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Learning to Hover

I did most of the flying at that time and became very familiar with the helicopter's operation. During my years in aviation, I had never been in a machine that was as pleasant to fly as this light helicopter was, with a completely open cockpit. It was like a dream to feel the machine lift you gently up in the air, float smoothly over one spot for indefinite periods, move up and down under good control, and move not only forward or backward but in any direction. As for landings, it was possible to come down not only within a few feet but even within a few inches of a spot previously designated on the ground and this was easily done, even with rather strong winds.

Igor Sikorsky,
describing the VS 300 in 1940;
his book, *The Winged S*

HOVERING MAKES A HELICOPTER A HELICOPTER. THAT MIGHT SOUND corny, but it really is true. If a helicopter couldn't hover, it might as well be an airplane. Or to put it another way, if your job doesn't require an aircraft that can hover or an aircraft that can take off from and land in a very small space (which essentially requires hover capability), you don't need a helicopter.

Hovering is the "raison d'ètre" of helicopters. It's the main advantage helicopters have over airplanes. It's the single most important rotary-wing capability that keeps helicopter operators all over the world in business (FIG. 6-1).

Fig. 6-1. *Picking people off a fishing boat with a hoist is a job that can only be done by helicopter.*

It's also fun.

Cars in parking lots at helicopter flight schools abound with bumper stickers that say, "Hover Lover" and "To Fly is Human, To Hover is Divine." You can't help getting a kick out of hovering.

You sit there motionless, a few feet over the ground, and unattached to anything earthbound. Want to see what's behind you? Press on a pedal and you turn around. What's that over there? Nudge the cyclic and you slide over to it. Can't see what's on the other side of that fence? Lift the collective and you climb like an elevator. No king ever sat on a more wonderful throne. It's great.

It's also hard.

It's the hardest thing you'll have to learn. But once you master it, you'll have it. Like riding a bicycle.

In fact, a pilot friend of mine likes to use a bicycle analogy when describing helicopter flying. He says flying an airplane is like riding a bicycle and flying a helicopter is like riding a unicycle. It's not a bad analogy.

There are a lot of similarities between airplane flying and helicopter flying, just like riding a bicycle is similar to riding a unicycle. But, riding a unicycle requires something more, too—more skill, better balance, greater concentration, more practice. Flying helicopters, and particularly hovering, is like that.

If you've flown airplanes, hovering will be a new, slightly disconcerting sensation. If you've never flown before, it will simply be awesome.

THE BASIC HOVER

It's important to remember that a hovering helicopter is a flying aircraft, even though it is stationary over one spot. The helicopter might only be a few inches above the ground, but it is now a creature of the air and all aerodynamic rules and principles apply. I say this because a hovering helicopter might look stable and easily controlled; it might be stable, but it's not necessarily easily controlled. The pilot is working hard, sometimes very hard, to keep it where it is.

Before lifting into a hover, check that the cyclic and tail rotor pedals are in their neutral positions, in other words, that you haven't inadvertently pushed the right pedal forward slightly or moved the cyclic stick one way or the other. On the ground, moving these controls will generally not move the helicopter, but anytime the rotors are turning you must pay attention to any control inputs. By checking the position of these controls immediately before takeoff, you help ensure that the helicopter will lift straight up and not veer or turn to the right or left.

Clear all around, right, left and above. Remember, you're going up and you don't want to hit someone flying low over the top of you. You can never be sure the way is clear, so check overhead. Check the sides for people, vehicles, and other aircraft (FIG. 6-2).

When you're ready to go, lift the collective slowly upward while at the same time increasing engine power with the throttle, keeping rotor rpm within limits. As the

Fig. 6-2. *A Bell 206 pilot clears the area, checking for traffic, prior to a practice maneuver.*

pitch on the main rotor blades increases, the lift increases and the helicopter becomes *light on the skids* or wheels. The machine is now half-flying and half on the ground and you'll have to make careful adjustments with the cyclic and tail rotor pedals. In American-made helicopters, whenever you raise the collective, the fuselage will want to turn to the right, so you can expect to progressively increase the pressure on the left pedal as you lift into a hover.

This transitional phase when the helicopter is not quite flying and not quite on the ground requires extreme vigilance. Two nasty things can happen if the pilot is not careful: *ground resonance* and *dynamic rollover*.

Ground resonance occurs when the pilot's collective inputs get out of synchronization with the aircraft and the machine starts bouncing up and down. The springiness of the skids or landing gear only aggravate the situation. Ground resonance usually occurs when the pilot is trying to be too precise and too cautious and starts pumping the collective up and down. A good way to avoid pumping the collective is to increase the friction on the collective pitch lever by rotating the friction lock in the proper direction. This will make the collective seem heavier and harder to move.

Dynamic roll-over is mainly a problem when taking off from a sloping surface or with a crosswind. It is caused by too much lateral cyclic, which is an easy mistake when you're trying to hold the machine steady on a slope. The problem is you could cause the machine to enter a condition in which it begins to roll over while balanced

on one skid and go past the point where no amount of opposite lateral cyclic will counteract the roll.

The way to avoid both ground resonance and dynamic roll-over is to be sure the cyclic is in the neutral position when light on the skids and to pull the collective up in one smooth motion. It shouldn't be a fast, jerking movement, but rather a steady, constant-rate pull. Whatever you do, don't stop halfway between firmly on the ground and fully in the air.

As you pull the collective upward, one skid or main wheel will leave the ground first, not because the helicopter has been loaded improperly but because of the way it is constructed. To improve forward flight performance, the main rotor mast is tilted a few degrees forward. The tilt and the gyroscopic effect cause the helicopter to hover with a slight bank in a no-wind condition, a compromise that is acceptable. It should also be noted that a crosswind can exaggerate the bank, eliminate it, or even cause the helicopter to bank in the opposite direction.

The tendency of most helicopters to lift into a hover with one gear lower than the other is another reason you don't want to be too prim with your upward collective movement. If you dally too long with one wheel or skid touching the ground, sooner or later the helicopter is going to want to move. The wheel or skid will act as a pivot point and cause the machine to pirouette, but not very gracefully.

The hardest part of hovering will be pilot-induced turbulence (PIT), your own erratic and unnecessary control inputs. Try to calm down. That's easy to say, but hard to do. You will be clutching the controls and your instructor will tell you to relax your grip. That's easy to say and hard to do, too. Believe it or not, you'll eventually be able to hover using only finger pressure.

Although the cyclic will feel about as firm as a wet noodle and you'll be concentrating a lot on it, the biggest offender is often the collective. It is the one control that will always create the need for correcting inputs from the other controls, so calm it down first. Try to find a fixed power setting that will hold a comfortable hover and leave the collective at that setting; at most, make very small adjustments. Whatever you do, don't pump the collective up and down (FIG. 6-3).

Stabilizing the collective will eliminate a multitude of other sins. Now you can adjust the throttle and leave it set. After that you can pay less attention to the pedals because you won't be changing torque. Then you can concentrate on that wet noodle.

It's very important to find a comfortable seat height and position so that you can rest your right forearm on your right thigh. This will give you a stable platform from which you can control the cyclic. Cyclic movements should be done from the wrist, not the elbow. Actually, the movements needed are so precise, that they are more on the magnitude of pressures than movements. If you find yourself working the cyclic like an old-fashioned butter churn, your movements are much too big. All you're doing is creating PIT and working against yourself.

Your first attempts at hovering will be worse than your first attempts at straight-and-level flight. I think you will appreciate the wisdom of getting a feel for the

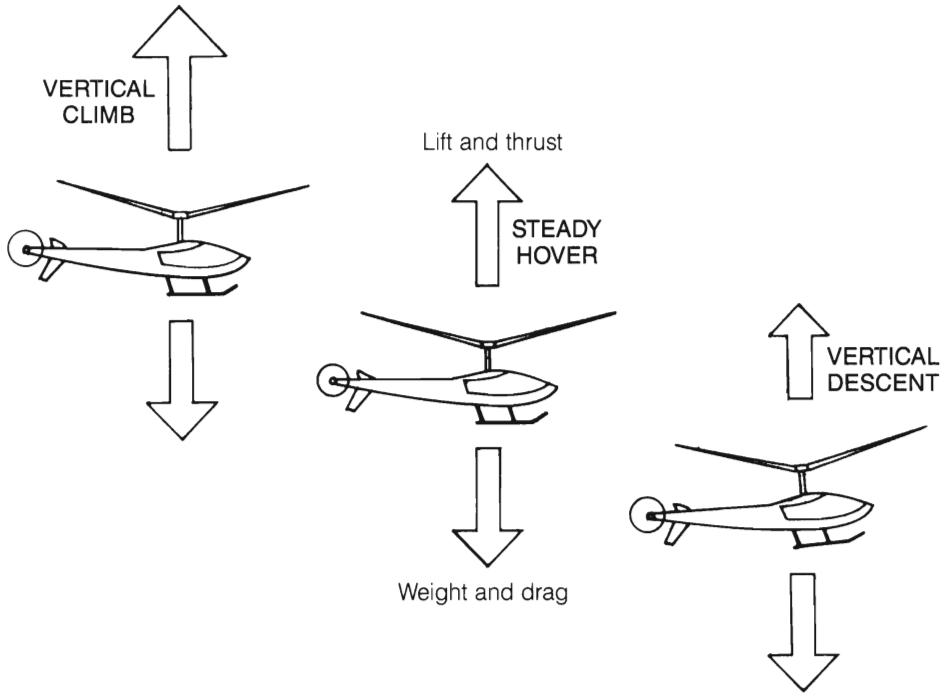

Fig. 6-3. *Forces acting upon a helicopter in a hover, no wind condition. Increasing the collective increases lift and causes the helicopter to ascend vertically. Decreasing the collective decreases lift and causes the helicopter to descend vertically. Holding the collective constantly, stabilizes the hover at a precise height. (Blade coning angle exaggerated in drawing.)*

machine in cruise flight before attempting to hover. Hovering takes practice, lots of practice, so don't be discouraged.

If you've flown airplanes before, an excerpt from an article by J. Mac McClellan in FLYING Magazine, might raise your spirits:

"I believe the experienced airplane pilot has a small edge (over the nonpilot) when transitioning to helicopters, though learning to fly helicopters is the most challenging and difficult aviation task I have ever faced."

A FEW TRICKS OF THE TRADE

Helicopter pilots use a few tricks of the trade to hold a steady hover over one spot. One is to use two or three hover references instead of concentrating on only one spot. Pick one hover reference about 20 to 30 feet in front of you, another at a 45-degree angle to the side at about the same distance, and a third between the two a few feet away. Move your eyes from one reference spot to another and occasionally bring the

horizon into your field of vision, too. If you look only at one point, it will be difficult to see small changes in attitude.

Try to think of the entire windshield as a big attitude indicator. Heading control will be easy because small deviations will be readily apparent on the horizon. Peripheral vision will give you depth perception and help you detect movement to the sides without having to turn your head.

One of the best tricks involves the "gun sight technique." First, pick an object relatively close to your position, for example a small tree or pole, and then line one point of that object onto another object in the distance. The trick is to hold the first object on top of, or in the same relation to, the second object. Using one "gun sight" works fairly well, but you can still end up moving forward or backward along the line of the sight; therefore, it helps to have another gun sight at an angle to the first one. Very small movements of the helicopter are very easy to detect using this method and by correcting the small deviations quickly, you avoid the big ones.

HOVERING TURNS

Hovering turns are relatively easy in no-wind conditions, once you've mastered the ability to hover over one spot. In theory, all you need to do is to add pressure to the pedal on the side you want to turn toward. Push the right pedal forward and you move to the right; push the left pedal forward and you move to the left.

Of course, as we have seen before, making an input on one control usually necessitates a correcting input on one or more of the other controls. Hovering turns are no different.

In a stable, no-wind hover everything is in equilibrium. The engine is providing just enough power to keep the main rotor turning at just the right rpm to hold the height over the ground and to keep the tail rotor spinning at just the right angle to counteract the torque of the main rotor. When you push one or the other of the tail rotor pedals forward, you upset this balance and must do something to compensate in order to hold the same hover height.

In a hover, the torque of the main rotor tries to turn the fuselage to the right and therefore pressure on the left pedal is required to keep the nose straight. Forward left pedal means the tail rotor blades are biting the air at a greater angle of attack and therefore producing more lift. If you add even more forward left pedal to initiate a left hovering turn, you increase the tail rotor blade pitch angle even more. This requires more power from the main gearbox and, if engine power remains constant, the only way the gearbox can satisfy this increased demand for power from the tail rotor is to allow main rotor rpm to decrease.

If you push left pedal while hovering and do not compensate with collective and throttle, the helicopter will not only begin to turn left, but will also begin to descend as rotor rpm decreases. You might not descend all the way to the ground if you are very gentle with the left pedal, but you will probably get close.