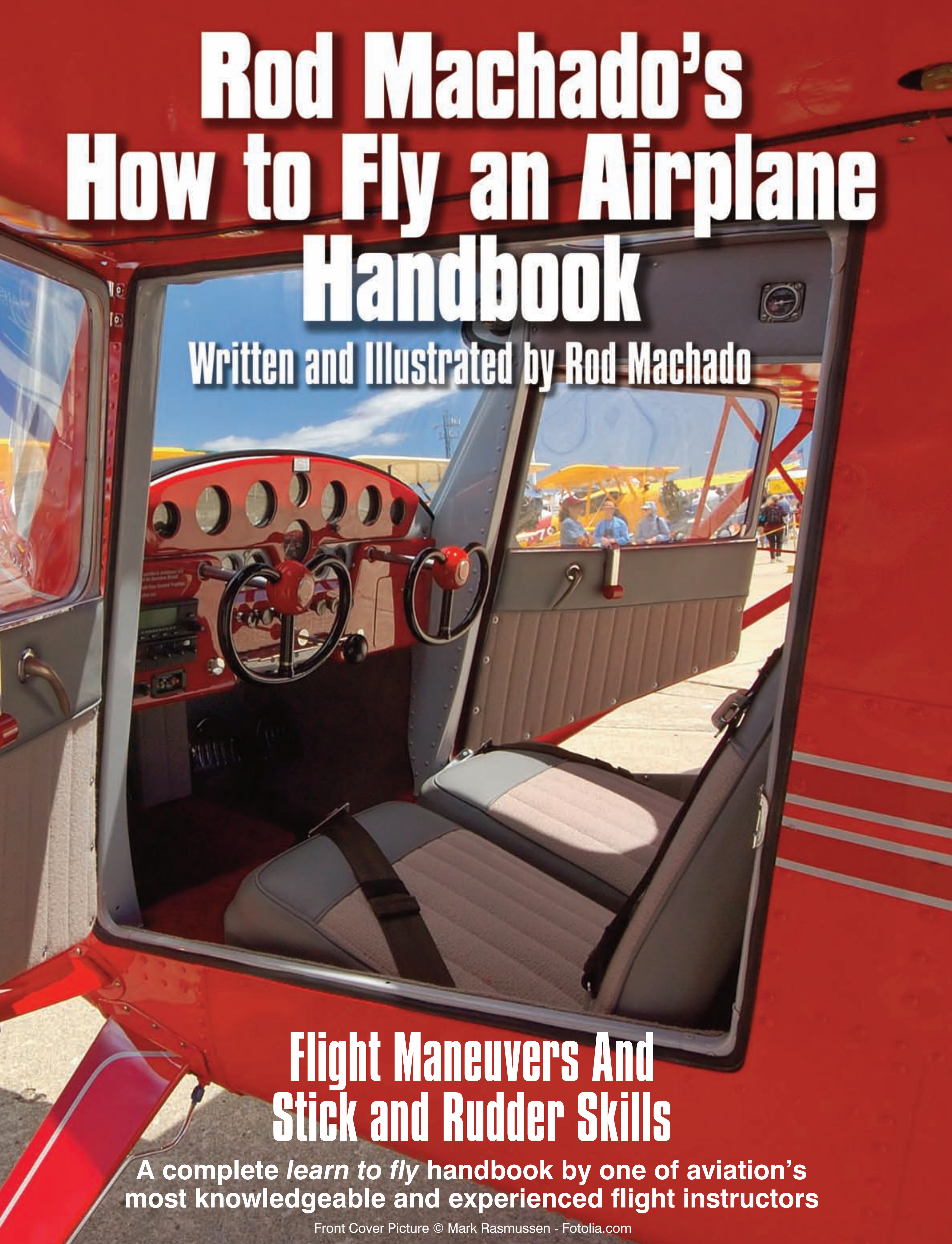


Rod Machado's How to Fly an Airplane Handbook

Written and Illustrated by Rod Machado

Flight Maneuvers And Stick and Rudder Skills

A complete *learn to fly* handbook by one of aviation's most knowledgeable and experienced flight instructors

The Airplane's Axes

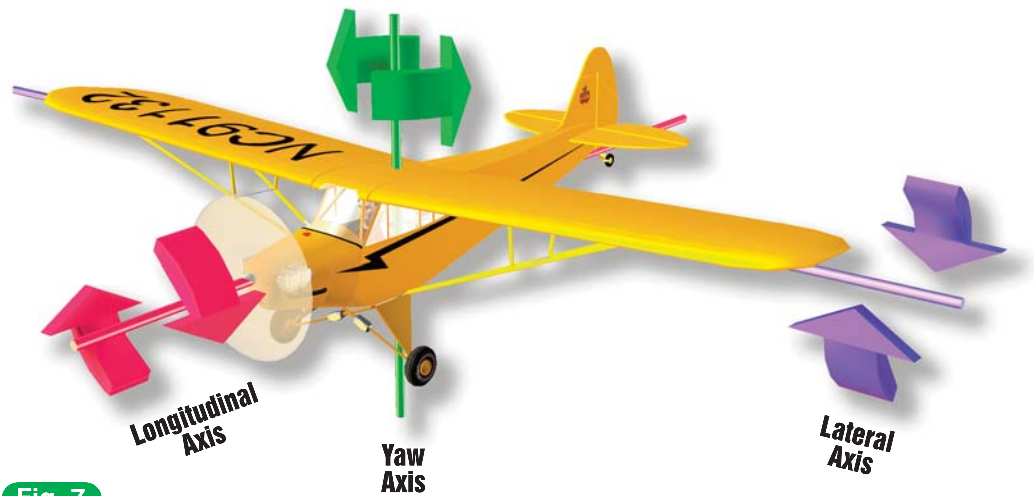


Fig. 7

> **Having an Attitude**
>
> In aviation, words sometimes mean something a little different. And so it is with *attitude.*
>
> While it is not necessarily good for your teenager to have an attitude, it is something your airplane always has, and that's not bad. It has more to do with pitch than petulance.
>
> In the aviation, world *attitude* means the orientation of one of the airplane's three axes relative to the horizon or another reference line. So, when we speak of the plane's *pitch attitude* having increased, it means that the angle between the horizon line and the place the nose is pointing is greater (vertically) than it was previously.

We'll discuss its use in detail later in this chapter.) The rod runs top to bottom (cockpit ceiling to wheels) and the plane rotates around it in a circle.

All three flight controls allow you to rotate the airplane about one or more of its axes. Combining these rotations in the right way, at the right time, yields one or more of the following four basic flight maneuvers: *straight and level flight*, *turns*, *climbs* and *descents*. There are your building blocks. Everything you'll do (or undo) in an airplane is a combination of one or more of these basic flight maneuvers, and all are done by manipulating the flight controls.

Let's put you in control by looking closely at how each flight control operates.

Yoke and Pedal

You manipulate the airplane's elevator surface from the cockpit by forward and aft movement of the *yoke*. Moving the yoke forward or aft rotates the nose up or down around the lateral axis, changing the airplane's pitch attitude relative to the horizon. Rotating the yoke right or left (causing rotation along the longitudinal axis) banks the airplane relative to the horizon.

Pulling the yoke toward you (pulling back) deflects the elevator surface (located at the rear of the airplane) upward, causing the moving air to deflect the tail downward (Figure 8). This results in the airplane's nose pitching upward about the lateral axis. Moving the yoke forward deflects the elevator surface downward causing the tail to move upward (Figure 9). This results in the nose pitching downward about the lateral axis.

Pull Aft, Pitch Upward

Fig. 8

Push Forward, Pitch Downward

Fig. 9

Application of Rudder Compensates for Adverse Yaw - Rolling Into a Turn

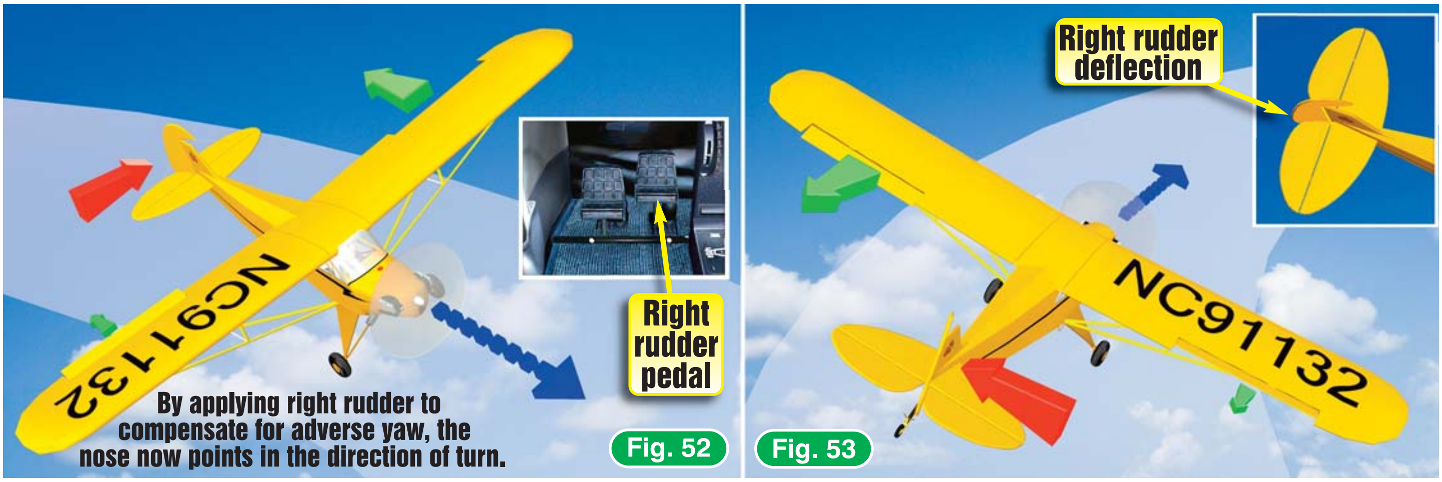


Fig. 52 Fig. 53

(Figure 52 and 53). Deflect the yoke to the right and you should *simultaneously* press on the right rudder pedal. Deflect the yoke to the left and you should simultaneously press on the left rudder pedal. As a general rule, the harder and faster that you deflect those ailerons, the harder and faster you apply simultaneous rudder pressure.

How Much Rudder Do You Use to Enter a Turn?

How do you know if you're applying the proper amount of rudder when *rolling* into a turn?

You look directly over the nose of the airplane as shown in Figure 54, position A, then roll into the bank while simultaneously applying sufficient rudder pressure to keep the nose from moving *opposite* the direction of turn (Figure 54, position B). That's the secret to *entering* a coordinated turn (used in this context, the term *coordinated* means that aileron and rudder are being used in such a way that the nose always points in the direction of turn).

Another way of saying this is, if the nose doesn't move opposite the direction of turn during the roll in, then you've at least applied the proper amount of rudder pressure to compensate for the effects of adverse yaw. Figure 54, position C shows how the airplane's nose yaws to the left without the sufficient use of right rudder during the turn entry. Of course, you can use too much rudder when entering the turn causing the nose to yaw excessively in the direction of the turn before the bank actually results in a turn (Figure 54, position D).

That's why, when rolling into any turn, the correct amount of rudder usage allows the nose to *appear* to remain pointed straight ahead (primarily because of inertia) until the lifting force begins pulling the airplane in the direction of turn. Too little or too much rudder during the roll in results in the nose yawing outside or inside of the turn arc, respectively.

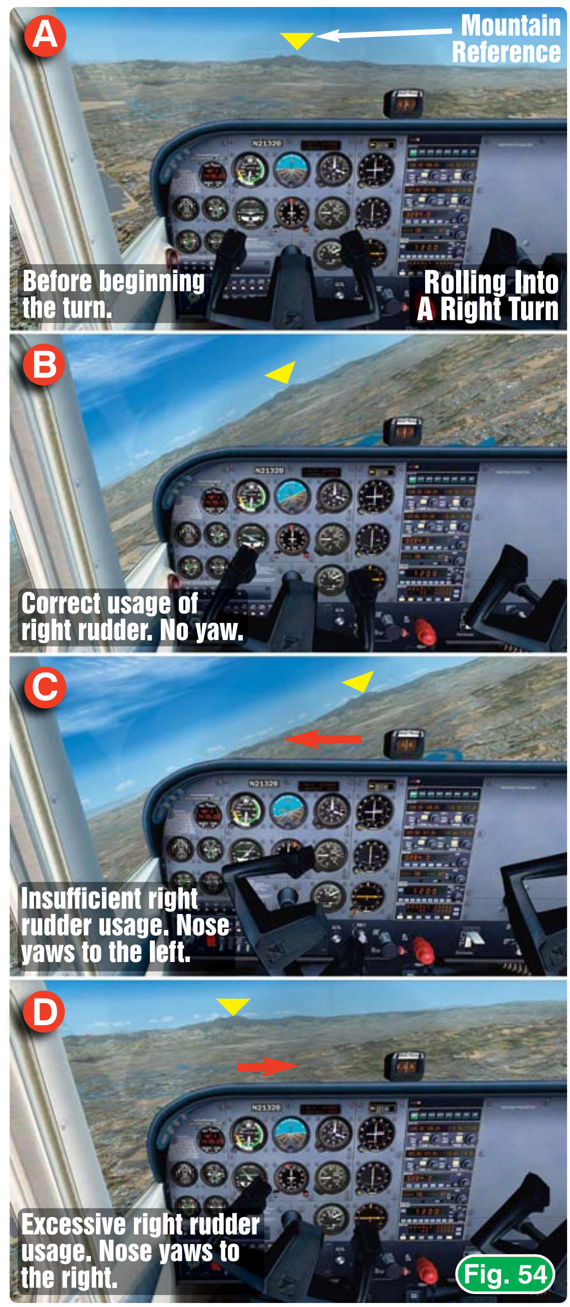


Fig. 54

Application of Rudder Compensates for Adverse Yaw - Rolling Out of a Turn

Fig. 55

Rolling out to the left results in an increase in adverse yaw on the right wing.

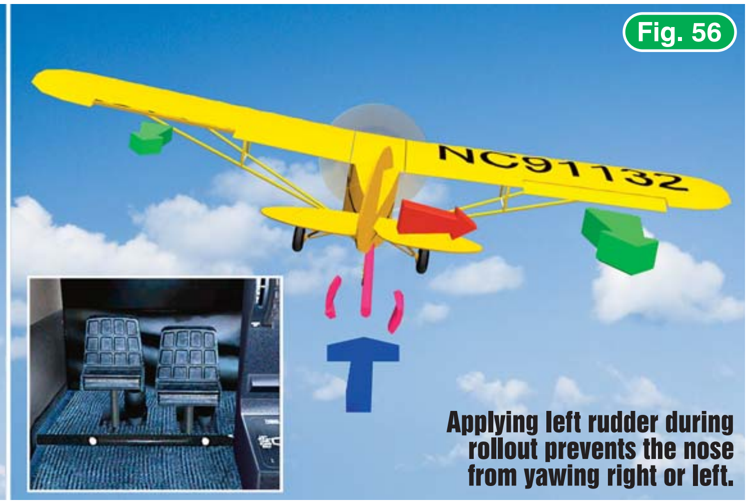


Fig. 56

Applying left rudder during rollout prevents the nose from yawing right or left.

Fig. 57

The same principle applies when rolling out of a turn. To begin any rollout, you'll apply aileron to reduce the bank angle and simultaneously use rudder in the same direction to compensate for the adverse yaw of the lowered aileron on the rising wing.

For instance, when rolling out of a right turn into straight and level flight, the aileron on the right wing moves downward, which increases the lift as well as the drag on that wing (the aileron on the left wing moves upward decreasing the lift and the drag on that wing). The nose wants to yaw to the right because of the adverse yaw produced by the lowered right aileron (Figure 55). To keep the nose from yawing, you must use left rudder in coordination with left aileron application.

Done correctly, the nose *appears* to stop moving during the rollout with the airplane pivoting about its longitudinal axis as it returns to a zero banked condition (Figure 56). Yes, of course the nose moves a very tiny bit during the rollout, but if you roll out at a moderate rate, you'll hardly notice this horizontal movement. Too much or too little rudder causes the nose to yaw left or right during the rollout. This is how you determine the precise amount of rudder to use when rolling out of a turn.

Figure 57 shows how a rollout from a right turn looks from the airplane cockpit. As you begin the rollout from a right turn (Figure 57, position A) you apply left aileron and left rudder simultaneously. You're using just enough left rudder application to keep the nose from yawing to the right (or the left). Done correctly, you should see the nose appear to pivot about the distant point where the rollout began (Figure 57, position B). Let me emphasize this point one more time. During the coordinated rollout, the nose bank angle, you might even find that once you are established in a climbing left turn, you'll need to hold a little right rudder pressure as well as a little right aileron to keep the airplane in coordinated flight and prevent overbanking (Figure 10).

The same cowling pitch reference used during a straight climb also applies in climbing turns. Refer to your windscreen dot and keep it properly placed above the horizon to maintain the correct climb attitude. Then again, you might find it easier to use a point located at the intersection of the horizon line and the engine cowling or top of the instrument panel directly ahead of you as your pitch reference, since this is vertically closer to the horizon line.

In Figure 8, positions A and B, the intersection of the horizon line with the top of the instrument panel (locations X and Y, respectively) can be used as *additional* attitude clues along with the red dot's displacement above the horizon to aid you in maintaining the desired climb attitude.

Always keep in mind that you need to be ready to make whatever adjustments in pitch attitude are necessary to maintain the desired climb airspeed when changing the bank angle.

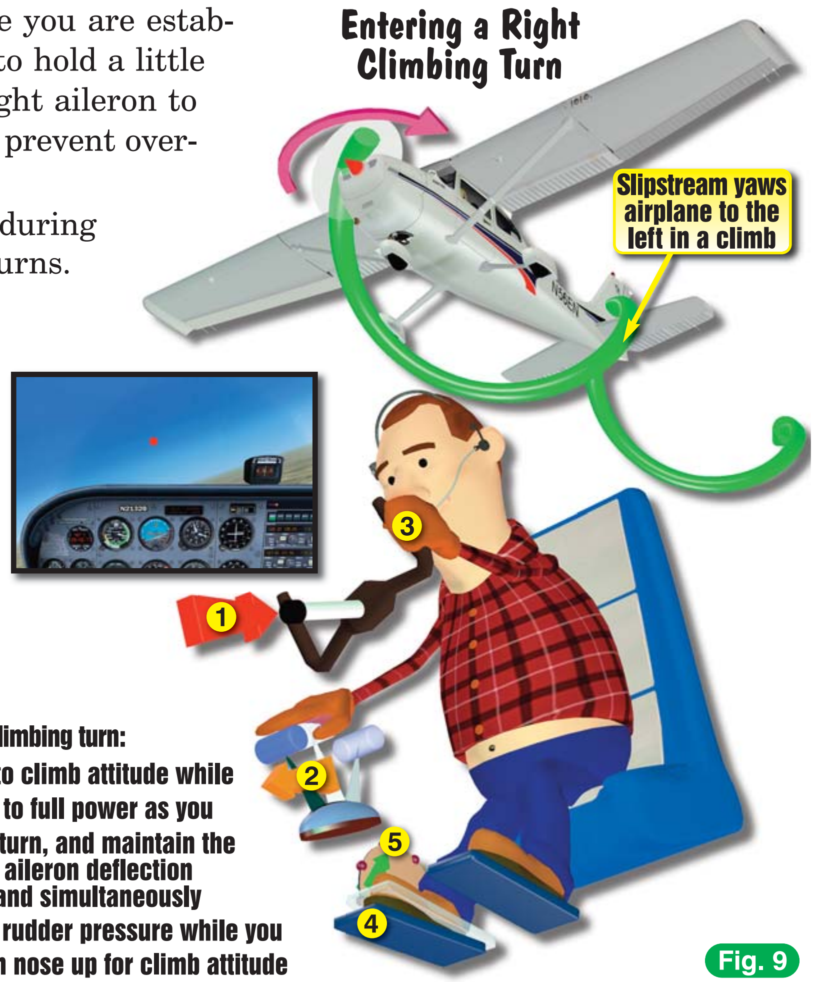


Fig. 9

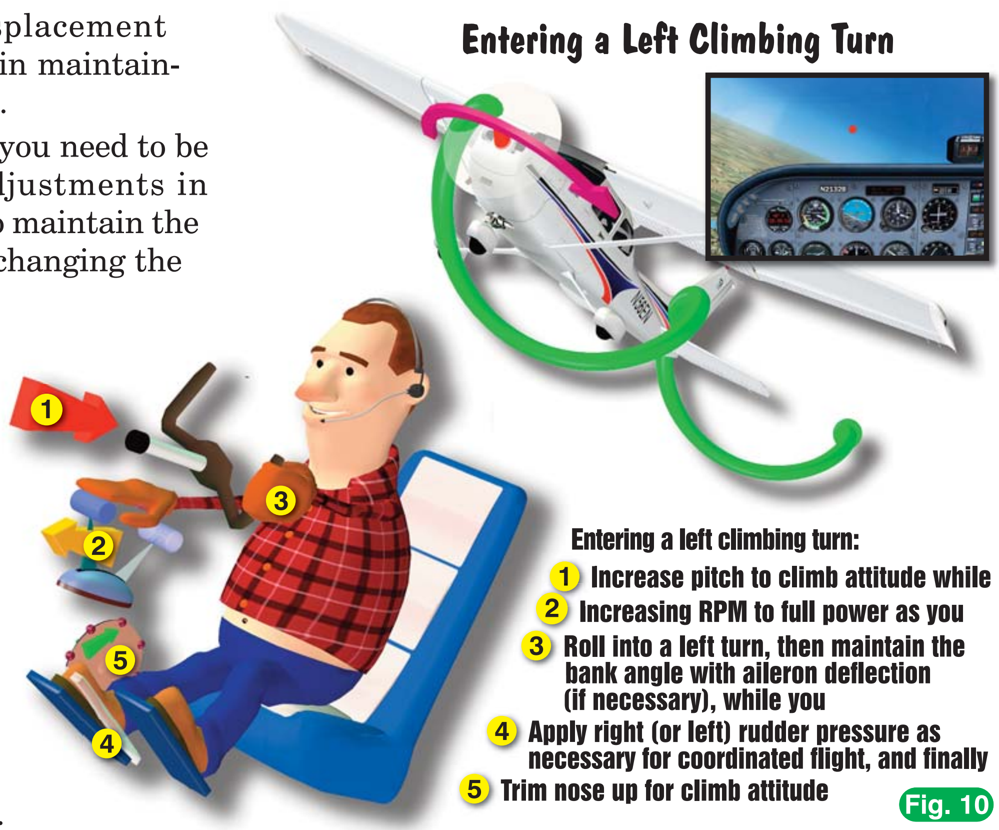


Fig. 10

Straight Descents

You should be happy that you're not learning to fly during the disco era, in the 1970s. Why? When a flight instructor of that era said, "Let's get down," it usually meant dancing and partying, but no training. Of course, in today's aviation language that's not what the term means (sorry, I hope I didn't disappoint you).

minimum sink speed is normally found somewhere between stall speed and the best glide speed. It's not, however, a speed that you'll find posted in most POHs. If you know what this speed is, then it makes sense to use it when descending over the desired landing spot since it gives you more time to troubleshoot the engine problem or let someone know you're making an emergency landing. Your final approach and landing, however, should be made at approximately 30% above stall speed.

Pitch and Power Techniques for Flying Your Airplane

Up to this point I've primarily discussed using the elevator control (pitch) and throttle (power) *simultaneously* when making changes in your glidepath and/or airspeed. This is just one of three different ways you can use the yoke and throttle to change either of these two conditions. Before we discuss the other two methods, let's be clear about what we're going to discuss here.

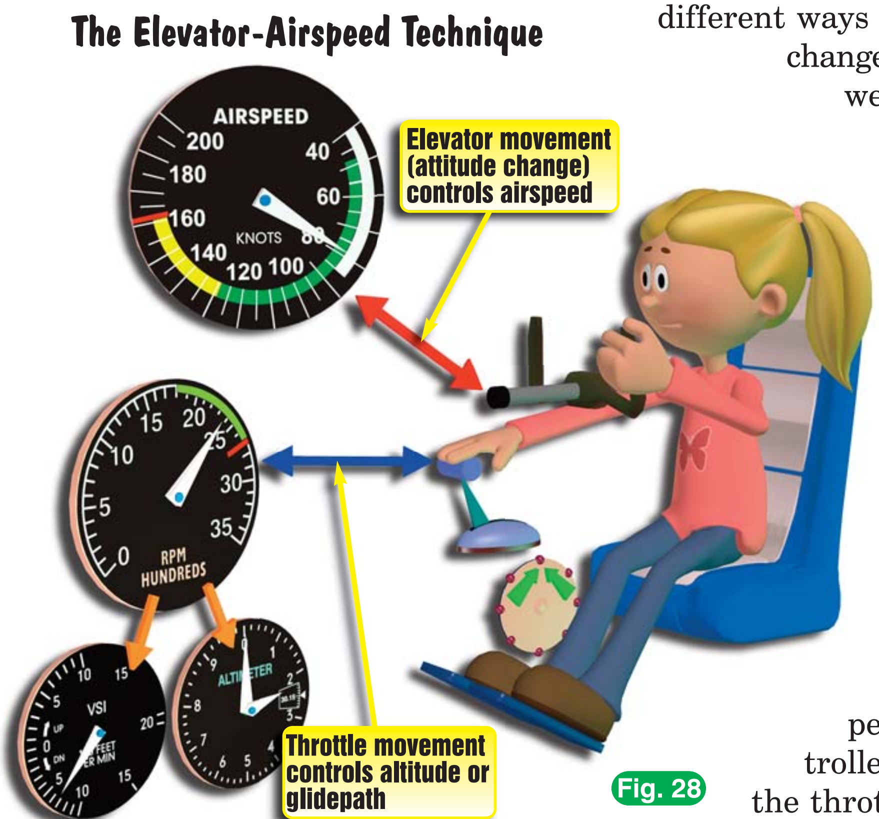


Fig. 28

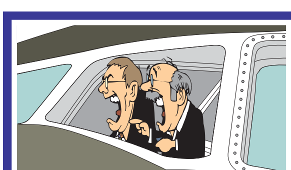
When we say that you *control* your airspeed, we're saying that you manipulate either the throttle or elevator control to produce a specific airspeed or keep the airspeed at a specific value. When we say that you *control* your glidepath, we're saying that you manipulate your throttle or yoke to produce a specific change in your airplane's vertical speed (which can be a descent rate or a climb rate). This follows from our previous airplane performance equation: *Attitude* (controlled by the yoke)+*Power* (controlled by the throttle)=*Performance* (the resulting airspeed and glidepath).

There are two conditions under which the formula A+P=P applies during flight. There's a *fixed* power condition and a *variable* power condition. Let's take the first condition first.

If you're in an airplane that's either climbing with full power or descending with the throttle set at some value and left alone, then your power (throttle) is considered to be *fixed*. In a fixed power condition, you manipulate the elevator to change your airspeed, which also produces a change in your flight path (either your descent rate or your climb rate if you're climbing with full power).

For instance, during a climb (power fixed) you adjust the elevator to provide a specific climb airspeed and accept the resulting climb rate. During a power-off descent (power fixed at idle), you typically adjust the elevator to yield a specific descent airspeed and accept whatever descent rate results.

What happens when you make the power *variable* instead of leaving it fixed at either full power or flight idle? Now things really get interesting because variable power allows you to have *three*



The story goes like this. Two military C130 pilots decided to play a joke on a General riding jump seat on a flight. When the airplane is aligned with the runway, the copilot says, "Would you mind if I make the takeoff?" The captain says, "Please do." Once airborne the captain says, "That's a mighty fine takeoff for a Landing Pilot. The copilot says, "Oh, I'm not a Landing Pilot. I'm a Takeoff Pilot." At which point the captain replies, "You can't be a Takeoff Pilot because I'm the Takeoff Pilot. Surely they wouldn't have put two Takeoff Pilots on the same airplane, would they?" The look on the General's face was priceless.

Why One Wing Stalls Before the Other

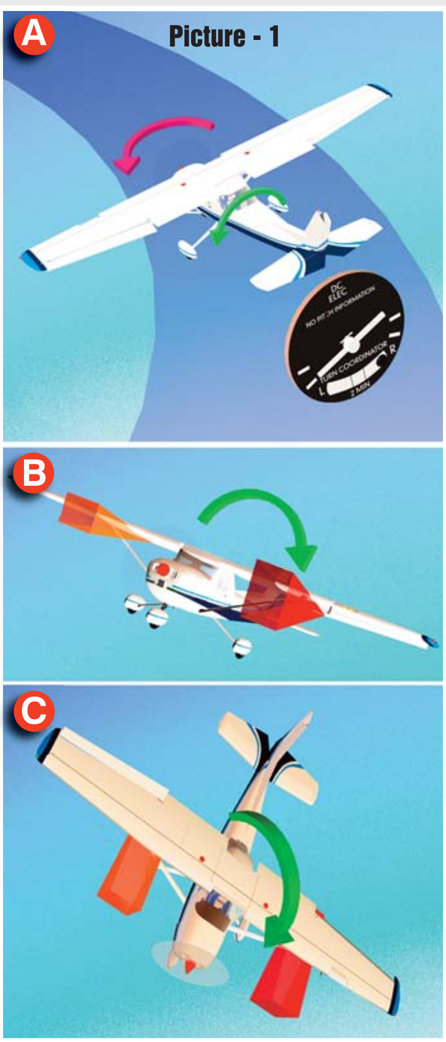
What causes one wing to stall before the other? The most common way for this to happen is to induce a skid as the wings approach their critical angle of attack. For instance, as the airplane approaches a stall from a left turn (Picture-1, position A), excessive left rudder is applied (or P-factor and slipstream yaw the nose to the left, same effect). This results in the nose yawing to the left, causing the right wing to move forward slightly, giving it a slight increase in speed (and a bit more lift), and the left wing to move aft slightly, giving it slightly less speed (and a little less lift). Now the airplane begins to roll to the left with the nose pointed inside the turn arc.

The rising right wings' angle of attack decreases slightly, while the descending left wings' angle of attack increases slightly, as shown in Picture-1, position B. As the left wing moves down, it generates a relative wind from underneath, which tends to increase its angle of attack. A rising right wing generates a relative wind from above (from a more forward angle), which tends to reduce its angle of attack. Any deflection of the aileron control to the right to maintain the bank angle further increases the angle of attack on the left wing and decreases the angle of attack on the right wing. Ultimately, the left (descending) wing reaches its critical angle of attack before the right (rising) wing and the airplane enters a spin to the left, in the direction of the initial yaw (Picture-1, position C).

This is why a skidding turn at the moment of a stall is likely to result in an airplane entering a spin. That's why you want to prevent the nose from yawing and rolling by applying rudder during the stall if one wing begins to *drop* before the other.

Now you also know why you don't want to raise a *dropping* wing with use of aileron. Attempting to raise a dropping wing means the aileron on the descending wing moves down, which further increases its angle of attack, deepening the stall on that wing.

On the other hand, what happens if insufficient rudder is applied in the turn and the airplane slips at the moment of stall entry? Is this as conducive to spin entry? Let's see.



As the wings approach a stall from a left turn (Picture-2, position D), too much right rudder (and/or excessive left aileron control deflection) is applied. This results in a slipping turn to the left with the nose yawing to the right, or outside the turn arc. This causes the left wing to move forward slightly, giving it a slight increase in speed (and a bit more lift) and the right wing to move aft slightly, giving it slightly less speed (and a little less lift).

Now the airplane begins to roll to the right, with the nose pointed outside the turn arc. The rising left wing's angle of attack decreases slightly and the descending right wing's angle of attack increases slightly, as shown in Picture-2, position E. As the right wing moves down, it generates a relative wind from underneath, which tends to increase its angle of attack. A rising left wing experiences a reduction in angle of attack. Any deflection of the aileron control to the left to sustain the left bank further increases (right wing) and decreases (left wing) the angle of attack. Ultimately, the right (descending) wing reaches its critical angle of attack before the left (rising) wing, and the airplane might enter a spin as the left wing goes over the top of the airplane as the airplane yaws and rolls to the right (Picture-2, position F).

Did you notice that I was very careful to say "might" enter a spin there? It's more difficult to enter a spin from a slip than a skid. Why? Looking at the airplane in Picture-2, position E, it should be clear that the slipping airplane is still turning left (it's in a slipping left turn). If a spin does occur in our example, it occurs to the right, which happens to be opposite the direction of the turn. Because the direction of spin (to the right) would be opposite the airplane's momentum (to the left) in the turn, the two tend to work against each other and diminish the potential for the airplane to rotate and enter a spin. The result is that airplanes tend to stall (not spin) more often from a slip.

If they do begin to spin from a slip, the spin *entry* is not as dramatic as one from a skid. That's not to say you can't spin from a slipping turn, because you can. Keep in mind, however, that pilots regularly use slips when landing, and they do so at slower approach speeds. If the potential to spin from a slip were significant, slips certainly wouldn't be such a popular maneuver among pilots, much less a maneuver you're required to demonstrate on a private pilot checkride. Just remember that the aft moving wing always stalls FIRST!

How does the use of aileron to raise a dropping wing increase the angle of attack on that wing? Figure 27 shows how turning the yoke to the right lowers the aileron on the stalled (left) wing, thus further increasing the angle of attack on that wing beyond its critical value.

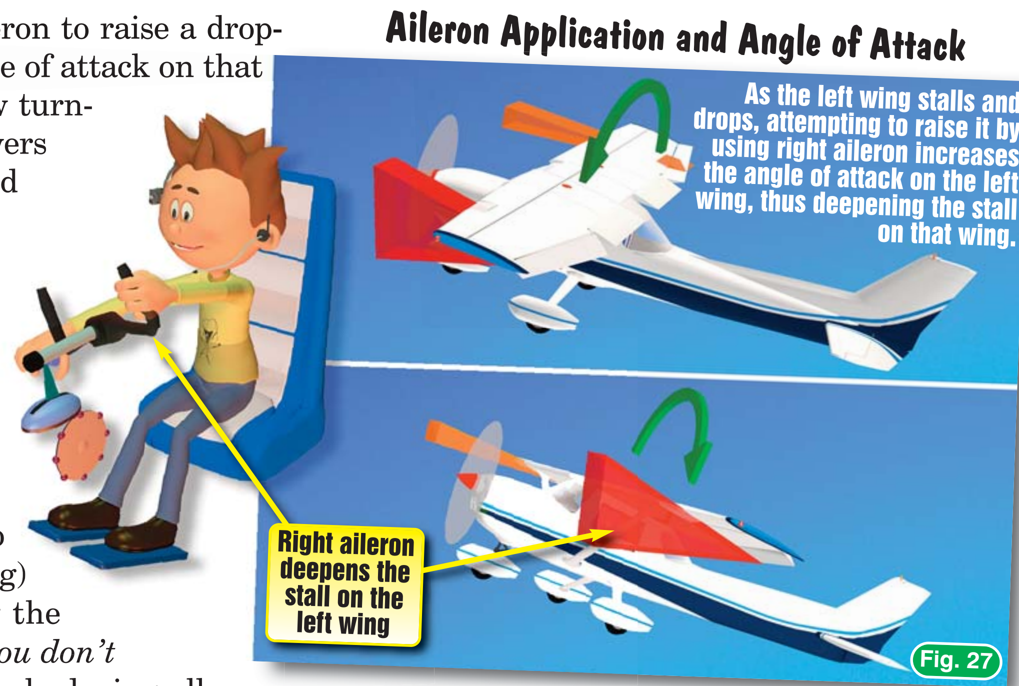


Fig. 27

Your first reaction whenever a wing drops should be to reduce the angle of attack and simultaneously apply rudder to stop the yawing (or rolling) motion while neutralizing the ailerons. *You can't spin if you don't yaw.* Period! As a general rule during all stalls, if one wing drops (or begins to drop) during a stall, resulting in the airplane yawing and rolling toward the dropping wing, leave the ailerons in their neutral position and release elevator back pressure to reduce the angle of attack on both wings while *simultaneously* applying sufficient rudder pressure to stop the yawing motion.

Fig. 28

If a left wing drops, resulting in a yaw and roll to the left, apply right rudder (Figure 28); if the right wing drops, resulting in a yaw and roll to the right, apply left rudder (Figure 29). As you are applying rudder, you are simultaneously reducing the angle of attack.

Fig. 29

How much rudder pressure should you apply to stop the yawing motion? Enough to stop the yawing motion!

That's right. Do whatever it takes, and don't be shy about doing it. Push that rudder pedal all the way to the floorboard if necessary. You're usually at a very slow airspeed, which means the aileron in this example). This is quite common when the pilot realizes his bank is excessively steep and uses aileron to reduce the bank angle. The adverse yaw caused by the lowered aileron on the inside wing (left wing in this example) pulls that wing aft, further yawing the airplane to the left, opposite the direction of turn (Figure 53). The result is a classic cross control condition that exacerbates the skid, possibly leading to the wing inside the turn (left wing in this example) stalling first.

Fig. 54

Now let me put a kink in your wheel pants by saying that a skidding turn onto final approach in a right turn is less likely to occur than one in a left turn. How can that be? It's all about engine power. At the slower airspeeds and higher angles of attack associated with power usage, the power-induced left turning tendencies tend to counteract the extra right rudder the pilot might apply to pull the airplane's nose to the right and align it with the runway centerline (I'm assuming the pilot has poor stick and rudder skills and is attempting to correct for a centerline overshoot). Given that most pilots are likely to *underuse* rather than *overuse* their rudder pedals, in a right turn to final it's more likely that they'll accidentally end up in coordinated flight (or something close to it) rather than skidding. Of course, the airplane can still stall, but without the skid it's not as likely to stall and then spin.

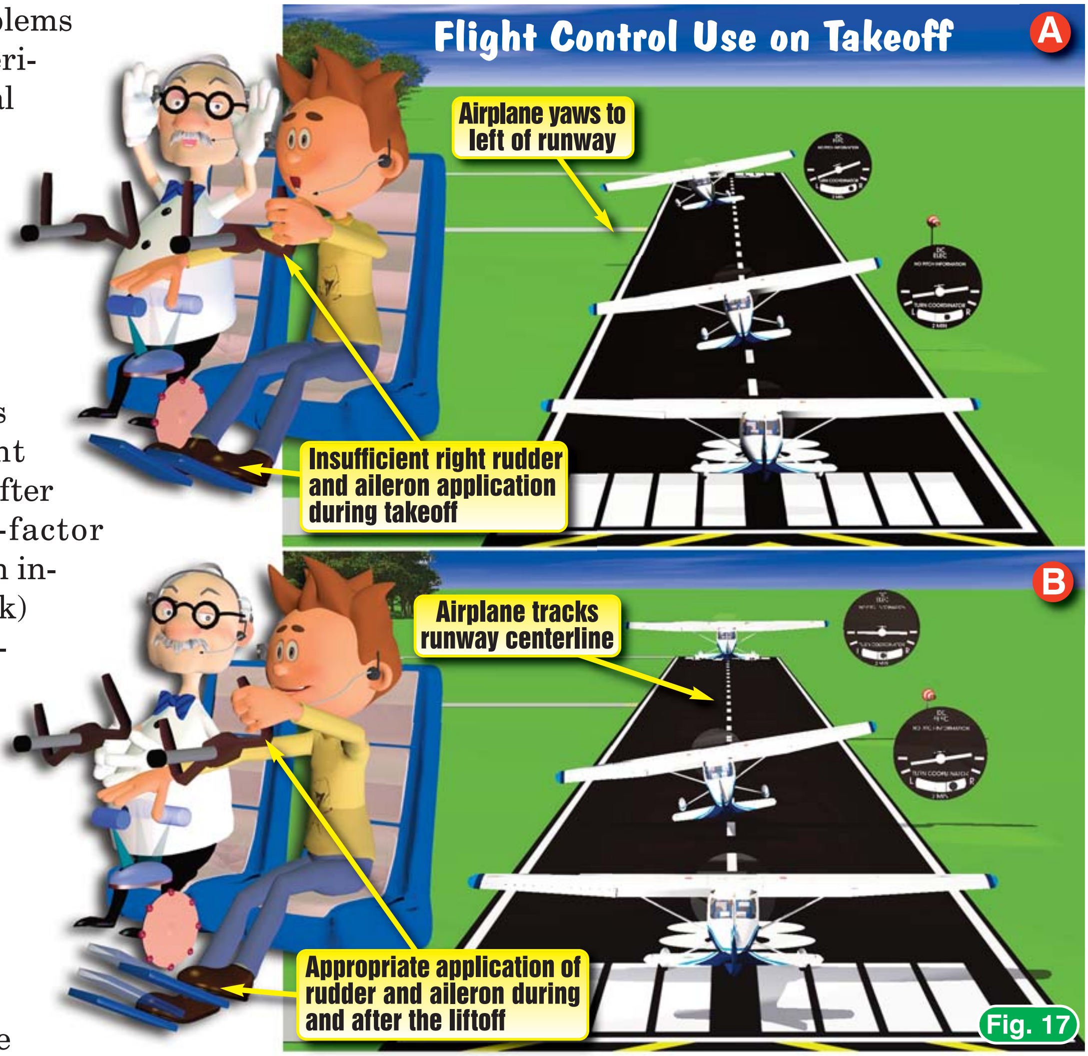
On the other hand, the pilot might attempt to correct for the overshoot by increasing the bank angle only (not using excessive rudder in this instance), as shown in Figure 54. He's increasing the bank angle by adding right aileron with insufficient right rudder pressure. Adverse yaw pulls the nose to the left, outside the turn, with the left yawing tendency exacerbated by the power-induced left turning tendency. As the left wing moves aft, its speed decreases, decreasing the lift on that wing, resulting in it moving downward slightly. The downward movement increases the angle of attack on the left wing, which makes the wing outside the turn more likely to stall first (Figure 55).

Fig. 55

This type of stall results from a slipping turn onto final approach. If the airplane does stall from a slip, the right wing (the wing inside the

There are two problems students typically experience during the initial takeoff. The first is that they tend to be either ham fisted or ballet-dainty on the elevator control—either pulling aft too hard or not hard enough. The second big takeoff issue occurs when insufficient right rudder is applied just after liftoff. Until liftoff, P-factor (which increases with an increase in angle of attack) has no affect on the airplane. As soon as the angle of attack increases during rotation, the left yawing tendency of the nose increases (Figure 17, position A). You must apply sufficient right rudder to keep the airplane aligned with the extended runway centerline and keep it coordinated, too. Whatever you do, don't be like the pilot whose rudder skills are so poor that the only reason his airplane appears to fly straight on takeoff is because of the coriolis force. Adding right rudder also means applying whatever aileron deflection is needed to keep the wings level (Figure 17, position B).

How do you know if you're aligned with the runway centerline after liftoff? The best reference is to look directly ahead of you at either the end of the runway (if you can still see it over the airplane's nose) or some distant reference you spied just before takeoff. Sometimes that's a bit challenging, given the high nose-up attitude that's normal during climb. You simply can't see through your instrument panel



During the takeoff roll and subsequent climb, apply sufficient right rudder pressure to compensate for the airplane's power-induced left turning tendency or the airplane will track left of the centerline.

Squeeze Play

This instructor and student used the POH to calculate the rotation speed but neglected to follow the procedure for leaning the fuel mixture [for takeoff]. They put their C172 into a spot where there was not enough speed to takeoff and not enough runway left to abort.

...With full tanks and increasing density altitude, the engine was unable to produce the needed power to achieve the rotation speed of 48 knots. After passing the intersection of Runway 13/31 we were at 42 knots. At this point we decided to rotate because there was not enough runway left to abort the takeoff.... Unfortunately, after rotation, the stall warning horn sounded at about 10 feet. We did not have enough distance to climb and clear the obstacles at the departure end of the runway. We decided to cut the power and land.... At this point we believed that there was some runway and hard grass surface to stop the plane. Unfortunately, the brakes did not catch the wet grass and we slid into the plowed field 200 feet south of the runway....

In my opinion, if we had tried to keep it in the air the outcome could have been much worse. However, there were some errors in our judgement. The density altitude was significantly higher than it had been in the last several months. Keeping the high density altitude in mind, apparently one thing that we could have done to produce more power [would have been to] lean the mixture for takeoff....

ASRS Report

As you approach the upwind point of the circle (the 270 degree turn point), as shown in Figure 24, position D, your groundspeed begins to increase slightly because the wind is no longer blowing directly on your nose. You'll have to increase the bank slightly to maintain the correct turning radius. However, you'll also need to keep the airplane's nose pointed slightly outside your imagined circular ground track in order to keep your turn radius from decreasing. Apply the same WCA you used at the 90 degree of turn point (the WCA won't change much and if it does change a little, that's due to slight changes in airspeed due to bank angle).

How do you do that? Gradually increase the bank angle to compensate for the increasing groundspeed but not so fast as to pull the nose parallel to or inside the imagined turn arc (Figure 25, position D). In

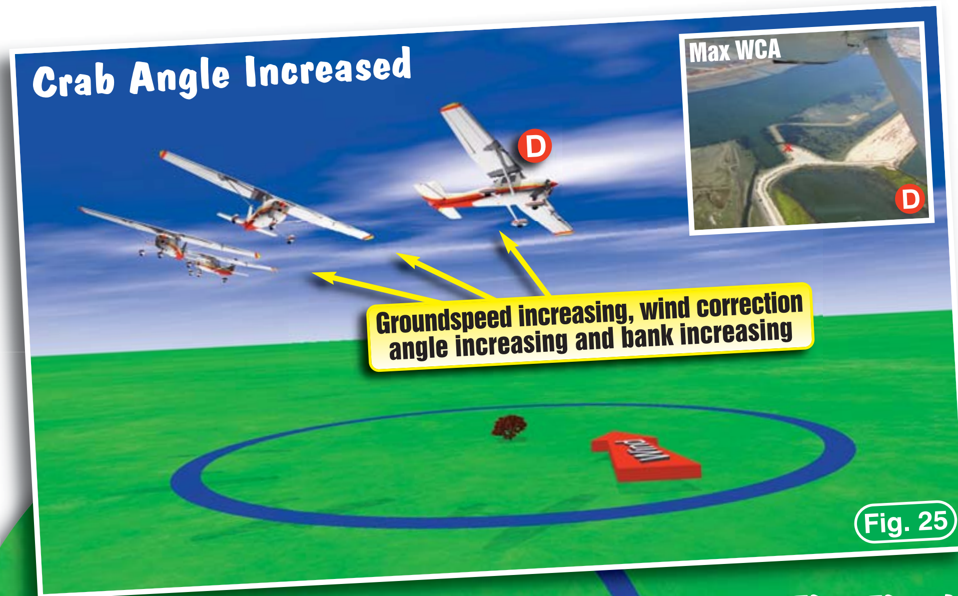
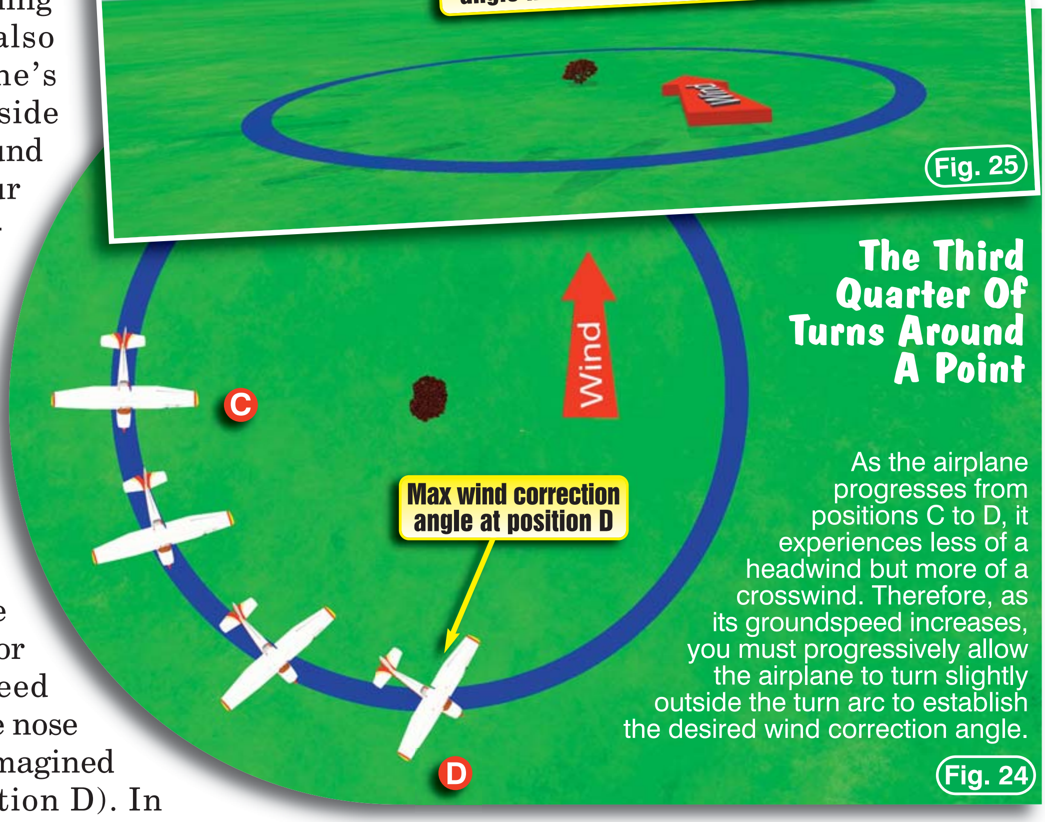


Fig. 25



The Third Quarter Of Turns Around A Point

As the airplane progresses from positions C to D, it experiences less of a headwind but more of a crosswind. Therefore, as its groundspeed increases, you must progressively allow the airplane to turn slightly outside the turn arc to establish the desired wind correction angle.

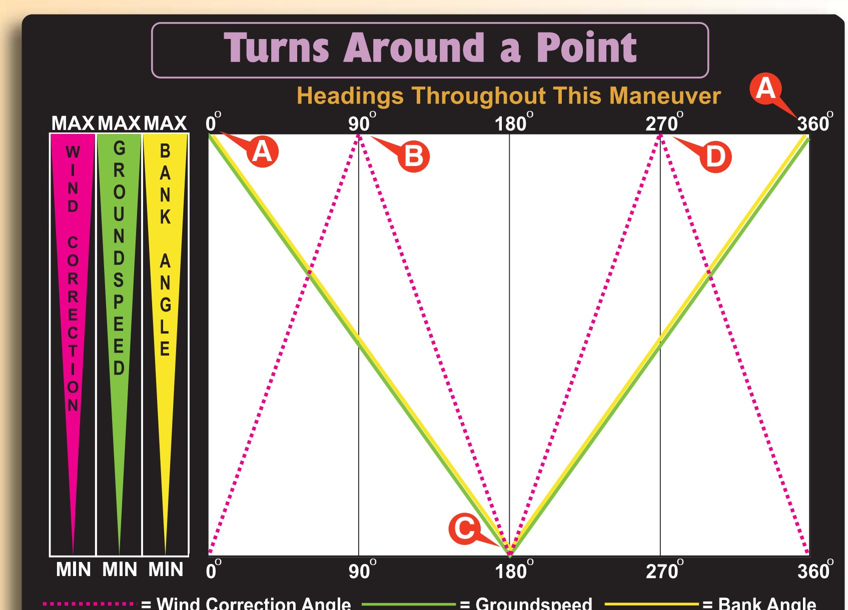
Fig. 24

Turns Around a Point - Graphically Explained

Sometimes there's nothing like a good graph to help you make sense of a particular maneuver. So let me help you understand how to use the *Turns Around a Point* graph to the right.

On the left side of the graph are three vertical color coded bars representing the wind correction angle, the groundspeed and the bank angle used in this maneuver. The top of these bars represent maximum values (MAX) while the bottom represents minimum values (MIN).

The graph's horizontal axis represents the degrees of turn throughout the maneuver. Position #A represents the beginning and end of the maneuver (0° and 360° of turn) where the groundspeed and the bank angle are the largest (MAX). At positions #B and #D (90° and 270° of turn) the wind correction angle is at a maximum and the groundspeed and bank angle are approximately half of their max value. At 180° of turn all three values are at a minimum.



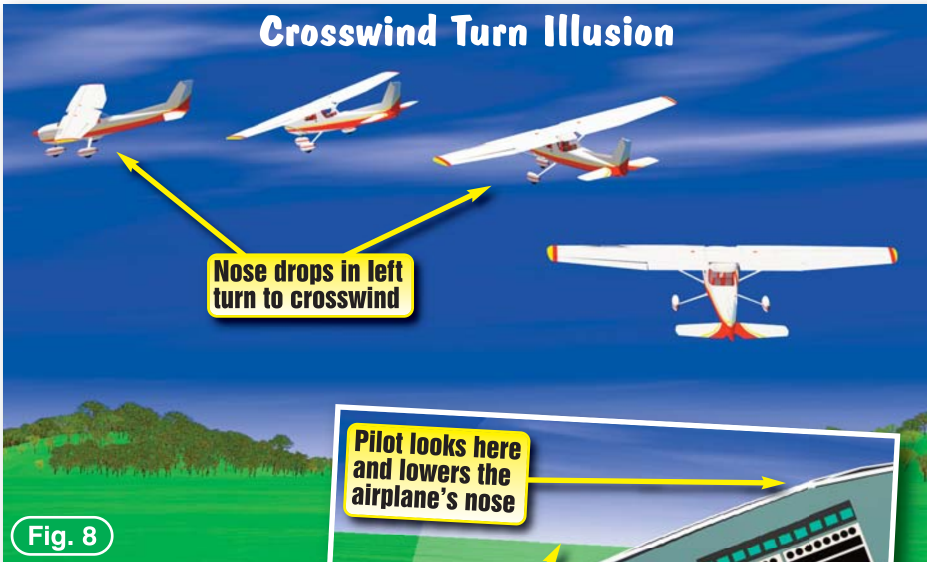


Fig. 8

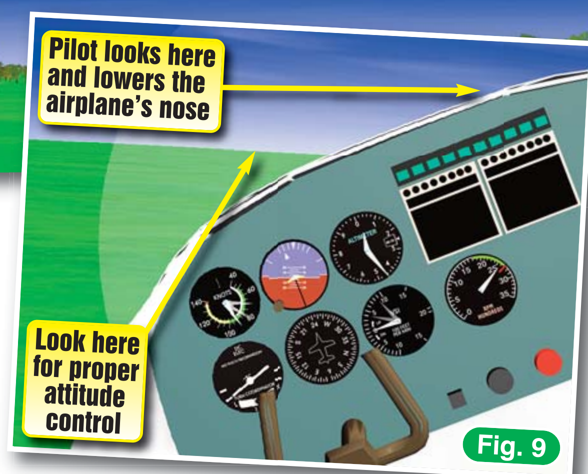


Fig. 9

When making a left turn to crosswind, pilots tend to let the nose drop because the right side of the instrument panel appears raised above the horizon. Instead, they should use their normal pitch attitude reference located directly ahead of their seated position.

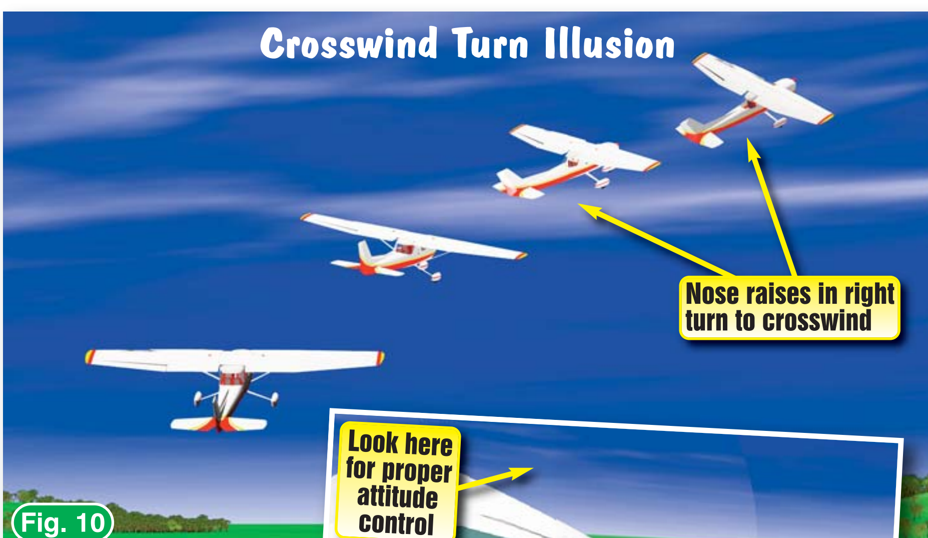


Fig. 10

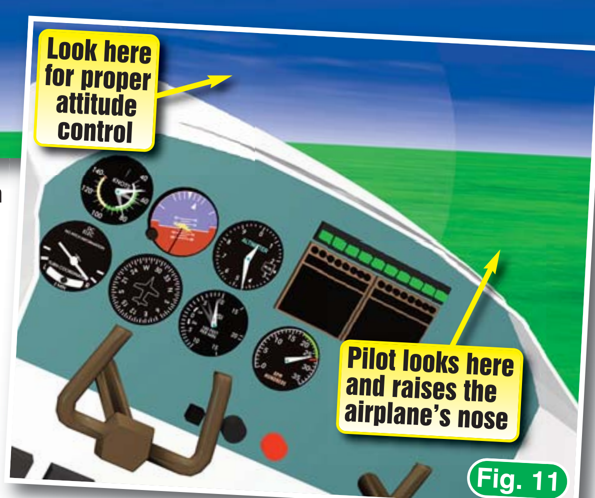


Fig. 11

When making a right turn to crosswind, pilots tend to raise the nose because the right side of the instrument panel appears lower than the horizon. Once again, they should use their normal pitch attitude reference located directly ahead of their seated position.

Looking at the ground expands your aesthetic horizons but unfortunately does nothing about giving you horizon (attitude) information. The airplane often descends in these conditions.

Turning to a right crosswind in a right hand traffic pattern, the tendency is to raise the airplane's nose (Figure 10) because students look to the *apparently* lowered right side of the airplane (Figure 11). And the attraction to the view of the ground out the right window is often just too tempting for pilots without the requisite Jedi mind training needed to resist. You can imagine what raising or lowering the nose in either one of these conditions does to the airplane's climb performance, right? We discussed this viewing bias in Chapter Three, but the point is worth repeating here.

Now I want you to make me a promise. First, uncross those fingers. Good. I need you to promise me that during the climb on the crosswind leg that you'll quickly but smoothly lower the nose, look for traffic, then return the nose to climb attitude. That's right. Thumbs up to nose down, for a brief moment. I need you to look for traffic that may be entering the traffic pattern directly ahead of you. In many cases, you just can't see well enough over the nose during a climb to ensure that there's no traffic ahead of you. So lower the nose, look, then return to climb attitude pronto. Promise? OK, I believe you.

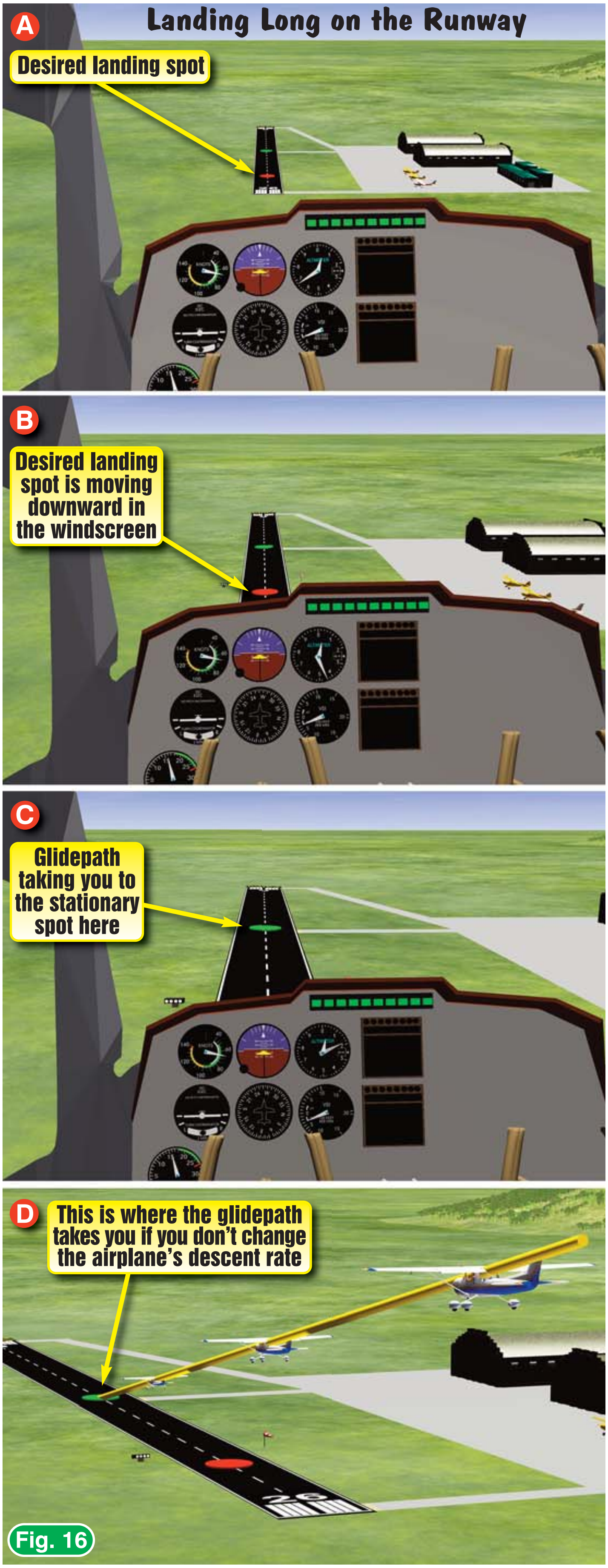


Fig. 16

If you reduce power and don't reduce the pitch attitude slightly, your airspeed will decrease, perhaps to the point where you end up behind the power curve. You don't want to be there. So when reducing power, the nose must move down a bit to maintain the desired approach speed. Now that's a nice place to be.

Observe the spot where you want to land (Figure 18). If it remains stationary (doesn't move up or down in the windscreen), then you're headed directly toward it. Nice job. Keep on keeping on. Is the magic spot still moving downward a bit? Make the same adjustments again (assuming the throttle isn't already at flight idle). Several iterations might be necessary while on final approach

Modifying Your Glidepath

If your desired landing spot moves down in the window (red dot), then reduce power to increase the descent rate and lower the nose slightly to maintain the desired approach airspeed.

Fig. 17

Fig. 18

Reducing power and lowering the nose slightly allows you to steepen your glidepath and maintain your airspeed.

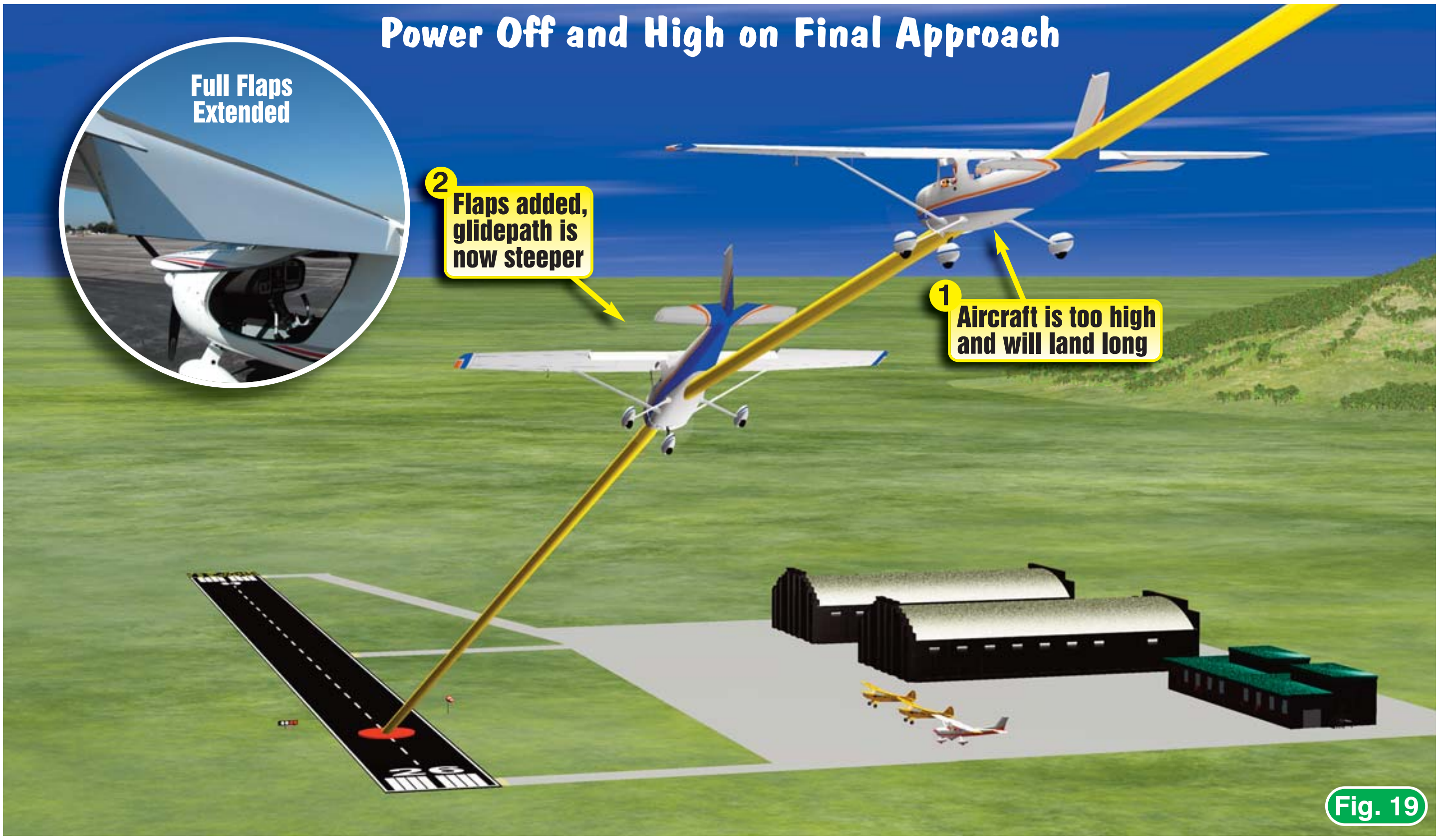
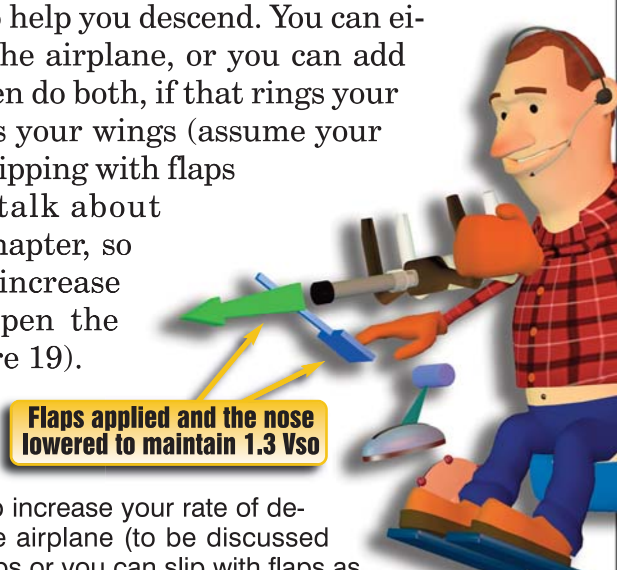


Fig. 19

before you get the landing spot properly dialed in. Even when you nail it, wind conditions can change on the way down, so keep checking. And remember to trim the airplane after you've made any change in power.

The second case is when you are high on final approach with the power already at flight idle. You're powerless to further reduce power, but you're not out of options. You have two choices to help you descend. You can either forward slip the airplane, or you can add flaps or you can even do both, if that rings your chimes and wiggles your wings (assume your POH approves of slipping with flaps extended). We'll talk about slips in the next chapter, so let's add flaps to increase the drag and steepen the descent rate (Figure 19).



When the airplane is high on final approach, there are three options available to you to help increase your rate of descent. You can slip the airplane (to be discussed soon), you can add flaps or you can slip with flaps as long as this is approved by your airplane's POH. When adding flaps, you'll want to lower the nose to maintain the desired airspeed and you'll want to use 1.3 Vso (the new approach speed based on the airplane's reduced stalling speed with full flaps applied.

Fig. 20

your left, where the blurry motion stops yet the runway still appears to move. Now you have the depth perception necessary to gauge your height above the landing surface. See how I let you down by not letting you down with these important tips? Now it's time to sweeten things up by taking a closer look at the sweet spot.

The Sweet Spot

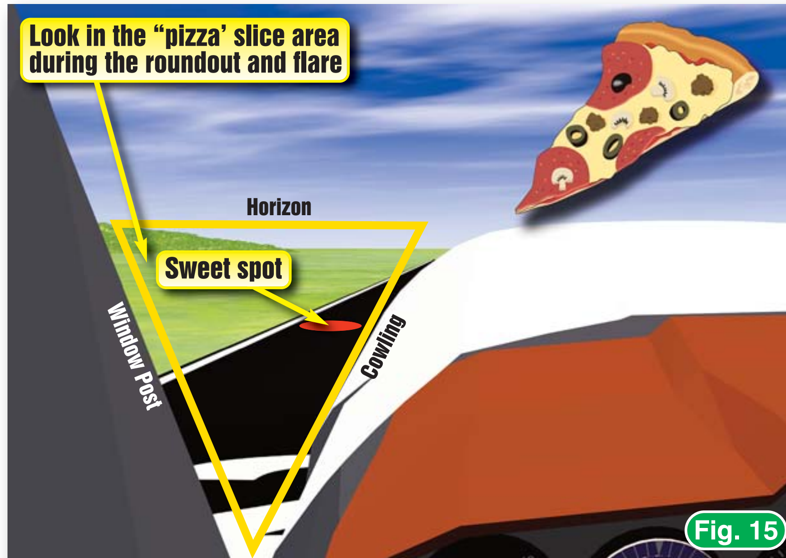
The sweet spot for us is typically framed by the left side of the engine cowling, the right side of the window post (on those airplanes with window posts, of course), and the horizon. The frame takes the shape of a pizza slice through which you're viewing a portion of the non-moving runway and the horizon (Figure 15). This is only available as takeout, by the way.

Looking anywhere besides in the pizza slice during the landing flare generally means you're looking in all the wrong places and won't know how high you are above the ground. And how much fun can that be when a large solid slab of solid runway is rising to meet you?

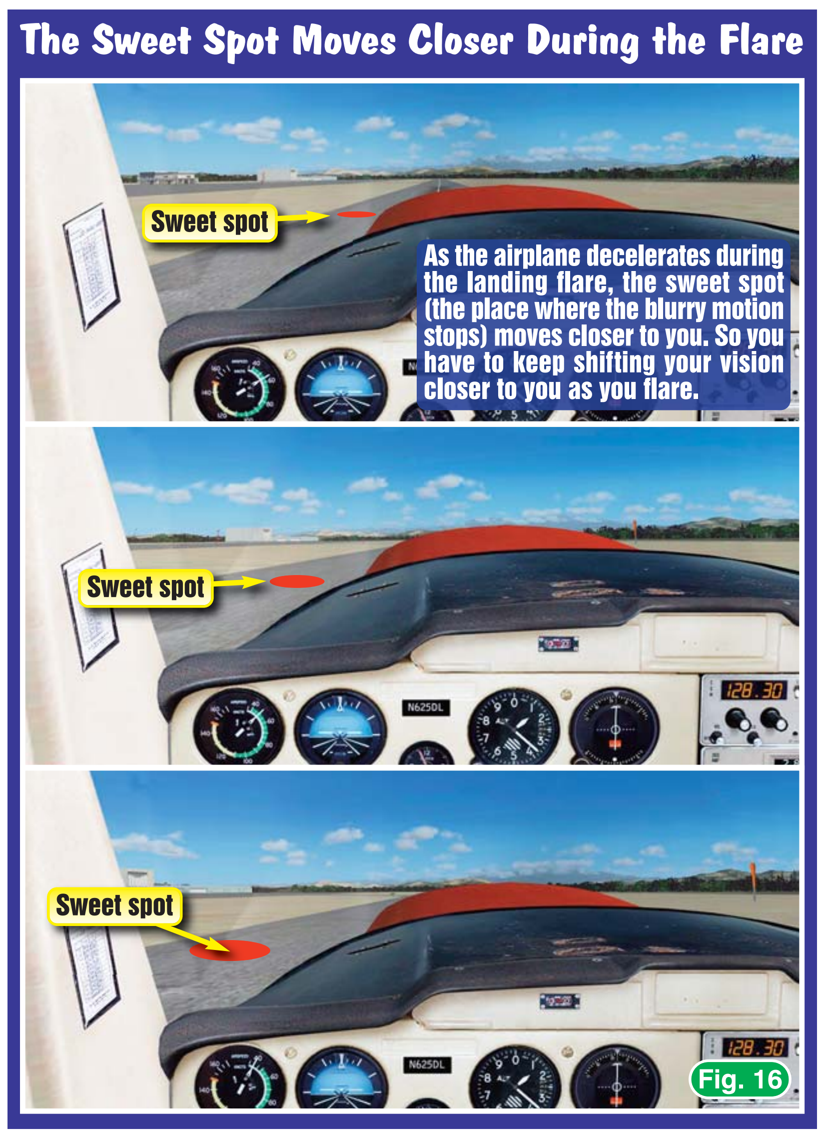
You should also be aware that the sweet spot ahead of you where the blurry motion stops will appear to move toward you (horizontally) as the airplane slows down during the landing flare (Figure 16). In other words, the sweet spot is approximately 50 to 80 feet ahead of you as you begin the roundout and flare, then it moves closer (think 40 feet, then 30 feet, then...you get the idea, right?) as your speed decreases.

Think about it for a second and you will see just how much sense this makes. When the airplane is stopped on the runway, you can look directly down out your left window and see a non-moving section of the runway with perfect clarity. How sweet is that? That's why you have to continually shift your vision just a little closer toward the airplane during the landing flare to maintain visual contact with the sweet spot.

The Sweet Spot and Where It's Found



The sweet spot is framed by the "pizza slice" triangular area formed between the horizon, the window post and the engine cowling.



feel as safe as you'd like it to be. These are the times when you must quickly reconfigure your mind *and* your airplane; both were set up to land, and now must be briskly transitioned into the right attitude for a *go around*.

The go around is just what the name says—you go around and try again. The go around is a maneuver that can be started at any altitude. You must be mentally and physically prepared to initiate a go around at any moment until the airplane is on the ground and safely off the runway (Figure 37).

Whether at 500 feet or in the flare, all go arounds begin the same way—with the application of climb power (Figure 38). Smoothly move the throttle handle forward. Don't jab it into and through the instrument panel. If carburetor heat had been applied, it should be turned off in order to maximize power production.

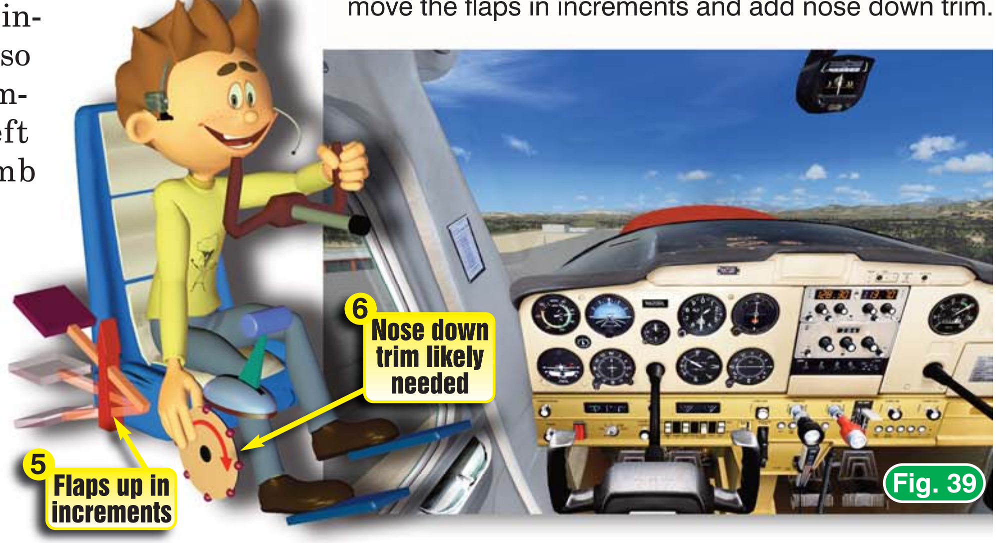
Because you've probably had the airplane trimmed for landing, when you apply climb power with flaps extended the airplane will tend to pitch nose-up quite dramatically. You might need to apply a great deal of forward elevator pressure to keep the nose attitude from increasing excessively. You'll also need a lot of right rudder to compensate for the airplane's left turning tendency with climb power applied (Figure 39).

Your objective after power is applied is to select an attitude that allows the airplane to accelerate to climb airspeed. In most instances, the airplane is already close to its climb airspeed so climb attitude can be immediately selected.

Executing a Go Around

You never quite know what might prevent you from landing on a runway. It can be a wandering animal, someone in a dragster (yep, that's happened) or a tower controller's command to execute a go around.

The first step is to add climb power, simultaneously raise the nose to climb attitude and remove any carb heat applied. You'll need to add right rudder, too. Next you'll need to remove the flaps in increments and add nose down trim.



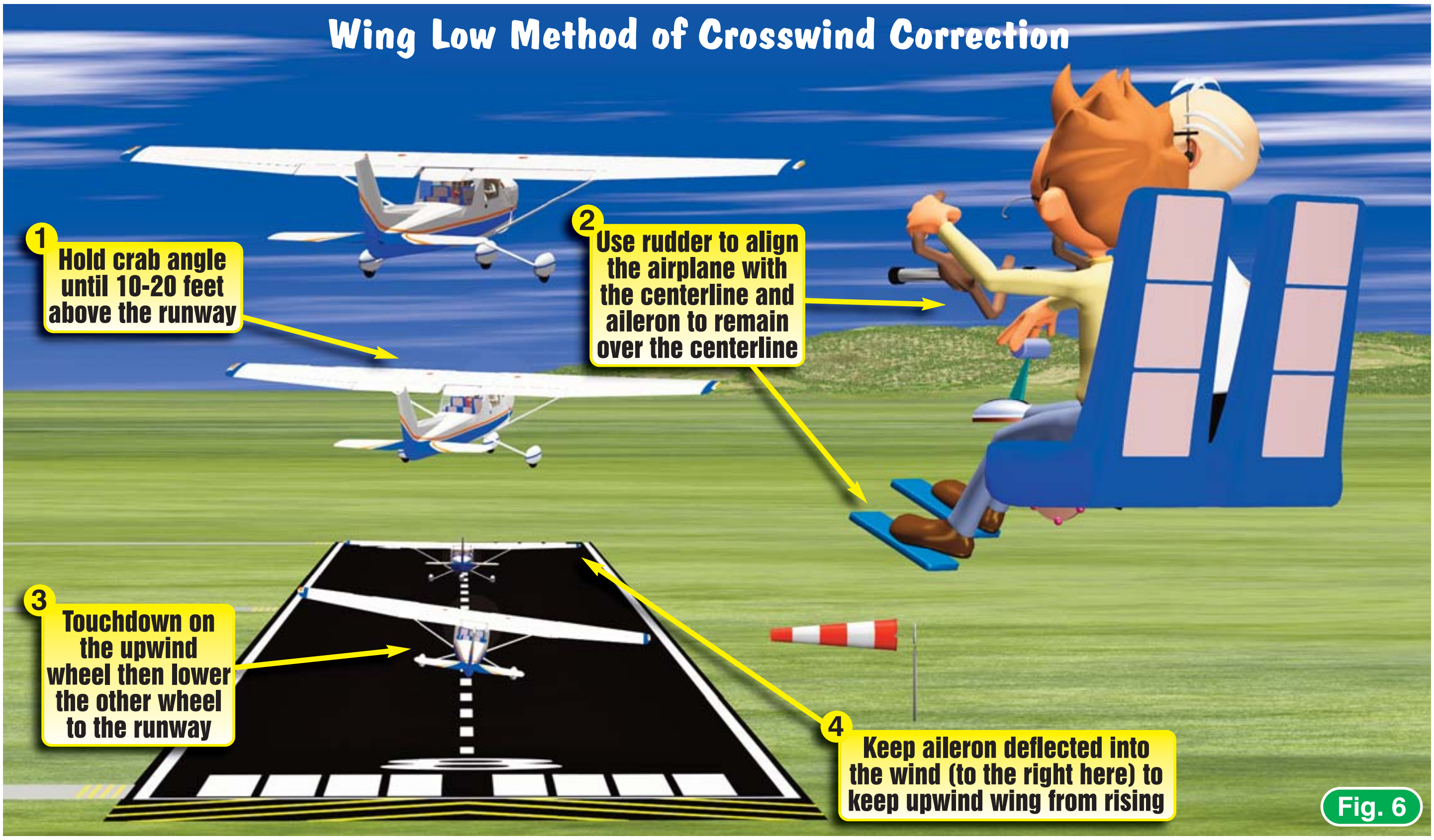


Fig. 6

Does this sound challenging? Well, it is. It can even be challenging for experienced pilots, but it's a perfectly acceptable way to handle a crosswind. While I certainly introduce the crab method to my students, I actually prefer that they use what's called the *wing low* method of crosswind correction. So what's the low down on the wing low method? Let's find out.

The Wing Low Method

Rumors that the *wing low* method of landing was created on the back of a napkin at a dingy Chinese restaurant are mostly not true. The restaurant was not dingy. The same maneuver was diagrammed at a Mexican-Chinese fusion place and dubbed the *Juan wing low*. Call it whatever you like, but we're calling it the wing low method of crosswind correction. This method of crosswind correction is a far easier method of preventing crosswind drift just prior to touchdown than the crab method, and from our rule that "easier is better," we can conclude that it is the better choice.

With this method, you use the rudder pedals to keep the airplane's longitudinal axis aligned with the runway centerline while deflecting the ailerons to correct for wind drift. This allows you to slip sideways into the wind while not exposing the main landing gear to excessive sideways stress at the moment of touchdown (it is also called the *sideslip* crosswind technique, too). Yes, you'll touch down on one wheel (the upwind wheel) after which you'll gently lower the other main gear wheel to the ground (followed by the nosegear last) while maintaining directional control of the airplane. Let's take a closer look at this maneuver, which has you slip sliding away.

Up to a point before the roundout begins (or even a little before that, if you like) you're maintaining the required crosswind correction by crabbing into the wind. Now you activate the wing low method. As you begin the roundout and the subsequent flare, apply whatever rudder is needed to align the airplane's longitudinal axis (the airplane's nose) with the runway centerline, and control for drift by using the ailerons (Figure 6).

If the drift resulting from the sideslip matches the amount of wind drift, the airplane remains directly over and tracks the runway centerline. So deflect the yoke into the wind until the airplane

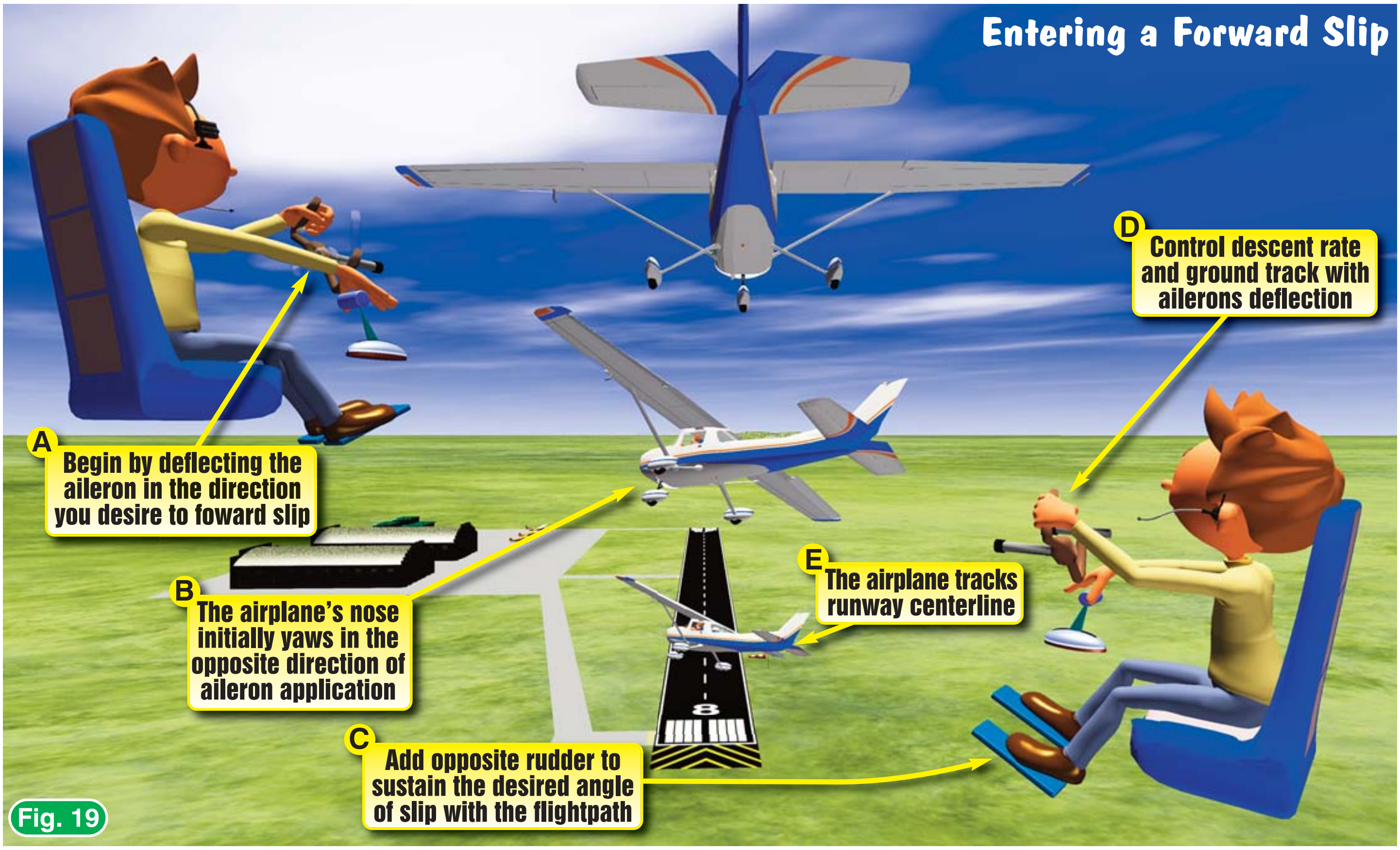


Fig. 19

limited by the efficiency of the airplane's rudder to maintain a heading at an angle to the flight path. This is known as the airplane's *practical slip limit*. For a dress, this is the length of hemline.

On airplanes with smaller rudder surfaces, it's difficult to induce more than a moderate amount of forward slipping. Fly an airplane with a large rudder surface and you'll be surprised at how steep the slip angle can be. Then again, even in airplanes that can make steep forward slips, it's not always necessary to slip steeply. You only need to deflect the rudder and aileron to the degree necessary to achieve the required descent rate (Figures 20 and 21). A little slip will do ya.

In a slip, one side of the fuselage is exposed to the relative wind, which produces an enormous increase in drag. This requires you to reduce the pitch attitude (decrease the wings' angle of attack) sufficiently to maintain the correct approach speed. In doing so you're actually moving slightly farther from the critical angle of attack. The exposure of the side of the airplane's fuselage to the relative wind is also providing some of the lift sustaining the airplane in a nonaccelerated descent (meaning that the airspeed can remain constant while descending).

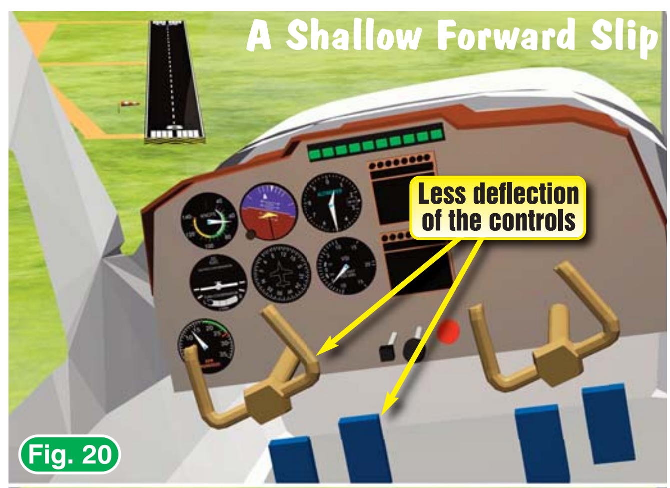
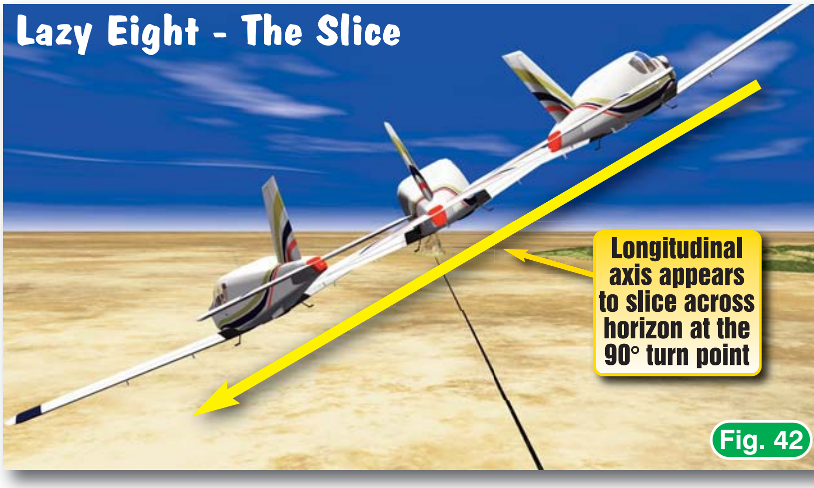


Fig. 20

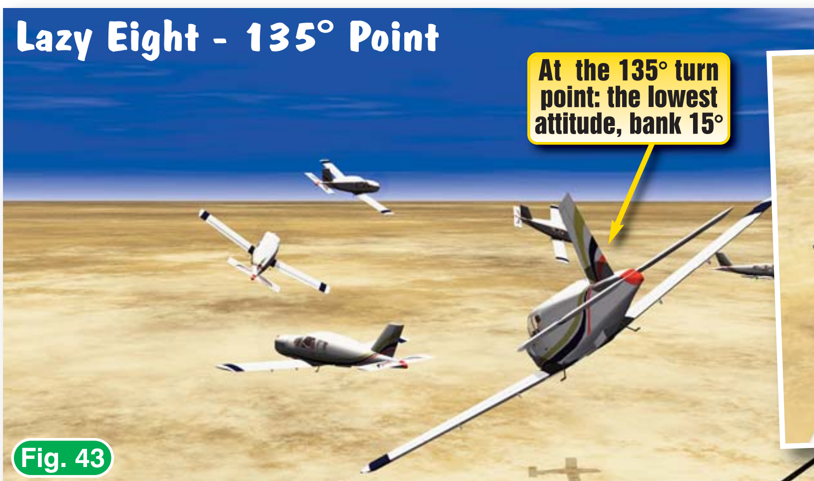
Fig. 21



At 90 degrees of turn, the airplane's longitudinal axis is parallel to the earth's surface and *appears* to slice through the horizon on its way to the 135 degree turn point. The slicing motion is more of a personal perception based on the use of proper aileron and rudder coordination at slow airspeeds.

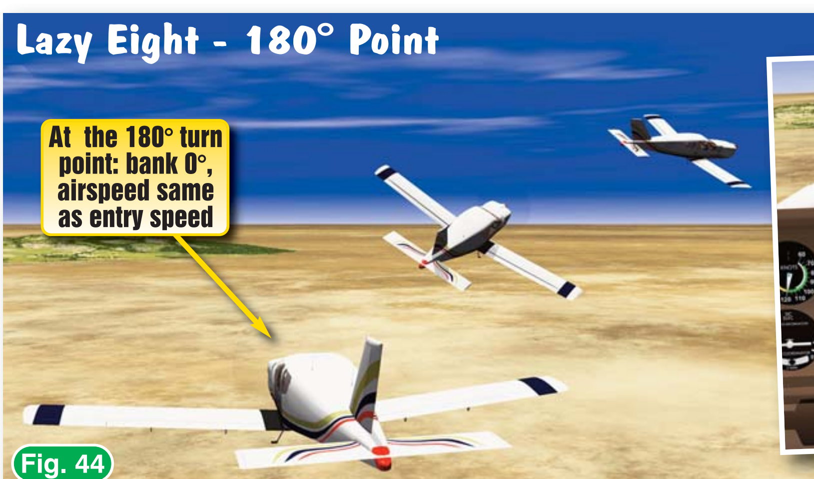
Keep in mind that from 45 degrees up to 90 degrees of turn, the nose is always elevated (to some degree) above the horizon. Therefore your airspeed continues to decrease until reaching 90 degrees of turn (to approximately 5-10 knots above stall speed). At this point, the airplane's nose (it's actually the longitudinal axis, but we'll use *nose* here) appears to slice diagonally through the distant reference point (Figure 42) as it descends below the horizon and heads toward the 135 degree of turn point.

Past 90 degrees of turn, the attitude continues to decrease while the airspeed increases and the bank decreases. Your objective is to reach the lowest pitch attitude for this maneuver at 135 degrees of turn at approximately 15 degrees of bank and airspeed increasing in value toward your entry speed as shown in Figure 43.



At the 135 degree turn point, the airplane should reach its lowest pitch attitude while the airspeed continues to increase. Bank should be approximately half the starting bank, or 15 degrees.

From 135 degrees to 180 degrees of turn, the pitch attitude increases, the airspeed increases and the bank continues to decrease (Figure 44). At 180 degrees of turn, you should be in wing's level flight (albeit for only a fraction of a second) at the same altitude and airspeed at which you entered the maneuver. At this point you'll immediately, without hesitation, repeat the maneuver in the opposite direction. The maneuver continues in right and left turns until the



The airplane should pass through the 180 degree turn point in a wings level attitude at the same altitude and speed used upon entry. Here you'll immediately continue with a lazy eight in the opposite direction.