SHORT FIELD AND SOFT FIELD TAKEOFFS

Operating from runways that aren't routine

By Budd Davisson

Every student who has spent more than 20 hours flying an airplane has received some instruction in short- and soft-field landings. It's part of the private pilot tradition, as well as a required training subject. Of course, few instructors—and even fewer of their students—have ever actually landed on a runway either shorter than 1,500 feet, or with six inches of snow, mud, or water standing on it. The soft/short-field thing is a training exercise that's fun to do—and it will pay off if the skills are ever needed in a real-life situation.

The difference between practice and real in the short/soft-field game is that in the real world there is something at stake other than the disappointment of rolling past a specific runway light, or not turning off before passing a designated intersection. When it's actually a short or soft field, the ante is pretty high—you're putting your airplane and maybe your neck on the line. For that reason, we're going to develop some guidelines that can be used to get you in and out with a minimum of hassle and risk. These aren't going to make you into a bush pilot, but they'll work in the sort-of-short/soft-field situations that we're likely to see.

Don't try it if the outcome isn't obvious

So, you're sitting on the end of the runway. It's 98 degrees; there's no wind; the runway is 2,200 feet long, paved, and has pine trees at the end. The elevation is 2,800 feet above mean sea level, and you're loaded to maximum gross weight. You look in the pilot's operating handbook and it says you'll clear a 50-foot obstacle in 1,900 feet. According to the POH you have a 300-foot runway margin, so it looks like a go. Or does it?

First, you should know something about POHs. They don't really lie, but they aren't accurate, either. They aren't accurate because none of us is the equivalent of the experienced test pilot who generated those numbers, and we aren't flying a brand-new airplane like he or she was (see "POH Hype," September 2002 AOPA Flight Training). Yes, the airplane has performed as the POH says it can, but probably only once, while the tests were being conducted. We all know we can't expect those numbers. What we don't know, however, is exactly what we can expect.

One of the unknowns is how much of your airplane's performance has been stolen by the aging process. For another, you can be pretty certain you won't fly the airplane as well as the test pilot did. Plus, you don't actually know how tall the trees are—you only know that they are taller than you wish they were. In addition, the engine won't be putting out maximum power because you probably won't be able optimize it for the conditions even by leaning. You'll come close, but it won't be perfect. Questions, questions.

So, what do you do? This is a real judgment call. A guess, actually. The POH says you have 300 feet of runway length to spare, but that doesn't sound like much, does it? Do you try it?

The quick answer is that if you have to ask yourself whether or not you're cutting it too close, then you're cutting it too close. If there's any question, you simply don't do it. You wait until either the temperature goes down or the wind comes up, or both, so that the POH gives you a bigger margin. Even then, you should pick a go/no-go point where you can abort and still get stopped on the runway.

Takeoff goals

In doing either a short- or a soft-field takeoff, remember what you're trying to accomplish. Also, notice that the goals of the two types of takeoffs are wildly different, which is why the techniques are so different.

The goal of a short-field takeoff is to get up to best angle (not best rate) of climb speed as quickly as possible. Yes, we are

concerned about the amount of runway we use, but we are even more concerned about the distance to the trees at the end. It doesn't do any good to get off early if, in the process of doing so, we build up so much drag that we lounge around nose-high in ground effect and eat up valuable distance between us and the trees.

The only number that counts in a short-field takeoff is that magic best-angle-of-climb speed. Anything above or below that number means we're moving closer to the trees than we would at best angle. Trying to climb the second we get off the ground actually hurts us when trying to clear an obstacle. The technique is simple enough: We want to maximize the engine's effect on our acceleration by directing the thrust vector in the optimum direction while minimizing the drag generated by our contact with the runway and the aerodynamic drag of the airplane.

Runway drag is minimized by reducing our contact with the surface. That means getting the little wheel, whether it's in front or back, off the runway as soon as practical. At the same time, however, we don't want to introduce too much drag in the process of picking the wheel up. Starting with full aft elevator (nosewheel) or full forward stick (tailwheel) means the tail surfaces are fully deflected and producing maximum drag, which slows our acceleration. It's better to wait just a few seconds until there is more wind over the tail before we change its position. Then, as soon as the wheel is off the runway, we want to hold a low angle of attack. When taking off from a soft field we need maximum lift, but in short-field takeoffs, remember that we're going for maximum acceleration. We want to keep the drag lower, so we keep the angle a little flatter, which also points the thrust vector more nearly horizontal and helps acceleration. The angle is a compromise between an early liftoff and maximum acceleration.

The POH will tell you what amount of flaps to use, but lacking that information, use the number of notches that give you the closest to 15 degrees. That is the most efficient lift deflection for most airplanes. As you go past 15 degrees, many flaps start generating increasing amounts of drag.

As soon as the airplane is off the ground with a positive rate of climb, the nose should be lowered. We don't want to settle back on, but we do want the thrust vector from the engine as close to horizontal as we can get it and still stay in the air. We want that thrust dedicated entirely to building speed.

Incidentally, the technique we're discussing here is for "normal" airplanes, not those with serious performance. Short-field takeoff technique in an Aviat Husky, for instance, is to simply hold three-point and thunder along until the main gear lifts off first, then relax and enjoy the ride. Every airplane has a different recommended method.

Soft-field objectives

The soft-field takeoff is the flip side of the short field. When the runway is producing excess wheel drag because it is soft, muddy, or snow-covered, we want to lighten the load on the wheels as soon as possible. It doesn't make any difference how much runway it takes or doesn't take. We're willing to accept high drag in exchange for high lift.

Unlike a short-field takeoff, we want the little wheel out of the mud immediately - no matter what the cost - because its drag plowing through the mud could be enough to make the takeoff impossible. So, the yoke is hugged to the chest (stick is forward on a taildragger) as soon as the takeoff roll is started. You can feel the prop blast hammering at the tail as it forces the little wheel into the air.

We want the nose angle to be high, as close to the maximum angle as we can get it—but at the same time, we don't it want it so high that the airplane will never get off the ground. In most airplanes, however, the design of the gear makes it impossible to get the angle too high because the tail will touch the ground first. We want to be short of that angle. As a nosewheel airplane speeds up, the nose is going to try to keep coming up because the tail is getting more and more efficient. We don't want the nose too high, so we pick an attitude and, as the nose tries to climb, we ease off the back pressure to nail the angle.

Holding the angle is no big deal when practicing on a paved runway, but in a real-world soft-field situation it can be a challenge. Actual soft runways are never consistent in their texture. They have puddles and soft spots mixed in with harder areas. The result is that the drag on the tires is not constant, and every time the gear hits a soft spot, the nose will try to go down, and every time you hit a hard spot the reverse happens. You can't let the nose bob up and down. If it touches the ground again, even for an instant, it'll eat up a lot of runway. You can't let it bob up, or it may suck the airplane off the ground momentarily and drop it back in a mighty splash. The airplane will plow along, slowly gaining speed until it finally waddles into the air. It's flying, but barely, and this is where we find out how sensitive you really are as an aviator. The airplane is clinging to flight by its fingernails, and it is your job to ever so slowly ease the nose down, allowing it to accelerate while at the same time keeping it from touching the runway again.

Even though the airplane is super slow, it'll fly in ground effect just fine, but all bets are off if it's allowed to climb out of ground effect too early. The trick is to picture ground effect as meringue on an asphalt pie (the runway); we want to skip along right on the top edge of it.

The critical period is the first few seconds after liftoff. If you ease off the back-pressure too quickly, it'll sag back into the quicksand. If you wait too long, it'll climb out of ground effect and sag back into the quicksand. Look around the nose at the edges of the runway and, as you ease off (we repeat, ease off) the back-pressure slightly, try to judge whether the airplane is losing altitude or not. Usually the feeling in your butt will tell you you're going downhill before your eyes do. Your control inputs at this point are minuscule. You aren't moving anything, and you aren't asking the airplane to do anything. You make subtle suggestions to it, but that's about it.

In a matter of seconds, as you ease off the back-pressure, you can take a breath because the airspeed will start building and you're comfortably in the air. At the same time, you'll let it climb high enough to bring the flaps in. Bring them in really slowly and stop if the airplane starts downhill and doesn't immediately recover.

Before taking off from a field that is really mushy, it is a good idea to find out if the owner is going to resent having a pair of deep ruts to deal with after you have left and the ground has hardened to the consistency of cement again. If so, plan your flight for a better day.

Any runway longer than 1,800 feet generally will accommodate most small airplanes without using special techniques, as long as the density altitude isn't too high and the obstacles aren't very tall. Still, using short-field techniques can't hurt. Even though 1,500 feet isn't really short, it is short to the pilot accustomed to landing on a mile of concrete. "Short" is a personal definition. If the runway looks and feels short to you, or if it may be soft, treat it accordingly—whether you're taking off or landing on it.

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