Takeoffs & Landings Refresher

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About Wally Moran

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What is the one area that causes many general aviation accidents? Yes, you guessed it: takeoffs and landings. Imagine if we could eliminate all takeoff and landing accidents. That would reduce our accident rate by almost 50%. While we can't eliminate all of them, this seems to me to be an area we should invest some time in.

Is it just the student pilots who are having the takeoff and landing accidents? No not at all, they only account for approximately 10%, the other 90% are caused by private, commercial and ATP pilots. This interesting fact tells me that no matter what your certificate level, you need to pay attention to your takeoffs and landings. With that in mind, let's review the things that contribute to good and safe takeoff and landings.

Most all aircraft have an FAA approved pilot's operating handbook. Depending upon the make model and year, takeoff and landing procedures are described in various detail. This discussion is intended to be general in nature and if it conflicts in any way with the aircraft manufacture's AFM/POH, the airplane manufacturer's recommendations take precedence.

Normal Takeoff

Step 1: Confirm the winds
An important factor in both takeoffs and landings is developing a good wind sense. Getting the ATIS or AWOS prior to taxi is a good thing but one also needs to use other sources during taxi and early takeoff so you know exactly what that wind is up to. Thinking about the ATIS, it could be as much as one hour old. A lot can happen with the wind in one hour. While the AWOS is updated more frequently, I have experienced many AWOS reports that did not reflect the wind I actually encountered.

The wind you are interested in is the wind affecting you during the moments you are actually on or over the runway. The best indicator of that is a wind sock located near the runway. Fortunately many airports have wind socks located near the takeoff end of each runway.

I am aware of a near disaster when a heavily loaded Boeing 747 crew failed to notice a change in the wind after they recorded the ATIS. The wind had changed such that they had a four knot tailwind rather than the 4 knot head

wind they planned on. They barely cleared the fence at the end of the runway. They had absolutely no margin for engine failure or any other problem on that takeoff. They could have picked up that wind change if they had just observed the wind sock at the takeoff end of their departure runway.

Another way to maintain a wind awareness at towered airports is to pay attention to the takeoff and landing clearances, they often include the current wind. You should be listening for that information and that will give you a sense of what the wind is doing as well.

Bear in mind that advertised winds are dependent upon where the anemometer is located and may or may not have much to do with the wind you experience on the runway. So paying attention to those wind socks near the runway end will give you the information you need.

Knowing what the wind is going to do to you prior to takeoff or landing is sort of like riding a horse, it's easier if you start on top.

Step 2: Takeoff roll

Assuming we have completed all of our pre takeoff checks, reviewed emergency procedures, cleared the final approach and are lining up on the runway, we still must confirm that we are in fact on the correct runway as assigned or intended. Check the numbers on the runway or use your compass if there are no runway numbers. Many airline pilots have taken off on taxiways and wrong runways so it can surely happen to us as well.

Establish the aircraft on the center line prior to adding power. I often see pilots who add a lot of power as they take the runway only to have to ride the brakes while lining up. Watch for this and if you are doing this, you are simply heating up your brakes which wears them out and reduces their effectiveness in the event of an aborted takeoff.

Even if the wind is calm, there are still some factors in play that can mess up an otherwise good takeoff. They are those evil left turning tendencies. Let's look at each and see how they affect us during takeoff.

As we began to advance the power, the first of the left turning forces appear. That is torque. So we need to advance the power smoothly and steadily until we have full throttle adjusting the rudder as necessary to handle that ever increasing torque. As the propeller increases speed, it moves more air and that air rotating around the airplane creates the corkscrew or spiral effect, this adds an additional requirement for right

rudder. For now these are the only two left turning forces affecting us. How do we handle them? Put that center line right between your legs and use the rudder as necessary to keep it there. Smoothly advancing the throttle will make your rudder adjustments easier. Take care during this phase of the takeoff that you keep your feet low on the rudder pedals so you don't accidentally apply braking as you move the rudder.

In a nose wheel airplane, the elevator can be held in approximately a neutral position at the beginning of the takeoff roll. This is generally where the slip stream will put it. Now as we accelerate, you will notice the elevator becoming effective. It is at this time that you should apply a slight back pressure and as further speed is gained, the nose will began to lift. Oh-Oh, here come two more turning forces to mess up our directional control. As the nose wheel comes off the ground, you will lose any steering help you were getting from the nose wheel so you will need to add a little more right rudder to compensate for that loss. In addition P factor kicks in causing a further requirement for right rudder. Now there is also some good news here as the gyroscopic effect will actually induce a slight right turning force. But, the loss of nose steering and p factor are greater forces so that means that in most airplanes, as the nose comes up, you will need to add right rudder in a no wind situation.

Here is where many pilots make a common mistake, as the airplane begins to drift to the left, instead of adding enough right rudder, they instinctively add right aileron trying to steer like they would in their car. About this time the aircraft becomes airborne and so the right wing drops due to the right aileron input. Watch a number of airplanes take off and see how many of them drop the right wing just at lift off. This is because they failed to properly correct for the left turning forces.

Step 3: Lift off

We have just raised the nose and added the proper amount of right rudder to keep that center line right between our legs. Now hold the nose in a slight nose high attitude and the aircraft will lift off when sufficient airspeed is attained. That's all there is to it. Done properly, the aircraft simply flies itself off when it attains the proper speed. At this point, you need to relax a bit of the back pressure you have on the elevator to allow the airplane to accelerate to the desired climb speed.

Step 4: Climb out

It is my practice to initially climb at Vx (best angle of climb) until I have cleared any obstacles in my path and then accelerate to Vy (best rate of

climb) and maintain that until I am at a minimum of 1000 feet AGL and headed in the direction I want to go then I accelerate to a cruise climb airspeed. Maintaining Vy until at least 1000 AGL gets you quickly to an altitude where you have some options in case of an emergency and it reduces the noise around the airport.

Crosswind Takeoff

Step 1: Use the rudder

Crosswinds by their nature cause problems because they rarely blow steady in either direction or strength. Therefore we need to continually adjust the controls to compensate for more or less crosswind during the takeoff. During the takeoff roll, the aircraft will tend to weathervane into the wind so each time the wind changes velocity or direction; we need to make an adjustment of the rudder. Further, as our speed increases the rudder becomes more and more effective therefore the input required decreases. So how on earth does a pilot handle all those variables? Simply do whatever you need to do with those rudder pedals to keep the airplane on the center line of the runway. But, that also means you can no longer use those rudder pedals for a foot rest. You have got to keep your feet in the game.

Step 2: Use the ailerons

A crosswind will also tend to lift the upwind wing before the downwind wing and can actually blow the aircraft sideways. We must prevent this from happening by using aileron control. At the start of the takeoff roll, the aileron control either yoke or stick, should be held fully into the wind. That is if the crosswind is from the left, the aileron control should be held fully over to the left. In this example, keep that aileron held fully left until you began to feel the right wheel start to get light, then slowly decrease aileron. If the ailerons are used properly, the right wheel will come off the ground before the left wheel. In a strong crosswind, you will lift off with considerable left aileron control still in.

In this example, as you lift off, you will be in a slight slip with the left wing low. Just after liftoff, you should make a shallow turn to the left to establish a crab angle that will keep the airplane track on the centerline of the runway.

A common mistake that I see with the ailerons is that the pilot starts the takeoff roll with full aileron control in but then they take out the aileron too

quickly. Often I see a lifting off with aileron control neutral which results in the upwind wing lifting before the downwind wing. Then the airplane starts to drift downwind even before lifting off. This is not good for the airplane tires or the pilot's nerves. You need to keep enough aileron control in to the wind to prevent that upwind wing from lifting first.

Step 3: Rotation

Some people advocate delaying rotation and lifting off at a higher speed to improve control effectiveness. I believe under most crosswind conditions, a normal rotation and lift off are adequate. If extreme measures are needed to get off the ground, perhaps you need to rethink your decision to takeoff.

Step 4: Practice

How can you practice a crosswind takeoff if there is no crosswind? It is easy, just pretend there is one. You can practice lifting off on either the left or right wheel first by using the crosswind technique. You just won't need to crab after liftoff. This will get you comfortable with picking up one wheel before the other prior to liftoff. I suggest you try this with your instructor until you are proficient.

Many pilots I fly with taxi, take off and land to the left of the center line. Maybe they are practicing to drive the rent a car on their next European vacation, I am not sure. But, you can develop center line discipline by making yourself always taxi on the yellow taxiway center line. You can also practice landing just on the right side of the centerline. When you learn to do that, then you can also land on the centerline.

So, if you are good at patting your head while you rub your stomach, you should have no troubles with crosswind takeoffs.

Normal Landing

Step 1: Consider the wind

As with the takeoff we need to develop a wind awareness for landing. Sure, we need to get the ATIS or AWOS as a start, but don't stop there. Remember, the ATIS can be almost an hour old.

Of course if you are at a towered airport, you can always ask for a wind check. You can also use smoke from smokestacks or waves on the water if you are planning to land in a lake or at a factory.

But, the best way to get a handle on what the wind is doing at your runway is to find a windsock. At most airports you can see a windsock while on final. That is your best indication of what the wind is going to do to you during the landing. You can also observe you apparent groundspeed and drift as you travel around the pattern. Another factor that will affect your landings is obstacles like a row of trees or hangars upwind of the runway which can create turbulence as the wind blows over them. Watch for an upslope of the terrain as you approach the runway end. When the wind is strong you will usually encounter a downdraft there. Knowing what the wind is doing prior to landing allows you to plan for those problems rather than reacting to them after they mess up your approach.

Step 2: Be stabilized

It has been said that you can make a bad landing from any approach but you can only make a good landing from a good approach. Based upon my experience, that is a true statement. So if you don't have your approach stabilized as you approach the airport, you might as well go around early, or you can take a shot at disproving that saying. Stabilized means being on the manufacturer's recommended speed and configuration, trimmed properly and on the glide path. Line up with the runway early on final. Get that job done sooner as you are going to be very busy later.

Step 3: Where to aim the approach

Just exactly where should we be aiming the aircraft? The Airplane Flying Handbook tells us that "The descent angle should be controlled throughout

the approach so that the airplane will land in the center of the first third of the runway." I prefer to be a little more specific than that. I like to pick a specific point on the runway where I wish to touchdown. For example, perhaps the third centerline stripe or on the 500 foot bar or abeam the third set of runway lights. Any specific point you like that is within that first third of the runway is fine. Practicing to land on a specific point will make you a more precise pilot and will come in handy when we get to short field landings.

To achieve a touchdown on a specific point, we must then aim the aircraft at a spot prior to that point. How much prior depends upon aircraft type and approach speed. If one aims at the planned touchdown spot, you will always overshoot as you need distance to flare and dissipate the energy. Maintaining a stable approach during final is the key to knowing where you will touch down.

Step 4: Getting from approach to touchdown.

In most aircraft it is normal to reduce the power to idle at the point where you know you can glide to the touchdown spot. As you reduce the power the nose may need to be lowered a bit to maintain the proper airspeed. At approximately 10 to 20 feet above the runway, the flare or round out should began, first enough back pressure to reduce the sink rate and then as the aircraft settles further, the pilot needs to add further back pressure on the yoke so as to level the aircraft off just above the runway. As the aircraft continues to slow, greater back pressure is needed to hold the aircraft in the air and now only inches above the runway. Eventually when all the energy is dissipated, the aircraft will settle smoothly to the runway and with the airspeed just above stall speed.

While I have described the round out or flare in steps, ideally it should be a smooth and continuous process from the start to touchdown. The goal being to touch down on the main wheels only, at just above stall speed. As most experienced pilots will tell you there is really nothing to making this all come out correct!! For me it happens about once in a hundred landings.

Step 5: After touchdown

After touchdown hold elevator back pressure to keep the nose wheel off the runway as the speed is reduced, you can either gently lower the nose wheel or just hold the back pressure and it will come down on its own.
While this technique is appropriate for most single engine general aviation airplanes, some airplanes may require leaving a little power on until into the flare and may touchdown at a faster speed.

Step 6: Correcting mistakes

This all sounds so easy, what could possibly go wrong and why do people get into trouble? A typical accident scenario goes like this, first the pilot is high on the approach so he pushes the nose down which makes the site picture look better but only increases the airspeed. Then he tries to force the airplane on the runway but since it has way to much energy, it bounces back in the air, wherein the pilot pushes forward again trying to land with too much energy and usually by the second or third bounce the nose gear collapses. Never try to force the airplane on the ground, it won't land until it is ready. That is why a stable airspeed on final is critical.

Another scenario also starts from a high fast approach. This time the pilot floats and floats eventually touching down well past the half way mark and they run off the far end of the runway. Yet another bad situation is a high fast approach and this time the pilot decides to go around but way too far down the runway and they wind up hitting some obstruction off the end of the runway during the go around. This can be a deadly mistake.

What is the cure for all these problems? It is easy, go around early and often. In all the scenarios mentioned, the approach started out high. So when you recognize that you are high, go around and set it up again. If you miss that opportunity, then at least when you realize that you are not likely to land in the first third of the runway, go around. Don't delay that decision on the hope that you might make it. A large percentage of our landing accidents can be prevented simply by doing an early go around.

Crosswind Landings

Step 1: Pick your speed and flap setting.

With a strong crosswind usually also comes gusts and turbulence just to add to our fun. This makes it difficult to make a stabilized approach. In an effort to maintain control some pilots add lots of speed which then gives them lots of trouble during the flare. Excessive speed causes a longer float and more time to fight the airplane while over the runway. A better practice is to predetermine your approach speed, typically many POH's recommend ½ of the gust value. So if you have a wind of 15K gusting to 25K you would add 5 knots to your approach speed. Then fly and trim for that speed on final. Check your POH for the correct speed for your plane and use it. Too much speed has been the cause of more crosswind landing accidents than too little speed.

What about the use of flaps? Here is what the Airplane Flying Handbook (FAA 8083-3A) says: "Flaps can and should be used during most approaches since they have a stabilizing effect on the airplane. The degree to which flaps should be extended will vary with the airplanes handling characteristics as well as the wind velocity." Then in another place they say: "To maintain good control, the approach in turbulent air with gusty crosswind may require the use of partial flaps". So, it just depends on which page you read.

For what it's worth, most airliners use full flaps for all landings. Different planes have different landing characteristics and I suggest you use the maximum amount of flaps that work for your airplane and of course follow the POH.

Step 2: Crab or slip?

Now let's consider the controversy about the crab method vs. the wing low method. In my view, there is no reason to consider the crab method for touchdown in most general aviation airplanes. That is unless you own a 737. Yes, big airplanes like a 737 with wing mounted engines need to use a modified crab landing technique to avoid dragging an engine pod but most of

us don’t have that problem. Trying to kick out a crab at the very instant of touchdown is a very tricky thing. if it don’t not work, there you are landing sideways or drifting fast for the edge of the runway.

I suggest using a crab on final for passenger comfort but then as you enter the flare, drop that wing into the wind and straighten the longitudinal axis parallel to runway center line with the rudder. You now control the drift left and right with the aileron control (stick or yoke) and the heading with the rudder. You should touch down on the upwind wheel first and hold that aileron control into the wind as you roll out. As you slow down you need to keep adding aileron until it is full in.

It’s not uncommon for the wind to change direction and/or velocity during the time you are in the flare thereby causing you to adjust your inputs to maintain centerline and alignment. If you find that you are unable to control the drift, this means that the wind is too strong for your aircraft or you skill level. When this happens it is time to go around.

Step 3: Don’t do this

Here is the place I see a common crosswind landing mistake. As the pilot touches down, they release the aileron input back to neutral rather than continuing to increase it. Then the upwind wing comes up and the airplane weather vanes into the wind. Now off we go for the runway edge lights. Some people approach a crosswind landing trying pre-plan which controls go where, that is not necessary. Simply control the drift with ailerons and do whatever you need to do with the rudder to keep the nose parallel to the center line.

Step 4: Practice

Pilots who only fly when the wind is down the runway or calm will not be proficient at crosswind landings. Remember this is like rubbing your tummy and patting your head, you can’t do it if you don’t practice.

You can first practice on a calm day by landing on the right side of the centerline, next landing on the centerline then slightly left of the centerline. The important thing here is that you say in advance “here is where I am going to land” and you do it. If you don’t, try again. You will get better.

Then challenge yourself, get your instructor and go out on a breezy crosswind day and practice takeoffs and landings. A good exercise when there is a very strong crosswind is to just fly down the center line without touching down. I do this by making a normal approach and then as the pilot

begins to flare, I add enough power to keep us in the air and I have the pilot fly down the center line using proper rudder and aileron control. As we near the end of the runway, we add power and go around. After they learn how to hold the center line then I ask them to move us left or right over the runway. This exercise allows the pilot to practice the crosswind technique without having to worry about the flare and touchdown.

Now that we are greasing those crosswind landings, let's take a look at the Short Field Takeoff Over an Obstacle. Our goal here is not only to get off the ground quickly, but also to be in a position to climb over any obstacle after takeoff.

Short Field Takeoff Over an Obstacle

Step 1: Check your numbers

An interesting factor about most general aviation aircraft is that they can land in a much shorter distance than they can take off. This is especially true as the density altitude goes up. So just because you have landed at an airport does not necessarily mean that you can take off there.

This is a good place to talk a little about the numbers in your AFM/POH. Remember they are there because some test pilot with a new airplane demonstrated they could be achieved. Are we as good as the factory test pilots? Do we have a brand new airplane and are we operating in test conditions? Most likely we are not. Further those POH charts always consider only the FAA approved 50 foot tall tree as the obstacle. If you are faced with rising terrain or taller obstructions, you have no data to go by. Therefore, it is prudent to add a significant margin to the published takeoff and landing distances. Many smart pilots double those numbers.

There are lots of ways to improve your takeoff and landing performance such as departing earlier in the day when it is cooler, offloading passengers, baggage and fuel and waiting for a more favorable wind. Remember also that those published numbers are based upon a hard surface smooth runway. Gravel, grass or other surfaces can make a big difference. So can runway slope so don't forget to consider all factors before making a go decision. Remember, if you are concerned about the performance capability of your aircraft in a given situation that concern should be considered an alarm that is telling you to rethink what you are about to do.

Step 2: Be current

Not only does our aircraft need to have the capability to complete the takeoff, we also must have the proficiency to get that performance out of the airplane. If you don't practice short field takeoff and landings on a regular basis, I doubt you can do it exactly right on the first try. This too will add distance to your takeoff. So if you have not practiced a short field takeoff recently you better consider adding additional margins.

Step 3: Know your POH procedure

Having decided that our margins are safe for this short field takeoff, let's look at how it should be done. Most of our POH or AFM's give us a procedure, we need to know it and use it. First select the recommended flap setting from your POH/AFM. Then use all the runway available. Now holding the brakes, add full power. Do you know what your static RPM and or manifold pressure should be at this point? This is an important number as it is a way to confirm that your engine is putting out adequate power. If it is not, this is a good place to find out, Better here than approaching that line of trees at the far end of the runway. Static RPM will vary with density altitude so you need to experiment with your engine a bit to know what should be expected.

Step 4: Rotate properly

Now with the engine delivering good power, release the brakes and began to accelerate. Here again, if you feel you are not accelerating sufficiently, abort the takeoff and do something to improve your margins. Assuming all is going properly; rotate at the manufacturers recommended speed. Rotating early will cause extra drag and lengthen the takeoff distance. Here rotation technique is important and may take some practice. You should rotate at a rate that will cause the aircraft to lift off below Vx and then as the aircraft accelerates, you need to continue rotation so as to stop acceleration at Vx and continue your climb at Vx. Having done all this properly, you can then safely climb away at Vx until you have cleared your obstacles and then accelerate to Vy.

A common mistake I often see is the pilot who rotates to slowly and the speed exceeds Vx after liftoff. Now they find the speed above Vx and they then over rotate in an attempt to get the speed back, but they go too far and now the speed drops well below Vx. Not only does this decrease performance but it also puts the airplane in a dangerous low speed situation. Proper rotation technique takes practice and recent experience to get it right.

Short Field Landing Over an Obstacle

Step 1: Manage your energy

Proper energy management is the key here. Too much energy and you will float down the runway and have trouble stopping, but you also have to be careful not to get dangerously slow and stall during the approach. Most of our POH's have a recommended speed for a short field landing. You need to know this speed and use it. What about if it is windy or turbulent? Naturally, you need to fly at a speed fast enough to maintain aircraft control, if this speed is excessive and will result in a long landing, you simply can't make a landing at this short field today.

Step 2: Stabilize the approach

An important issue with a short field landing is to have that approach stabilized on speed and on the proper glide path. If either of these parameters is off, go around early and set it up again. If you cannot get the airplane set up properly, then divert to a field with a longer runway. There have been several accidents wherein a pilot made a number of attempts to land and finally forced a landing only to run off the end of the runway. If you are having trouble at a short field, just go away and land somewhere else.

Recognizing that you must have a stabilized approach, you need to give yourself enough room to set it up. I make a longer final when setting up for a short field. This gives me time to stabilize airspeed and descent. As soon as I roll out on final, I stabilize at the recommended speed with full flaps. I plan a power on approach that is aiming to just clear the obstacle.

Step 3: Control your glide path with power

You must have a power on approach so that you can control the glide path with throttle. If you get high enough that you must close the throttle, you now have lost any ability to shorten your approach and therefore cannot control where you will touchdown. This would be a good time to go around and set it up again.

If you cross your obstacle with some power in and on speed, you have control of your approach. After crossing the obstacle, you can slowly reduce the power remembering that you need to lower the nose to maintain the recommended speed. When you are sure you can glide to your planned touchdown point, you can close the throttle all the way. It takes close coordination between power and pitch attitude to avoid a high sink rate or to slow an airspeed on final. If you do all this correctly, you should touch down on your planned spot and just above stall speed. If it is not going to work out that way, go around.

Some manufacturers recommend raising the flaps after touchdown to increasing braking effectiveness. This will make a marginal improvement in braking but if that is the difference in going off the end of the runway or not, I think you should have chosen another destination.

Soft Field Takeoff

Step 1: Evaluate your field

You may choose to use this technique in many situations. Not all grass fields are soft but anything other than a clean hard surface will increase your takeoff distance. While some manufacturers' provide a performance decrement for takeoff from a grass runway, there is no way to determine how much additional distance you will need. Since all soft fields are not the same, you need to ask these questions: How tall is the grass? How soft is the runway surface? Are there water puddles? These are all factors that can significantly increase your distance required. If there is any question about adequate distance, don't try it.

Step 2: Start the takeoff with full back elevator control

Assuming we have a reasonably long runway with no obstacles, our goal on this takeoff is to transfer as much weight from the wheels to the wings as soon as possible during the takeoff roll. First select the manufacturers' recommended flap setting. Then as you enter the runway, hold the elevator control full back and keep the aircraft rolling. Smoothly apply full power and check RPS/manifold pressure to ensure you are getting full power. As elevator control becomes effective, raise the nose to get the nose wheel out of the soft ground as soon as possible. This also creates a positive angle of attack on the wings so they will start to deliver lift that will lighten the main wheels. Keep the nose attitude very high and lift the plane off at as slow a speed as possible.

Step 3: Accelerate in ground effect

Once the aircraft lifts out of the soft material and becomes airborne, lower the nose so as to accelerate in ground effect to a safe climb speed. Do not allow the airplane to climb until a safe speed is attained either Vx or Vy. This requires some delicate handling and takes practice. Here again any poor technique will only increase the distance required.

Since this type of takeoff results in a longer roll with the nose very high, P factor will have a greater affect than it does on a normal takeoff. More right rudder will be required to maintain the center line. Don’t let the aircraft drift toward the left side of the runway during the roll.

Soft Field Landing

Step 1: Evaluate your field

The good news about soft field landings is that the landing roll is usually very short. The bad news is that the aircraft can be damaged if the field is too soft. True soft field landings should be avoided except in emergency situations. Most grass runways are not necessarily considered soft fields. In fact many of them are very well kept and there is no reason to need this technique. A soft field landing should be considered for an off field landing or when landing on a grass runway that is wet or muddy or covered with snow.

It is always good practice to inspect a possible soft field landing area if you can. This can be done by making a low approach and flying the length of the runway. If there is question about the field and you are not in an emergency situation, don't land there.

Step 2: Land as slow as possible

Since our first goal is to land as slow as possible, most manufacturers' recommend use of full flaps. Establish the recommended approach speed for your airplane and make a normal approach. During the flare, hold the airplane off as long as possible only allowing it to touch down at just above a stall. If possible add just a touch of power as the wheels touch. Doing so will improve elevator effectiveness and help to keep the nose wheel from digging into the soft surface. After touchdown, keep the yoke full back to keep the nose wheel as light as possible and reduce power as the airplane slows down.

Step 3: Be gentle when adding power in the flare

A common mistake I often see when testing on soft field landings is that the pilot tries to add power early in the flare which causes a balloon, then the pilot lowers the nose a bit and the airplane lands three point. Just the opposite of what we want. So don't even think of adding any power until the airplane is just about to touch down and that stall horn is talking to you.

Then add just a touch. Much better to land without power but on the mains rather than to touch down three point.

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