- Excessive airspeed on touchdown.
- Failure to apply appropriate flight control inputs during rollout.
- Failure to maintain direction control on rollout.
- Excessive braking.

TURBULENT AIR APPROACH AND LANDING

Power-on approaches at an airspeed slightly above the normal approach speed should be used for landing in turbulent air. This provides for more positive control of the airplane when strong horizontal wind gusts, or up and down drafts, are experienced. Like other power-on approaches (when the pilot can vary the amount of power), a coordinated combination of both pitch and power adjustments is usually required. As in most other landing approaches, the proper approach attitude and airspeed require a minimum roundout and should result in little or no floating during the landing.

To maintain good control, the approach in turbulent air with gusty crosswind may require the use of partial wing flaps. With less than full flaps, the airplane will be in a higher pitch attitude. Thus, it will require less of a pitch change to establish the landing attitude, and the touchdown will be at a higher airspeed to ensure more positive control. The speed should not be so excessive that the airplane will float past the desired landing area.

One procedure is to use the normal approach speed plus one-half of the wind gust factors. If the normal speed is 70 knots, and the wind gusts increase 15 knots, airspeed of 77 knots is appropriate. In any case, the airspeed and the amount of flaps should be as the airplane manufacturer recommends.

An adequate amount of power should be used to maintain the proper airspeed and descent path throughout the approach, and the throttle retarded to idling position only after the main wheels contact the landing surface. Care must be exercised in closing the throttle before the pilot is ready for touchdown. In this situation, the sudden or premature closing of the throttle may cause a sudden increase in the descent rate that could result in a hard landing.

Landings from power approaches in turbulence should be such that the touchdown is made with the airplane in approximately level flight attitude. The pitch attitude at touchdown should be only enough to prevent the nosewheel from contacting the surface before the main wheels have touched the surface. After touchdown, the pilot should avoid the tendency to apply forward pressure on the yoke as this may result in **wheelbarrowing** and possible loss of control. The airplane should be allowed to decelerate normally, assisted by careful use of wheel brakes. Heavy braking should be avoided until the wings are devoid of lift and the airplane's full weight is resting on the landing gear.

SHORT-FIELD APPROACH AND LANDING

Short-field approaches and landings require the use of procedures for approaches and landings at fields with a relatively short landing area or where an approach is made over obstacles that limit the available landing area. [Figures 8-20 and 8-21] As in short-field takeoffs, it is one of the most critical of the maximum performance operations. It requires that the pilot fly the airplane at one of its crucial performance capabilities while close to the ground in order to safely land within confined areas. This low-speed type of power-on approach is closely related to the performance of flight at minimum controllable airspeeds.

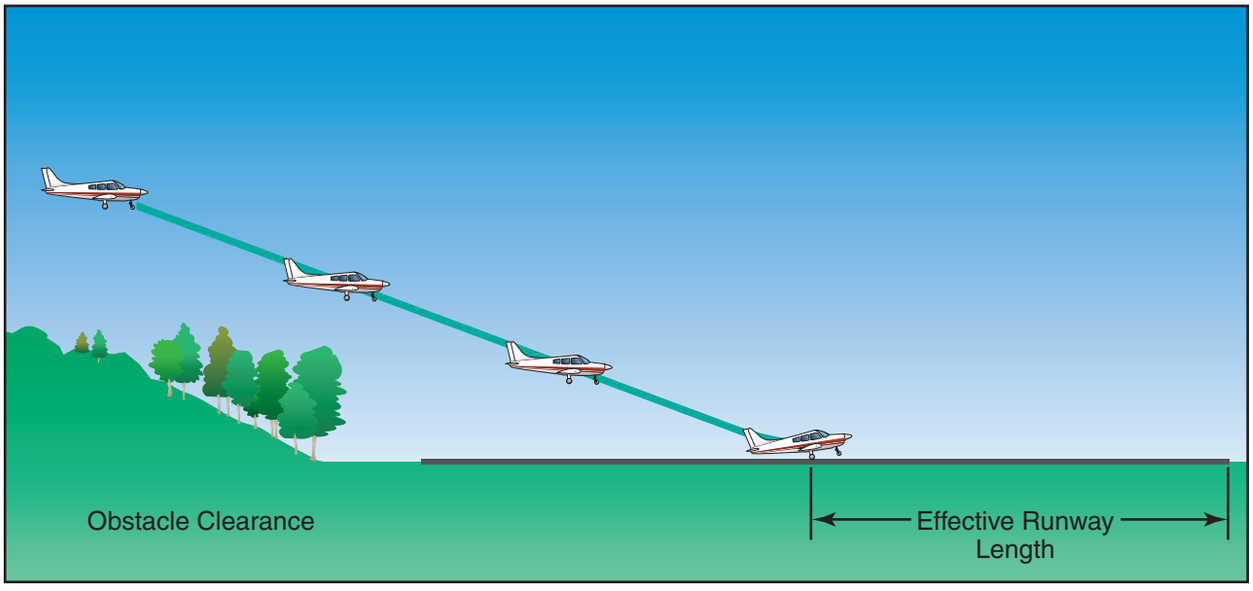

Figure 8-20. Landing over an obstacle.

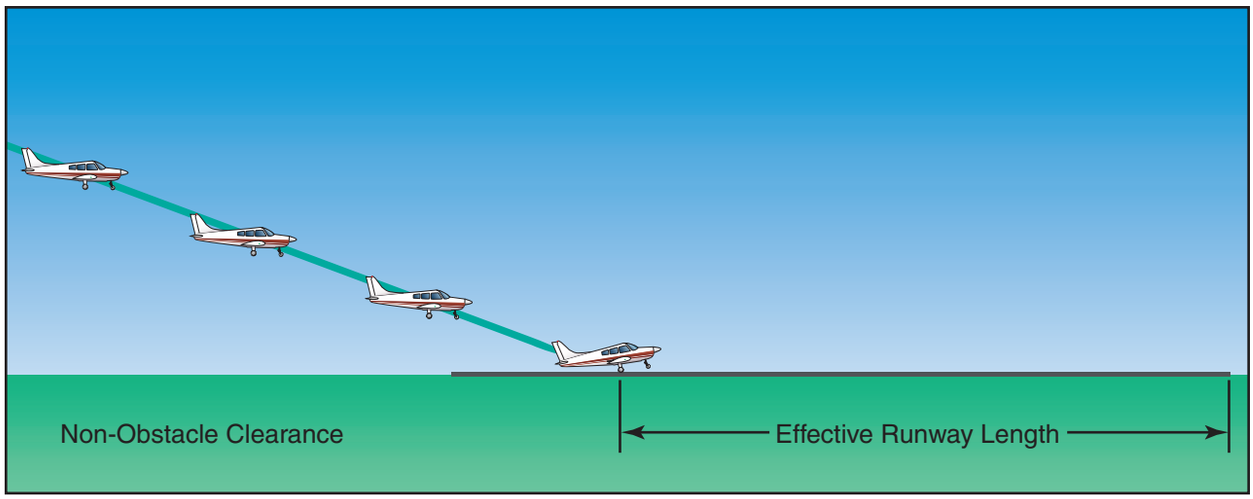

Figure 8-21. Landing on a short-field.

To land within a short-field or a confined area, the pilot must have precise, positive control of the rate of descent and airspeed to produce an approach that will clear any obstacles, result in little or no floating during the roundout, and permit the airplane to be stopped in the shortest possible distance.

The procedures for landing in a short-field or for landing approaches over obstacles, as recommended in the AFM/POH, should be used. A stabilized approach is essential. [Figures 8-22 and 8-23] These procedures generally involve the use of full flaps, and the final approach started from an altitude of at least 500 feet higher than the touchdown area. A wider than normal pattern should be used so that the airplane can be properly configured and trimmed. In the absence of the manufacturer's recommended approach speed, a speed of not more than 1.3 V_{SO} should be used. For example, in an airplane that stalls at 60 knots with power off, and flaps and landing gear extended, the approach speed should not be higher than 78 knots. In gusty air, no more than one-half the gust factor should be added. An excessive amount of airspeed could result in a touchdown too far from the runway threshold or an after-landing roll that exceeds the available landing area.

After the landing gear and full flaps have been extended, the pilot should simultaneously adjust the power and the pitch attitude to establish and maintain the proper descent angle and airspeed. A coordinated combination of both pitch and power adjustments is required. When this is done properly, very little change in the airplane's pitch attitude and power setting is necessary to make corrections in the angle of descent and airspeed.

The short-field approach and landing is in reality an accuracy approach to a spot landing. The procedures previously outlined in the section on the stabilized approach concept should be used. If it appears that the obstacle clearance is excessive and touchdown will occur well beyond the desired spot, leaving insufficient room to stop, power may be reduced while lowering the pitch attitude to steepen the descent path and increase the rate of descent. If it appears that the descent angle will not ensure safe clearance of obstacles, power should be increased while simultaneously raising the pitch attitude to shallow the descent path and decrease the rate of descent. Care must be taken to avoid an excessively low airspeed. If the speed is allowed to become too slow, an increase in pitch and application of full power

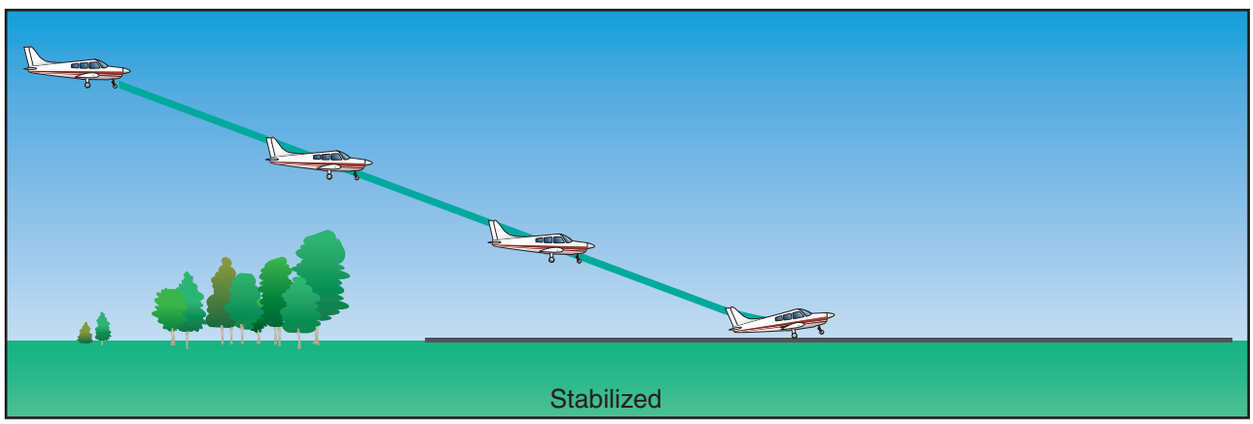

Figure 8-22. Stabilized approach.

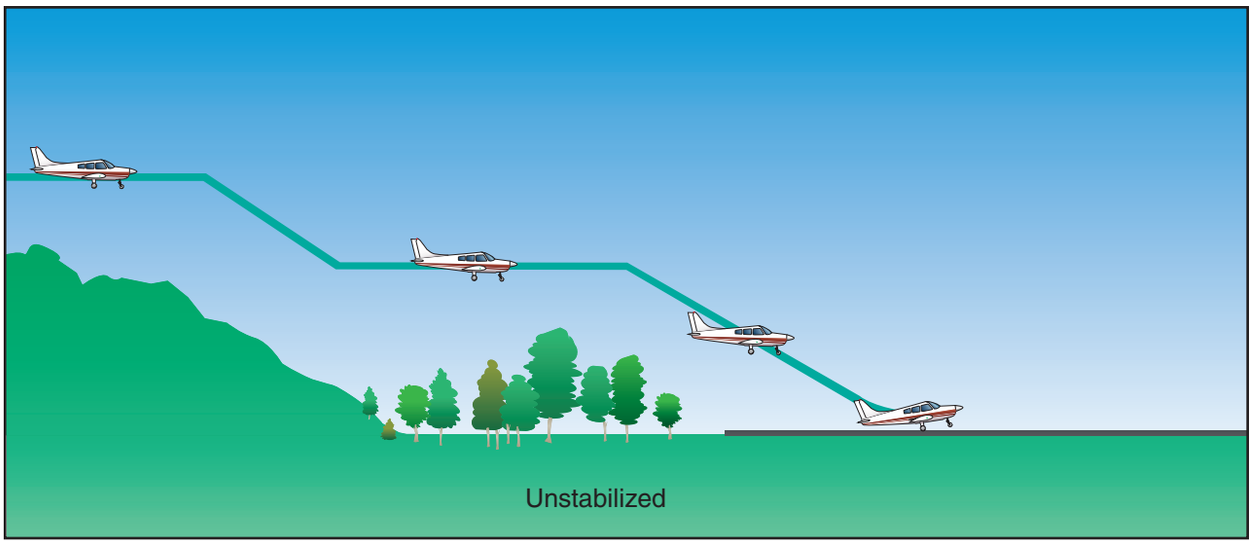

Figure 8-23. Unstabilized approach.

may only result in a further rate of descent. This occurs when the angle of attack is so great and creating so much drag that the maximum available power is insufficient to overcome it. This is generally referred to as operating in the **region of reversed command** or operating on the **back side of the power curve**.

Because the final approach over obstacles is made at a relatively steep approach angle and close to the airplane's stalling speed, the initiation of the roundout or flare must be judged accurately to avoid flying into the ground, or stalling prematurely and sinking rapidly. A lack of floating during the flare, with sufficient control to touch down properly, is one verification that the approach speed was correct.

Touchdown should occur at the minimum controllable airspeed with the airplane in approximately the pitch attitude that will result in a power-off stall when the throttle is closed. Care must be exercised to avoid closing the throttle too rapidly before the pilot is ready for touchdown, as closing the throttle may result in an immediate increase in the rate of descent and a hard landing.

Upon touchdown, the airplane should be held in this positive pitch attitude as long as the elevators remain effective. This will provide aerodynamic braking to assist in deceleration.

Immediately upon touchdown, and closing the throttle, appropriate braking should be applied to minimize the after-landing roll. The airplane should be stopped within the shortest possible distance consistent with safety and controllability. If the proper approach speed has been maintained, resulting in minimum float during the roundout, and the touchdown made at minimum control speed, minimum braking will be required.

Common errors in the performance of short-field approaches and landings are:

- Failure to allow enough room on final to set up the approach, necessitating an overly steep approach and high sink rate.
- Unstabilized approach.
- Undue delay in initiating glidepath corrections.
- Too low an airspeed on final resulting in inability to flare properly and landing hard.
- Too high an airspeed resulting in floating on roundout.
- Prematurely reducing power to idle on roundout resulting in hard landing.
- Touchdown with excessive airspeed.
- Excessive and/or unnecessary braking after touchdown.
- Failure to maintain directional control.

SOFT-FIELD APPROACH AND LANDING

Landing on fields that are rough or have soft surfaces, such as snow, sand, mud, or tall grass requires unique procedures. When landing on such surfaces, the objective is to touch down as smoothly as possible, and at the slowest possible landing speed. The pilot must control the airplane in a manner that the wings support the weight of the airplane as long as practical, to minimize drag and stresses imposed on the landing gear by the rough or soft surface.

The approach for the soft-field landing is similar to the normal approach used for operating into long, firm landing areas. The major difference between the two is