Regina Flying Club Tailwheel Training Handout

Purpose and Intent

Tailwheel flying builds fundamental abilities, develops disciplined aircraft control, and refines core flying skills that apply across all aircraft types and environments. It also opens access to advanced flying opportunities such as aerobatics, bush and backcountry operations, and vintage aircraft. The intent of this course is to train capable, confident pilots who can safely operate tailwheel aircraft while pursuing a higher level of flying mastery.

Requirements

- Valid Student Pilot Permit or higher with valid Medical
- No formal regulatory requirements in Canada to fly Tailwheel aircraft (based solely on proficiency of each pilot learning to fly) as long as you have a SEL licence (Single Engine Land Aeroplane)

Note: There are no set time requirements for tailwheel training and no exams to complete. This means tailwheel training is a very individualized course and is based on each pilot's comfort and proficiency in the aircraft but also dependent on what the student is wanting to accomplish from this training. As a rough estimate for a licenced pilot you can expect roughly 5 hours dual flight time to be ready to solo under ideal weather conditions. If you plan on renting this aircraft, time building or flying more than just a first solo, then plan on it taking roughly 10 hours (including some more supervised solo time). Total time is all dependent on the student's ability to learn new things and their proficiency in flight.

Study Material

- This handout and RFC reference Material
- Pilot Operating Handbook - for the type of aircraft you are training on (The POH is one of, if not the best sources of information when you are learning to fly a new type of aircraft. A thorough and comprehensive understanding of the Pilot Operating Handbook is essential for success during this course.
- Airplane Flying Handbook Chapter 14: Transition to Tailwheel Airplanes https://www.faa.gov/sites/faa.gov/files/regulations_policies/handbooks_manuals/aviation/airplane_handbook/15_afh_ch14.pdf
- Tailwheel Conversion Handbook – Citabria 7ECA 2nd Edition by David LeFrancois
- https://youtu.be/E3q2Swzi2q8?si=2T0C7HvygBhfTDOP
- https://youtu.be/Ow_x0O8a53Q?si=OjJGBTBho7onFJzC

Flight Training (Basic Tailwheel checkout)

Note: This syllabus is to be used as a guideline for reference only. As each student has different levels of experience and knowledge, each lesson will be based on individual student proficiency on each topic.

1. **Basic Introduction to Tailwheel Flying**
   - Pre-Flight Inspection & Cockpit Orientation/Familiarization
   - Weight and Balance
   - Basic Operations of Tailwheel Aircraft
     - Differences from Tricycle gear aircraft
     - Center of Gravity - Instability
     - Taxiing (control and visibility)
     - Yawing Tendencies (on ground and in flight)
     - Ground Loops
   - Handling characteristics (speeds)
   - Upper Airwork review

Depending on time, this first lesson may just be a ground briefing. If there is time it will include a short introductory flight to familiarize the student with the feel and handling of the aircraft including upper air work review and maybe an intro to circuit

2. **Normal Operations**
   - Cover Normal operations of flying this aircraft
   - Taxiing
   - Climb/cruise/descent
   - Normal Takeoff/Landing

3. **Takeoff, Circuit and Landing**
   - Takeoffs (normal)
   - Circuit (speeds, power settings, checks)
   - Landings (Normal – 3-point)

4. **Takeoff, Circuit and Landing**
   - Crosswind takeoffs and landings (3 Point)

5. **Takeoff, Circuit and Landing**
   - Review to proficiency

6. **First tailwheel solo**
    - Review with instructor for procedure and expectations
    - Complete a few solo circuits doing 3-point landings under light favourable wind conditions

* The above lessons will be approximately 1 hour each (some may be a bit longer; others may be a bit shorter). This syllabus is intended to be a guide only and times for completion will vary with each individual's progression in their training.

Flight Training (Advanced Tailwheel checkout)

Basic tailwheel checkout course required before this course

1. **Takeoff, Circuit and Landing (Dual)**
    - Takeoffs (normal)
    - Circuit (speeds, power settings, checks)
    - Accurate Landings with touchdown spots (Normal – 3-point)

2. **Complete above lesson solo**

3. **Wheel Landings (Dual)**
    - Wheel landings
        - Both under normal and cross wind conditions

4. **Wheel Landings (Dual)**
    - Accurate Wheel Landings with touchdown spots
        - Both under normal and cross wind conditions

5. **Complete above lesson solo**

6. **Soft/Short Field Takeoff and landings (Dual)**
    - Conduct soft/short field takeoffs and landings at a local grass runway (conditions permitting)
7. **Optional Night Checkout**
    - If you want to fly the Citabria at night, you must complete a night checkout with an instructor

* The above lessons will be approximately 1 hour each (some may be a bit longer; others may be a bit shorter). This syllabus is intended to be a guide only and times for completion will vary with each individual's progression in their training.

Students who want to rent the Citabria must successfully complete the advanced Tailwheel Checkout and then will be subject to RFC rental policy for this type of aircraft (30-day recency for less than 100 hours on taildraggers. 60-day recency for more than 100 hours on taildraggers). RFC reserves the right to reschedule rentals if weather is expected to exceed pilots demonstrated cross wind handling or other limitations.

Weather & Wind Limitations

Tailwheel operations require conservative wind limits due to the aircraft's directional sensitivity. The limits below are absolute maximums. Each student will be assigned personal limits by their instructor, which may be lower and must be strictly followed. No pilot may exceed either their personal limit or the club maximum.

Given we live in Saskatchewan and it's known to be windy, generally planning flights earlier in the morning or later in the evenings can be beneficial to take advantage of favourable wind conditions during those times.

Dual Training Maximum Limits (Instructor Discretion)

Maximum wind: 25 knots gusting 30
Maximum crosswind component (including gusts): 15 knots
Runway must be dry, unless the instructor authorizes otherwise for specific training purposes.

Solo Maximum Limits (Instructor discretion)

Maximum wind: 15 knots gusting 20
Maximum crosswind component (including gusts): 8 knots
Solo operations are prohibited on wet, icy, slushy, or contaminated runways.

Each pilot will have lower personal limits set by their instructor until proficiency is demonstrated.

Note: Instructor-assigned personal limits are binding and may be adjusted only by the instructor or Chief Flight Instructor based on demonstrated performance and currency.

Solo Authorization Policy

Pilots with less than 15 hours Pilot-in-Command (PIC) time on tailwheel aircraft must receive instructor approval prior to each solo flight. This requirement ensures consistent oversight during the initial proficiency-building phase.

Once a pilot has accumulated 15 hours PIC tailwheel time and has been assessed as proficient by an instructor, they may conduct solo flights without individual sign-off. However, they must operate within the crosswind and weather limits assigned to them by their instructor, which will be recorded in their training file.

Note: Instructors and the Chief Flight Instructor retain the authority to require additional supervision or limit solo privileges at any time based on proficiency, recency, or runway/operational conditions.

Overshoot (Go-Around) Policy

A go-around is a standard safety procedure and must be initiated immediately when a safe landing cannot be assured. Tailwheel aircraft are particularly sensitive during landing and rollout.

An overshoot must be initiated if any of the following occur, including but not limited to:

- Loss of directional control or runway alignment
- Lateral drift or inability to maintain centerline
- Ballooning, excessive bounce, or uncontrolled sink
- Speed, configuration, or approach stability not within limits
- Touchdown point cannot be made within the first third of the runway
- Any doubt exists regarding a safe and controlled landing or rollout

Pilots are expected to overshoot early and decisively rather than attempt to salvage an unstable landing. There is no penalty or negative judgment for conducting a go-around. Overshooting is considered good airmanship and an essential part of tailwheel safety.

Citabria Performance and Specifications

Aircraft Care and Handling

This is a fabric-covered tailwheel aircraft and must be handled with care to prevent damage. Pilots will be briefed on how to push, pull, position, and secure the aircraft correctly, as improper handling can cause structural harm. Many flying clubs and schools have been forced to discontinue tailwheel programs due to preventable damage and increased risk. The continued success of this program relies on each pilot demonstrating discipline, respect for the aircraft, and adherence to proper handling procedures on the ground and in the air.

Responsible aircraft handling ensures the aircraft remains safe, airworthy, and available for all members.

1972 Bellanca Citabria 7ECA (C-FAVS)

Refer to the aircraft POH for more detailed information on performance. The below numbers are given for reference and are calculated using the aircraft performance charts at max gross weight under standard conditions at sea level. Do not use these numbers for aircraft performance calculations, refer to the POH.

Engine	Lycoming four-cylinder normally aspirated, 115 hp
Engine	Lycoming O-235-C1
Engine	Air-cooled, carburetted
Max RPM	2800 rpm
Propellers	McCauley – 1C90CLM fixed pitch 2 bladed
Seats	2 (tandem – front and back)
Wingspan	33' 5"

Empty Weight	1,096.0 lbs
Weight with Full Fuel	1,252.0 lbs
Gross Weight	1,650.0 lbs
Baggage Area (Aft)	100 lbs max

Take-off Run (sea level)	450'
Take-off Over 50 ft Obstacle (sea level)	890'
Landing Roll	400'
Landing Over 50 ft Obstacle (short field)	775'

Cruise Power	2400-2600 rpm (for VFR manoeuvring)
Climb Power	Full
Fuel consumption	POH says 6 gph at 75% power (plan for 7 gph at 75%)
Total Fuel Capacity	26 gallons (13 gallons per side)
Useable Fuel	26 gallons (13 gallons per side)
Unusable Fuel	0 gallons
Oil Capacity	5 qts (run it between 4-5 qts)

Service Ceiling	12,000 ft
Best Rate of Climb	725 fpm

Speeds

Never Exceed (Vne)	162 mph (red line)
Caution Range (smooth air)	120 – 162 mph (yellow arc)
Normal Operating Range	51 – 120 mph (green arc)
Max. Structural Cruising (Vno)	120 mph
Maneuvering Speed (Va)	120 mph
Stall (Vs)	51mph
Max Demonstrated Crosswind Component	17 kts (~20mph)
Best Angle (Vx)	60 mph
Best Rate (Vy)	73 mph
Normal Climb	80 mph

Rotation (Vr)	60 mph

Approach Speeds:

- 3-point landing	80 mph base, 70 mph final
- Wheel landing	80 mph base, 75-80 mph final
- Crosswind	Approach slightly higher speeds for gusts

Aerobatics

The Citabria is approved for aerobatics, hence the name Citabria is “Airbatic” spelled backwards. HOWEVER, RFC policy states no person shall conduct Aerobatics in any RFC aircraft (including the Citabria) unless authorized by the CFI or an RFC Aerobatic Instructor.

LANDPLANE APPROVED FOR ONLY FOLLOWING ACROBATIC MANEUVERS

MANEUVER	ENTRY SPEED IAS	
	MPH	KNOTS
CHANDELLE, LAZY EIGHT	120	104
BARREL OR SLOW ROLL	120	104
IMMELMANN	145	126
LOOP OR CLOVER LEAF	140	122
SPLITS	80	70
SNAP ROLL	85	74
HAMMERHEAD TURN	140	122
CUBAN EIGHT	145	126
SPIN	SLOW DECELERATION	

DO NOT EXCEED +5.0 OR -2.0 G LOAD FACTOR. DO NOT EXCEED 135 MPH IAS DURING NEGATIVE G CONDITIONS. DO NOT PERFORM ACROBATICS IN TURBULENT AIR. CAUTION: NEGATIVE G FLIGHT WILL CAUSE LOSS OF OIL AND OIL PRESSURE. TO RECOVER FROM SPIN USE FULL OPPOSITE RUDDER AND NEUTRALIZE ELEVATOR.
Note: The Aircraft POH has slightly different speeds/maneuver listed, the above list comes from AD 77-22-05 which has been complied with on C-FAVS and therefore the above list of aerobatic maneuvers and speeds are applicable.

Emergency Procedures

Engine Fire During Start

If fire is believed to be confined to the intake or the exhaust system (result of flooding engine):

1. Continue cranking engine with starter
2. Mixture control – Idle Cutoff
3. Throttle – Full open
4. Inspect aircraft thoroughly for damage and cause prior to restart

If fire persists or is not limited to intake or exhaust system:

1. Mixture Control – Idle cut-off
2. Fuel Shut-off Valve – Off
3. Electrical and Magneto Switches – All off
4. Obtain Fire Extinguisher – Exit Aircraft
5. Direct fire extinguisher through the bottom of the nose cowl or through the cowl inspection door

Engine Fire in Flight

1. Mixture Control – Idle Cut-off
2. Fuel Shut-off Valve – Off
3. Electrical and Magneto Switches – All Off
4. Cabin Heat – Off Front and Rear
5. Use hand fire extinguisher if available
6. Land immediately using "Forced Landing Procedures"

Electrical Fire

And electrical fire is usually indicated by an odour of hot or burning insulation.

1. Electrical Switches – All Off (leave magneto switches ON)
2. Air Vents/Windows – Open if necessary for smoke removal and ventilation
3. Use hand fire extinguisher if available
4. If fire continues, land immediately

If fire/smoke stops and electrical power is required for the remainder of the flight, turn the master switch ON followed by the desired circuit switch. Allow sufficient time between turning on each switch in order that the faulty circuit may be located and switched OFF.

Alternator/Electrical failure

An alternator failure is indicated by a steady discharge on the ammeter.

1. Master Switch – Cycle in attempt to reset the overvoltage relay.
2. If excessive battery discharge continues, turn OFF all nonessential electrical equipment to conserve battery power.
3. Land as soon as practical as the battery will furnish electrical power for a limited time only.

If only one circuit (e.g. Radio) appears to be inoperative, reset the circuit breaker if popped only once. If the circuit breaker pops out again, do not reset.

NOTE:

Engine operation is unaffected by a complete electrical system failure with the exception of the engine starter.

Engine Malfunction

Engine Failure on Take-off

If sufficient runway remains:

1. Throttle – Closed
2. Land using maximum braking after touchdown

If airborne and insufficient runway remains for landing, attempt an engine restart if sufficient altitude permits:

1. Fuel shut-off valve – check on
2. Mixture Control – Full rich
3. Carburetor/Alternate Air – full hot
4. Magneto switches – both on (up)
5. Fuel boost pump – On (7KCAB Only)

If no restart is possible:

1. Select most favourable landing area ahead
2. Flaps – Full down (7GCBC)

Warning:

Maintain flying speed at all times and do not attempt to turn back toward the runway unless sufficient altitude has been achieved.

Engine Air Restart

1. Maintain Airspeed – 65 mph minimum recommended
2. Magneto Switches – Both on (up)
3. Fuel Boost pump – on (7 KCAB only)
4. Mixture – Full Rich or as required at high altitude
5. Fuel shut-off valve – Check on
6. Carburetor/Alternate Air – Full Hot
7. Engine Primer – Check Off (locked)
8. If restart not possible, change throttle, mixture, primer, magneto, carburetor/alternate air heat settings, in attempt to restart
9. Follow "forced landing procedure" if unable to start

Note: The engine starter may be engaged in flight should the engine stop windmilling

Partial Power Loss/Rough Running

1. Follow the engine air restart procedure
2. Land as soon as practical using "Precautionary Landing Approach" procedures.

Carburetor Icing is indicated if a gradual RPM loss is noticed. The carburetor/alternate air should be Full Hot as long as suspected icing conditions exist.

Abnormal Oil Pressure/Temperature Indications

Oil pressure and temperature problems are usually related with one affecting the other. Before any drastic action is taken, cross check other engine instruments and control settings in an attempt to determine the source of the problem.

High oil temperature is generally a result of loss of oil, overheating (note CHT if available) or a malfunctioning oil cooler by-pass valve. If the situation remains unchecked, oil pressure usually drops resulting in possible engine damage. Power should be reduced while maintaining cruise airspeed: place mixture in Full Rich position and land as soon as practical.

Little or no oil pressure is usually caused by failed pressure relief valve, pump, loss of oil, clogged oil line, high oil temperature or a defective gauge. A landing should be made as soon as practical using minimum RPM changes. Plan a "Precautionary Landing Approach" as complete engine failure is possible at any time.

Landing Emergencies

Precautionary Landing Approach

A precautionary landing approach should be used whenever power is still available but a complete power failure is considered imminent. Maintain a higher and closer pattern than normal in attempt to remain in gliding distance of the intended touchdown point. Use the normal landing procedures in addition:

1. Airspeed – 65 mph recommended (60 mph minimum)
2. Throttle – Closed when in gliding distance of runway
3. Flaps – lower as needed to increase approach descent angle (7GCBC only)

Note:

Slipping the aircraft by cross controlling the rudder and ailerons will increase the rate of descent both with or without flaps. If a crosswind exists, place the lower wing into the wind.

Forced Landing (Complete Power Failure)

If the engine cannot be restarted in flight, trim the aircraft to the recommended glide speed. Remain within gliding distance of the intended point of landing. Maintain a higher and closer pattern than normal making allowance for wind.

Additional altitude can be lost by extending flaps (7GCBC) or slipping the aircraft. Diving the aircraft in an attempt to lose altitude when fling into a headwind will only increase the required landing distance.

1. Airspeed – maintain 60-65 mph
2. Mixture – Idle Cut off
3. Fuel Shut-Off Valve – Off
4. Master Switch – On
5. Flaps – Up to increase glide range (7 GCBC)
6. Radio – Mayday 121.5 MHZ
7. Attempt to position the aircraft approximately 100 feet above ground level (AGL) over the intended point of landing.
8. Electrical Switches – All Off
9. On final approach
    a. Airspeed – 65 mph (60 mph minimum)
    b. Flaps – Down after intended point of landing assured (7GCBC)
10. Touchdown with minimum airspeed (three-point full stall) if landing on rough terrain.

Note:

If necessary, after aircraft has come to a complete stop, remove and activate the emergency locator transmitter from the aircraft for increased transmitting range.

<u>Ditching</u>

Should it become necessary to make a forced landing over water, follow the "forced landing procedures" in addition to the following:

1. Cabin Side Door Jettison
2. Land into wind if high winds are evident or parallel to swells with calm winds
3. Flaps – up (allows higher nose attitude at touchdown – 7GCBC)
4. Contact the water with nose high attitude
5. Do Not Stall prior to touchdown
6. After coming to a complete stop – Exit the aircraft

Note:

Aircraft cannot be depended on to provide floatation after contacting the water.

<u>Severe Turbulence</u>

To prevent overstressing the aircraft do not exceed 120 mph in rough air. To minimize personal discomfort, decrease the IAS below 80 mph. Maintain a level flight attitude rate than flying by reference to the altimeter and airspeed indicator as the pitot-static instruments may become very erratic.

<u>Stalls</u>

The Citabria stall characteristics are conventional. The stall warning horn if installed (not installed on C-FAVS) will proceed the actual stall by 5-10 mph depending on the amount of power used. There is sufficient aerodynamic buffeting preceding the stall to provide the pilot with an adequate warning.

Aileron response in a fully stalled condition is marginal. Large aileron deflections will aggravate near stalled condition and their use is not recommended to maintain lateral control. The rudder is very effective and should be used for maintaining lateral control in a stalled condition with the ailerons placed in the neutral position.

To recover from a stall, proceed as follows:

1. Nose attitude – Lower with forward movement of control stick
2. Throttle – full open simultaneously with control stick movement
3. Use rudder to maintain lateral control

Spins

If a spin is inadvertently entered, immediate recovery should be initiated. The recovery procedure is as follows:

1. Throttle – Closed
2. Rudder – Full deflection opposite direction of rotation
3. Elevator – Slightly forward of neutral
4. Ailerons – Neutral Position

When rotation stops (½ - 1 turn after recovery initiated)

5. Rudder – Neutralize
6. Nose attitude – Raise smoothly to level flight attitude

Warning:

During spin recovery, the airspeed will build very rapidly with a nose low attitude. No not use full or abrupt elevator control movements.

Inflight Overstress

Should an overstress occur due to exceeding the airspeed or load factor limit, aerobatics should be terminated immediately. Fly at a reduced airspeed, (60-70 mph) to a suitable landing point. DO NOT under any circumstance, make large control movements or subject the aircraft to additional G loadings above that required for straight and level flight. After landing, the aircraft should be inspected by a mechanic prior to the next flight.

Emergency Exit/Bail Out

1. Throttle – Closed
2. Door – Jettison using Emergency Jettison Handle
3. Use the cabin door frame for support. Dive straight out and slightly aft of wing struts
4. Parachute – open immediately when clear of aircraft. Preflight and familiarize yourself with operating procedures of the parachute before flight.

Note:

Emergency exit is also possible through the left window.

Airplane Flying Handbook (FAA-H-8083-3C)
Chapter 14: Transition to Tailwheel Airplanes

Introduction

Due to their design and structure, tailwheel airplanes (tailwheels) exhibit operational and handling characteristics different from those of tricycle-gear airplanes (nose-wheels). *[Figure 14-1]* A few aircraft, primarily antique and experimental, may have a tailskid instead of a tailwheel. The same principles discussed in this chapter usually apply to tailskid. In general, tailwheels are less forgiving of pilot error while in contact with the ground than are nose-wheels. This chapter focuses on the operational differences that occur during ground operations, takeoffs, and landings.

Figure 14-1. *The Piper Super Cub on the left is a popular tailwheel airplane. The airplane on the right is a Mooney M20, which is a nose-wheel (tricycle gear) airplane.*

Although still termed "conventional-gear airplanes," tailwheel designs are most likely to be encountered today by pilots who have first learned in nose-wheels. Therefore, tailwheel operations are approached as they appear to a pilot making a transition from nose-wheel designs.

Landing Gear

The main landing gear forms the principal support of the airplane on the ground. The tailwheel also supports the airplane, but steering and directional control are its primary functions. With the tailwheel-type airplane, the two main landing gear struts are attached to the airplane slightly ahead of the airplane's center of gravity (CG), so that the plane naturally rests in a nose-high attitude on the triangle created by the main gear and the tailwheel. This arrangement is responsible for the three major handling differences between nose-wheel and tailwheel airplanes. They center on directional instability, angle of attack (AOA), and crosswind weathervaning tendencies.

Proper usage of the rudder pedals is crucial for directional control while taxiing. Steering with the pedals may be accomplished through the forces of airflow or propeller slipstream acting on the rudder surface or through a direct mechanical linkage or a mechanical linkage acting through springs to turn the tailwheel. Initially, the pilot should taxi with the heels of the feet resting on the floor and the balls of the feet on the bottom of the rudder pedals. The feet should be slid up onto the brake pedals only when it is necessary to depress the brakes. This permits the simultaneous application of rudder and brake whenever needed. Some models of tailwheel airplanes are equipped with heel brakes rather than toe brakes. As in nose-wheel airplanes, brakes are used to slow and stop the aircraft and to increase turning authority when tailwheel steering inputs prove insufficient. Whenever used, brakes should be applied smoothly and evenly.

Instability

Because of the relative placement of the main gear and the CG, tailwheel aircraft are inherently unstable on the ground. As taxi turns are started, the aircraft begins to pivot on one or the other of the main wheels. From that point, with the CG aft of that pivot point, the forward momentum of the plane acts to continue and even tighten the turn without further steering inputs. Ordinarily, removal of rudder pressure does not stop a turn that has been started, and it is necessary to apply an opposite input (opposite rudder) to bring the aircraft back to straight-line travel. For this reason, many tailwheel airplanes are equipped with a centering spring(s) or similar device that returns the tailwheel to a center position upon relaxation of a rudder pedal input. However, this mechanism may not return the airplane to a straight line of travel from a tight turn.

If the initial rudder input is maintained after a turn has been started, the turn continues to tighten, an unexpected result for pilots accustomed to a nose-wheel. In consequence, it is common for pilots making the transition between the two types to experience difficulty in early taxi attempts. As long as taxi speeds are kept low, however, no serious problems result, and pilots typically adjust quickly to the technique of using rudder pressure to start a turn, then neutralizing the pedals as the turn continues, and finally using an opposite pedal input to stop the turn and regain straight-line travel.

Because of this inbuilt instability, the most important lesson that can be taught in tailwheel airplanes is to taxi and make turns at slow speeds.

Angle of Attack

A second strong contrast to nose-wheel airplanes, tailwheel aircraft make lift while on the ground anytime there is a relative headwind. The amount of lift obviously depends on the wind speed, but even at slow taxi speeds, the wings and ailerons are doing their best to aid in liftoff. This phenomenon requires care and management, especially during the takeoff and landing rolls, and is again unexpected by nose-wheel pilots making the transition.

Taxiing

On most tailwheel-type airplanes, directional control while taxiing is facilitated by the use of a steerable tailwheel, which operates along with the rudder. The tailwheel steering mechanism remains engaged when the tailwheel is operated through an arc of about 30° each side of center. Beyond that limit, the tailwheel breaks free and becomes full swiveling. In full swivel mode, the airplane can be pivoted within its own length, if desired. While taxiing, the steerable tailwheel should be used for making normal turns and the pilot's feet kept off the brake pedals to avoid unnecessary wear on the brakes.

When beginning to taxi, the brakes should be tested immediately for proper operation. This is done by first applying power to start the airplane moving slowly forward, then retarding the throttle and simultaneously applying pressure smoothly to both brakes. If braking action is unsatisfactory, the engine should be shut down immediately.

To turn the airplane on the ground, the pilot should apply rudder in the desired direction of turn and use whatever power or brake necessary to control the taxi speed. At very low taxi speeds, directional response is sluggish as surface friction acting on the tailwheel inhibits inputs through the steering springs. At normal taxi speeds, rudder inputs alone should be sufficient to start and stop most turns. During taxi, the AOA built in to the structure gives control placement added importance when compared to nose-wheel models.

When taxiing in a quartering headwind, the upwind wing can easily be lifted by gusting or strong winds unless ailerons are positioned to "kill" lift on that side (stick held into the wind). This is standard control positioning for both nose-wheel and tailwheel airplanes, so the difference lies only in the added tailwheel vulnerability created by the fuselage pitch attitude. At the same time, elevator should usually be held full back to add downward pressure to the tailwheel assembly and improve tailwheel steering response. However, in a strong quartering headwind a wing could lift, and the elevator may be held closer to neutral.

When taxiing with a quartering tailwind, this fuselage angle reduces the tendency of the wind to lift either wing. Nevertheless, the basic vulnerability to surface winds common to all tailwheel airplanes makes it essential to be aware of wind direction at all times, so holding the stick away from the crosswind is good practice (left aileron in a right quartering tailwind).

Elevator positioning in tailwinds is a bit more complex. Standard teaching tends to recommend full forward stick in any degree of tailwind, arguing that a tailwind striking the elevator when it is deflected full down increases downward pressure on the tailwheel assembly and increases directional control. Equally important, if the elevator were to remain deflected up, a strong tailwind can get under the control surface and lift the tail with unfortunate consequences for the propeller and engine.

While stick-forward positioning is essential in strong tailwinds, it is not likely to be an appropriate response when winds are light. The propeller wash in even lightly-powered airplanes is usually strong enough to overcome the effects of light tailwinds, producing a net headwind over the tail. This in turn suggests that back stick, not forward, does the most to help with directional control. If in doubt, it is best to sample the wind as you taxi and position the elevator where it will do the most good.

Weathervaning

Tailwheel airplanes have an exaggerated tendency to weathervane, or turn into the wind, when operated on the ground in crosswinds. This tendency is greatest when taxiing with a direct crosswind, a factor that makes maintaining directional control more difficult, sometimes requiring use of the brakes when tailwheel steering alone proves inadequate to counteract the weathervane effect.

Visibility

In the normal nose-high attitude, the engine cowling may be high enough to restrict the pilot's vision of the area directly ahead of the airplane while on the ground. Consequently, objects directly ahead are difficult, if not impossible to see. In aircraft that are completely blind ahead, all taxi movements should be started with a small turn to ensure no other plane or ground vehicle has positioned itself directly under the nose while the pilot's attention was distracted with getting ready to takeoff. In taxiing such an airplane, the pilot should alternately turn the nose from one side to the other (zigzag) or make a series of short S-turns. This should be done slowly, smoothly, positively, and cautiously.

Directional Control

After absorbing all the information presented to this point, the transitioning pilot may conclude that the best approach to maintaining directional control is to limit rudder inputs from fear of overcontrolling. Although intuitive, this is an incorrect assumption: the disadvantages built in to the tailwheel design sometimes require vigorous rudder inputs to maintain or retain directional control. The best approach is to understand the fact that tailwheel aircraft are not damaged from the use of too much rudder, but rather from rudder inputs held for too long.

Normal Takeoff Roll

Wing flaps should be lowered prior to takeoff if recommended by the manufacturer. After taxiing onto the runway, the airplane should be aligned with the intended takeoff direction, and the tailwheel positioned straight or centered. In airplanes equipped with a locking device, the tailwheel should be locked in the centered position. After releasing the brakes, the throttle should be smoothly and continuously advanced to takeoff power. The pilot should carefully avoid applying brake pressure during the takeoff roll.

After a brief period of acceleration, positive forward elevator should be applied to smoothly lift the tail. The goal is to achieve a pitch attitude that improves forward visibility and produces a smooth transition to climbing flight as the aircraft continues to accelerate.

It is important to note that nose-down pitch movement produces left yaw, the result of gyroscopic precession created by the propeller. The amount of force created by this precession is directly related to the rate the propeller axis is tilted when the tail is raised, so it is best to avoid an abrupt pitch change. Whether smooth or abrupt, the need to react to this yaw with rudder inputs emphasizes the increased directional demands common to tailwheel airplanes, a demand likely to be unanticipated by pilots transitioning from nose-wheel models.

As speed is gained on the runway, the added authority of the elevator naturally continues to pitch the nose forward. During this stage, the pilot should concentrate on maintaining a constant-pitch attitude by gradually reducing elevator deflection. At the same time, directional control should be maintained with smooth, prompt, positive rudder corrections. All this activity emphasizes the point that tailwheel planes start to "fly" long before leaving the runway surface.

Liftoff

When the appropriate pitch attitude is maintained throughout the takeoff roll, liftoff occurs when the AOA and airspeed combine to produce the necessary lift without any additional "rotation" input. The ideal takeoff attitude requires only minimum pitch adjustments shortly after the airplane lifts off to attain the desired climb speed.

All modern tailwheel aircraft can be lifted off in the three-point attitude. That is, the AOA with all three wheels on the ground does not exceed the critical AOA, and the wings will not be stalled. While instructive, this technique results in an unusually high pitch attitude and an AOA excessively close to stall, both inadvisable circumstances when flying only inches from the ground.

As the airplane leaves the ground, the pilot should continue to maintain straight flight and hold the proper pitch attitude. During takeoffs in strong, gusty winds, it is advisable to add an extra margin of speed before the airplane is allowed to leave the ground. A takeoff at the normal takeoff speed may result in a lack of positive control, or a stall, when the airplane encounters a sudden lull in strong, gusty wind or other turbulent air currents. In this case, the pilot should hold the airplane on the ground longer to attain more speed, then make a smooth, positive rotation to leave the ground.

Crosswind Takeoff

It is important to establish and maintain proper crosswind corrections prior to liftoff; that is, application of aileron deflection into the wind to keep the upwind wing from rising and rudder deflection as needed to prevent weathervaning.

Takeoffs made into strong crosswinds are the reason for maintaining a positive AOA (tail-low attitude) while accelerating on the runway. Because the wings are making lift during the takeoff roll, a strong upwind aileron deflection can bank the airplane into the wind and provide positive crosswind correction soon after the takeoff roll begins. The remainder of the takeoff roll is then made on the upwind main wheel while the pilot uses rudder to maintain the alignment of the longitudinal axis with the runway. As the airplane accelerates, the pilot smoothly decreases the pitch attitude and adjusts aileron and rudder control pressures to maintain the appropriate crosswind correction. If the pitch attitude remains excessively steep or if it is too flat, crosswind control during the ground roll becomes more difficult. As the aircraft leaves the runway, the wings can be leveled as appropriate drift correction (crab) is established.

Short-Field Takeoff

With the exception of flap settings and initial climb speed as recommended by the manufacturer, there is little difference between the techniques described above for normal takeoffs. After liftoff, the pitch attitude should be adjusted as required for obstacle clearance. However, note that manufacturers of some airplanes, especially of higher power, recommend a short-field technique with liftoff in a three-point attitude. Pilots should always review and follow the airplane manufacturer's recommended procedures.

Soft-Field Takeoff

Wing flaps may be lowered prior to starting the takeoff (if recommended by the manufacturer) to provide additional lift and transfer the airplane's weight from the wheels to the wings as early as possible. The airplane should be taxied onto the takeoff surface without stopping on a soft surface since mud or snow might bog the airplane down. The airplane should be kept in continuous motion with sufficient power while lining up for the takeoff roll. Due to the high power settings, it is usually best to have the elevator full up while taxiing onto the runway in soft conditions. There is not only the danger of the airplane bogging down, but also a danger of it tipping up onto its nose.

As the airplane is aligned with the proposed takeoff path, takeoff power is applied smoothly and as rapidly as the powerplant will accept without faltering. The tail should be kept very low to maintain the inherent positive AOA and to avoid any tendency of the airplane to nose over as a result of soft spots, tall grass, or deep snow.

When the airplane is held at a nose-high attitude throughout the takeoff run, the wings progressively relieve the wheels of more and more of the airplane's weight, thereby minimizing the drag caused by surface irregularities or adhesion. Once airborne, the airplane should be allowed to accelerate to climb speed in ground effect.

Landing

The difference between nose-wheel and tailwheel airplanes becomes apparent when discussing the touchdown and the period of deceleration to taxi speed. In the nose-wheel design, touchdown is followed quite naturally by a reduction in pitch attitude to bring the nose-wheel tire into contact with the runway. This pitch change reduces AOA, removes almost all wing lift, and rapidly transfers aircraft weight to the tires.

In tailwheel designs, this reduction of AOA and weight transfer are not practical and, as noted in the section on takeoffs, it is rare to encounter tailwheel planes designed so that the wings are beyond critical AOA in the three-point attitude. In consequence, the airplane continues to "fly" in the three-point attitude after touchdown, requiring careful attention to heading, roll, and pitch for an extended period.

Touchdown

Tailwheel airplanes are less forgiving of crosswind landing errors than nose-wheel models. It is important that touchdown occurs with the airplane's longitudinal axis parallel to the direction the airplane is moving along the runway. *[Figure 14-2]* Failure to accomplish this imposes side loads on the landing gear which leads to directional instability. To avoid side stresses and directional problems, the pilot should not allow the airplane to touch down while in a crab or while drifting.

There are two significantly different techniques used to manage tailwheel aircraft touchdowns: three-point and wheel landings. In the first, the airplane is held off the surface of the runway until the attitude needed to remain aloft matches the geometry of the landing gear. When touchdown occurs at this point, the main gear and the tailwheel make contact at the same time. In the second technique (wheel landings), the airplane is allowed to touch down earlier in the process in a lower pitch attitude, so that the main gear touch while the tail remains off the runway.

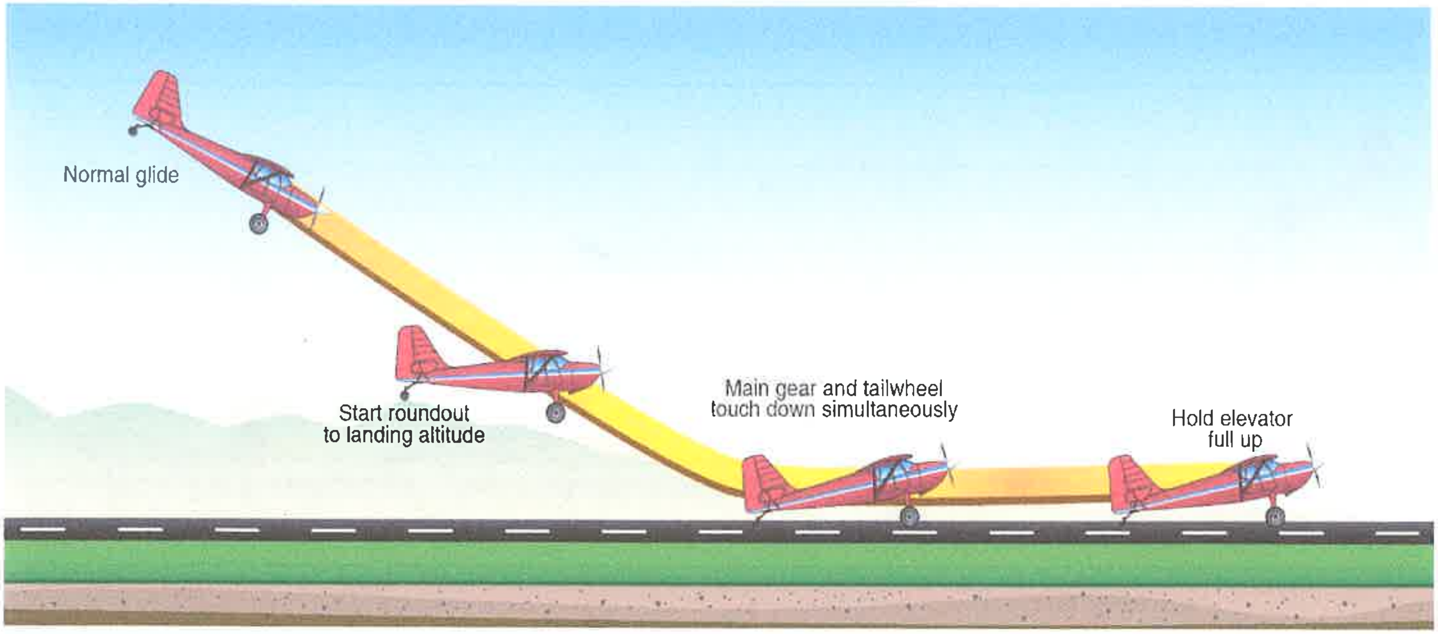

Figure 14-2. *Tailwheel touchdown.*

Three-Point Landing

As with all landings, success begins with an orderly arrival: airspeed, alignment, and configuration well in hand crossing the threshold. Round out (level-off) should be made with the main wheels about one foot off the surface. From that point forward, the technique is essentially the same that is used in nose-wheels: a gentle increase in AOA to maintain flight while slowing. In a tailwheel aircraft, however, the goal is to attain a much steeper fuselage angle than that commonly used in nose-wheel models; one that touches the tailwheels at the same time as the main wheels.

With the tailwheel on the surface, a further increase in pitch attitude is impossible, so the plane remains on the runway, albeit tenuously. With deceleration, weight shifts increasingly from wings to wheels, with the final result that the plane once again becomes a ground vehicle after shedding most of its speed.

There are two potential errors in attempting a three-point landing. In the first, the main wheels are allowed to make runway contact a little early with the tail still in the air. With the CG aft of themain wheells, the tail naturally drops when thmain wheelels touch, AOA increases, and the plane may become airborne again. This "skip" is easily managed by re-flaring and again trying to hold the plane off until reaching the three-point attitude. A large "skip" or bounce may result in being high above the runway with insufficient energy. In these circumstances, the pilot should execute a go-around.

In the second error, the plane is held off the ground a bit too long so that the in-flight pitch attitude is steeper than the three-point attitude. When touchdown is made in this attitude, the tail makes contact first. Provided this happens from no more than a foot off the surface, the result is undramatic: the tail touches, the plane pitches forward slightly onto the main wheels, and rollout proceeds normally.

In every case, once the tailwheel makes contact, the elevator control should be eased fully back to press the tailwheel on the runway. Without this elevator input, the AOA of the horizontal stabilizer develops enough lift to lighten pressure on the tailwheel and render it useless as a directional control with possibly unwelcomed consequences. This after-landing elevator input is quite foreign to nose-wheel pilots and needs to be stressed during transition training.

Note: Before the tailwheel is on the ground, application of full back elevator during the flare lowers the tail, increases the AOA, and quite naturally puts the plane in climbing flight.

Wheel Landing

In some wind conditions, the need to retain control authority may make it desirable to make contact with the runway at a higher airspeed than that associated with the three-point attitude. This necessitates landing in a flatter pitch attitude on the main wheels only, with the tailwheel still off the surface. *[Figure 14-3]* As noted, if the tail is off the ground, it tends to drop and put the plane airborne, so a soft touchdown and a slight relaxation of back elevator just after the wheels touch are key ingredients to a successful wheel landing.

Once the main wheels are on the surface, the tail should be permitted to drop on its own accord until it too makes ground contact. At this point, the elevator should be brought to the full aft position and deceleration should be allowed to proceed as in a three-point landing.

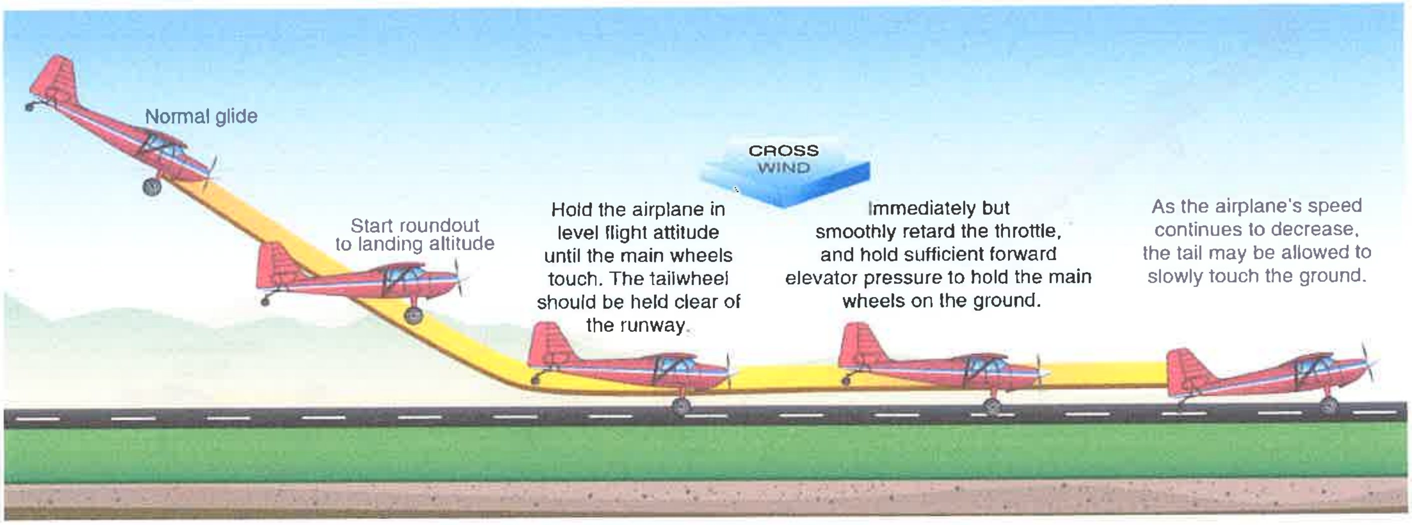

Figure 14-3. *Wheel landing.*

If the touchdown is made at too high a rate of descent, the tail is forced down by its own weight, resulting in a sudden increase in lift. If the pilot now pushes forward in an attempt to again make contact with the surface, a potentially dangerous pilot-induced oscillation may develop. It is far better to respond to a bounced wheel landing attempt by initiating a go-around or converting to a three-point landing if conditions permit.

Note: The only difference between three-point and wheel landings is the timing of the touchdown (early and later). There is no difference between the approach angles and airspeeds in the two techniques.

Crosswinds

As noted, it is highly desirable to eliminate crab and drift at touchdown. By far the best approach to crosswind management is a side-slip or wing-low touchdown. Landing in this attitude, only one main wheel makes initial contact, either in concert with the tailwheel in three-point landings or by itself in wheel landings. Many tailwheel pilots prefer completing a wheel landing in a crosswind, as the initial touchdown speed is higher than for a three-point landing, making the flight controls more effective. In addition, in some aircraft, the rudder effectiveness can be reduced by the blocking effect of the fuselage and flaps with the tail low and on the ground.

After-Landing Roll

The landing process should never be considered complete until the airplane decelerates to the normal taxi speed during the landing roll or has been brought to a complete stop when clear of the landing area. The pilot should be alert for directional control difficulties immediately upon and after touchdown, and the elevator control should be held back as far as possible and as firmly as possible until the airplane stops. This provides more positive control with tailwheel steering, tends to shorten the after-landing roll, and prevents bouncing and skipping.

Any difference between the direction the airplane is traveling and the direction it is headed (drift or crab) produces a moment about the pivot point of the wheels, and the airplane tends to swerve. Loss of directional control may lead to an aggravated, uncontrolled, tight turn on the ground, or a ground loop. The combination of inertia acting on the CG and ground friction of the main wheels during the ground loop may cause the airplane to tip enough for the outside wingtip to contact the ground and may even impose a sideward force that could collapse one landing gear leg. *[Figure 14-4]* In general, this combination of events is eliminated by landing straight and avoiding turns at higher than normal running speed.

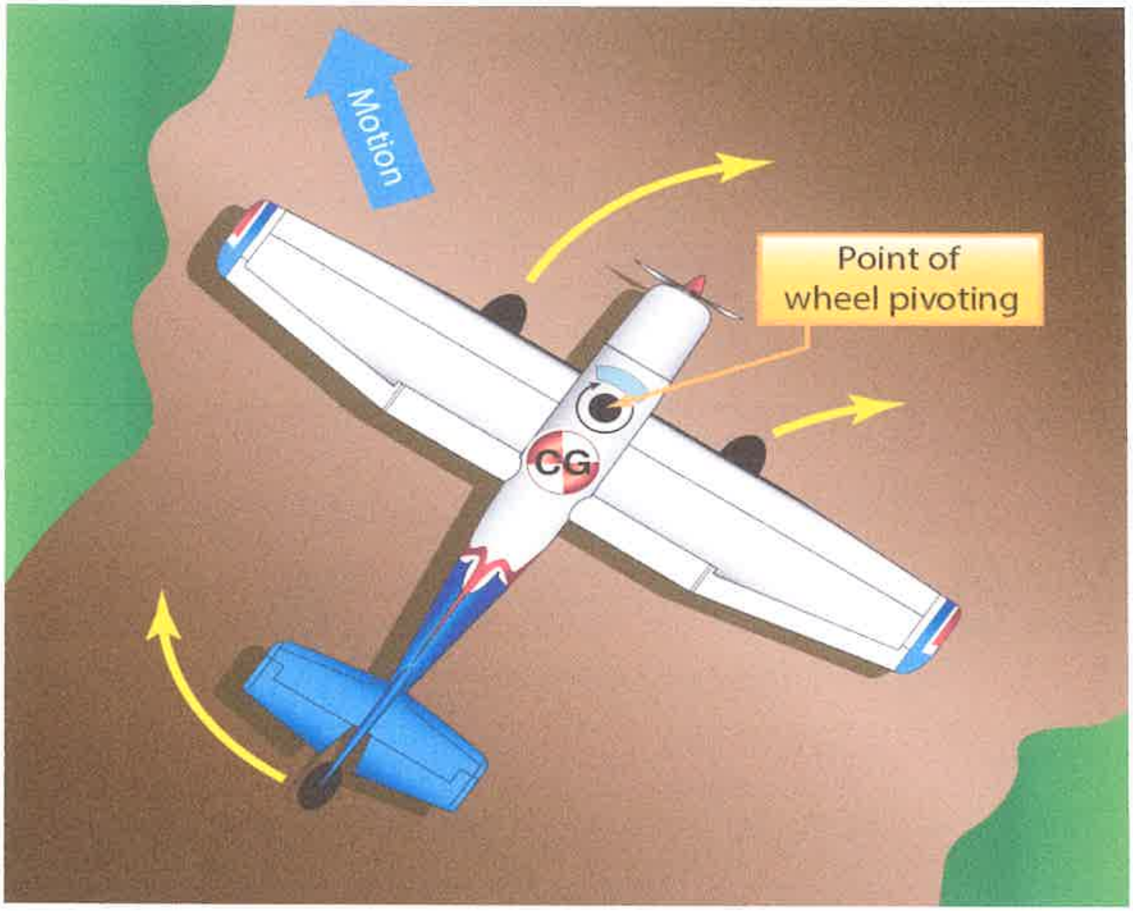

Figure 14-4. *Effect of CG on directional control.*

To use the brakes, the pilot should slide the toes or feet up from the rudder pedals to the brake pedals (or apply heel pressure in airplanes equipped with heel brakes). If rudder pressure is being held at the time braking action is needed, that pressure should not be released as the feet or toes are being slid up to the brake pedals because control may be lost before brakes can be applied. During the ground roll, the airplane's direction of movement may be changed by carefully applying pressure on one brake or uneven pressures on each brake in the desired direction. Caution should be exercised when applying brakes to avoid overcontrolling.

If a wing starts to rise, aileron control should be applied toward that wing to lower it. The amount required depends on speed because as the forward speed of the airplane decreases, the ailerons become less effective.

If available runway permits, the speed of the airplane should be allowed to dissipate in a normal manner by the friction and drag of the wheels on the ground. Brakes may be used if needed to help slow the airplane. After the airplane has been slowed sufficiently and has been turned onto a taxiway or clear of the landing area, it should be brought to a complete stop. Only after this is done should the pilot retract the flaps and perform other checklist items.

Crosswind After-Landing Roll

Particularly during the after-landing roll, special attention should be given to maintaining directional control by the use of rudder and tailwheel steering while keeping the upwind wing from rising by the use of aileron. Characteristically, an airplane has a greater profile or side area behind the main landing gear than forward of it. With the main wheels acting as a pivot point and the greater surface area exposed to the crosswind behind that pivot point, the airplane tends to turn or weathervane into the wind. *[Figure 14-5]* This weathervaning tendency is more prevalent in the tailwheel-type because the airplane's surface area behind the main landing gear is greater than in nose-wheel-type airplanes.

Pilots should be familiar with the crosswind component of each airplane they fly and avoid operations in wind conditions that exceed the capability of the airplane, as well as their own limitations. While the airplane is decelerating during the after-landing roll, more aileron should be applied to keep the upwind wing from rising. Since the airplane is slowing down, there is less airflow around the ailerons and they become less effective. At the same time, the relative wind is becoming more of a crosswind and exerting a greater lifting force on the upwind wing. Consequently, when the airplane is coming to a stop, the aileron control should be held fully toward the wind.

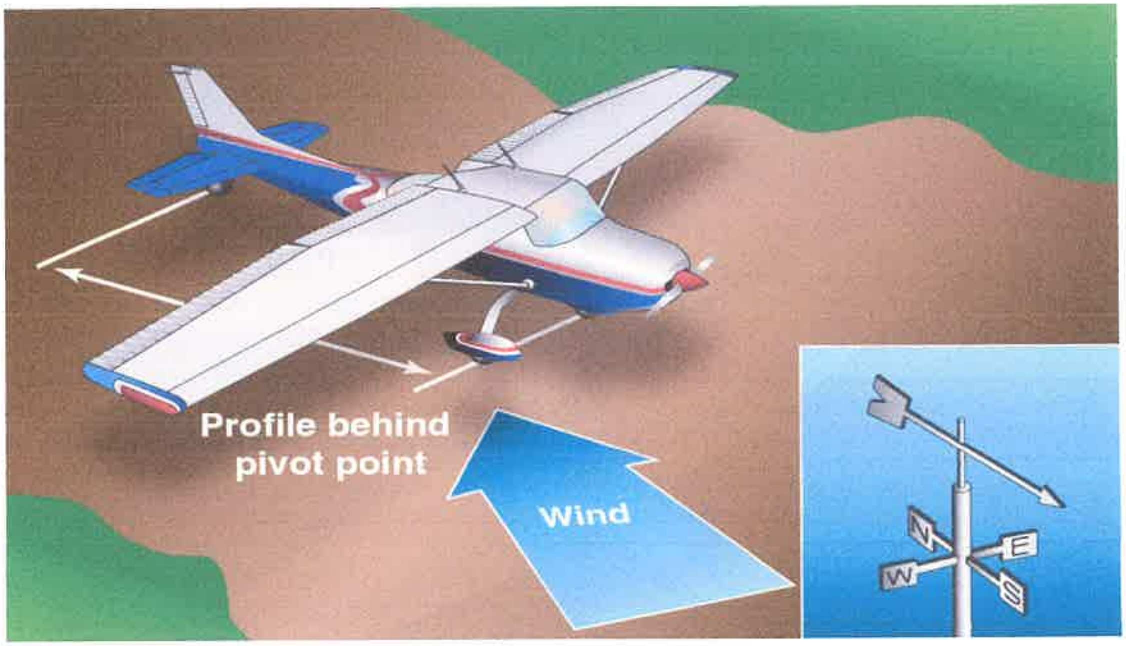

Figure 14-5. *Weathervaning tendency.*

Short-Field Landing

Upon touchdown, the airplane should be firmly held in a three-point attitude. This provides aerodynamic braking by the wings. Immediately upon touchdown and closing the throttle, the brakes should be applied evenly and firmly to minimize the after-landing roll. The airplane should be stopped within the shortest possible distance consistent with safety.

Soft-Field Landing

The tailwheel should touchdown simultaneously with or just before the main wheels and should then be held down by maintaining firm back-elevator pressure throughout the landing roll. This minimizes any tendency for the airplane to nose over and provides aerodynamic braking. The use of brakes on a soft field is not needed because the soft or rough surface itself provides sufficient reduction in the airplane's forward speed. Often, it is found that upon landing on a very soft field, the pilot needs to increase power to keep the airplane moving and from becoming stuck in the soft surface.

Ground Loop

A ground loop is an uncontrolled turn during ground operations that may occur during taxi, takeoff, or during the after-landing roll. Ground loops start with a swerve that is allowed to continue for too long. The swerve may be the result of side-load on landing, a taxi turn started with too much groundspeed, overcorrection, or even an uneven ground surface or a soft spot that retards one main wheel of the airplane.

Due to the inbuilt instability of the tailwheel design, the forces that lead to a ground loop accumulate as the angle between the fuselage and inertia, acting from the CG, increase. If allowed to develop, these forces may become great enough to tip the airplane to the outside of the turn until one wing strikes the ground.

To counteract the possibility of an uncontrolled turn, the pilot should counter any swerve with firm rudder input. In stronger swerves, differential braking is essential as tailwheel steering proves inadequate. It is important to note, however, that as corrections begin to become apparent, rudder and braking inputs need to be removed promptly to avoid starting yet another departure in the opposite direction.

Chapter Summary

This chapter focuses on the operational differences between tailwheel and nose-wheel airplanes that occur during ground operations, takeoffs, and landings. The chapter covers specific topics, such as landing gear, taxiing, visibility, liftoff, and landing. Comparisons are given as to how each react during the takeoff and landing, as well as situations that should be avoided. Pilots who use proper rudder control techniques should be able to transition to tailwheel airplanes without too much difficulty.