tunnel operator usually has much weaker clues and less training for doing the right thing at the right time. Many model and full-scale rotors have been damaged or even destroyed during wind tunnel tests in conditions that would have been perfectly safe in flight.

When to tie it down

Even though connecting the helicopter to a solid foundation when the rotor is turning must be considered carefully, tying it down when the rotor is not turning is usually a very good idea. Because the helicopter generally has a minimum landing gear tread, it is a candidate for being blown over by a strong wind coming either from natural sources or from another helicopter air-taxiing by.

Non-rotating blades are especially susceptible since they are long, limber structures without the stiffening effects of centrifugal force. Given a good wind, they will try to fly--sometimes with damaging results as was demonstrated at the Army training base at Ft Hood, Texas when many helicopters were damaged by a sudden wind storm.

From *Rotor and Wing*, November 1989 and Chapter 12 of *Even More Helicopter Aerodynamics*