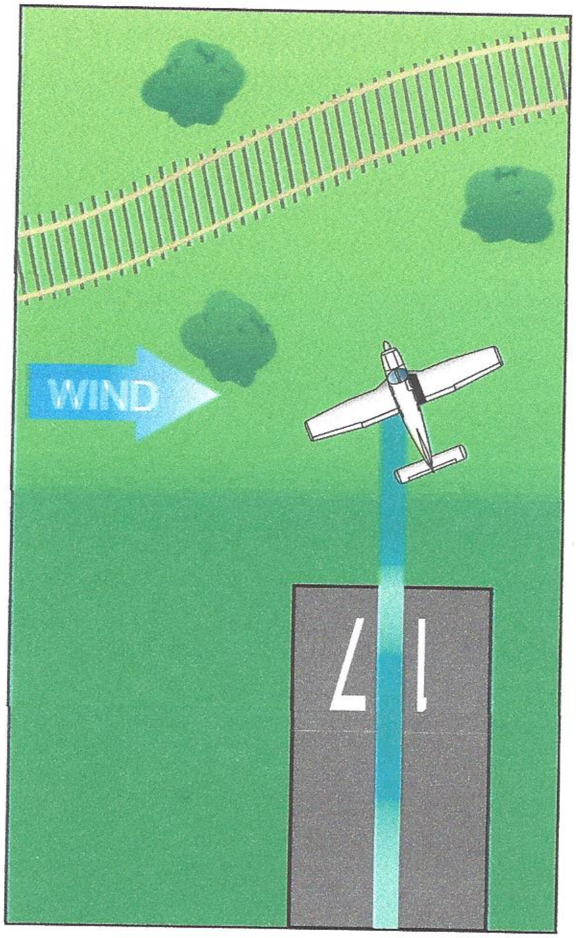

Figure 5-5. Crosswind climb flightpath.

- Premature lift-off resulting in side-skipping.
- Excessive aileron input in the latter stage of the takeoff roll resulting in a steep bank into the wind at lift-off.
- Inadequate drift correction after lift-off.

GROUND EFFECT ON TAKEOFF

Ground effect is a condition of improved performance encountered when the airplane is operating very close to the ground. Ground effect can be detected and measured up to an altitude equal to one wingspan above the surface. [Figure 5-6] However, ground effect is most significant when the airplane (especially a low-wing airplane) is maintaining a constant attitude at low airspeed at low altitude (for example, during takeoff when the airplane lifts off and accelerates to climb speed, and during the landing flare before touchdown).

When the wing is under the influence of ground effect, there is a reduction in upwash, downwash, and wingtip vortices. As a result of the reduced wingtip vortices, induced drag is reduced. When the wing is at a height equal to one-fourth the span, the reduction in induced drag is about 25 percent, and when the wing is at a height equal to one-tenth the span, the reduction in induced drag is about 50 percent. At high speeds where parasite drag dominates, induced drag is a small part of the total drag. Consequently, the effects of ground effect are of greater concern during takeoff and landing.

On takeoff, the takeoff roll, lift-off, and the beginning of the initial climb are accomplished in the ground effect area. The ground effect causes local increases in static pressure, which cause the airspeed indicator and altimeter to indicate slightly less than they should, and usually results in the vertical speed indicator indicating a descent. As the airplane lifts off and climbs out of the ground effect area, however, the following will occur.

- The airplane will require an increase in angle of attack to maintain the same lift coefficient.
- The airplane will experience an increase in induced drag and thrust required.
- The airplane will experience a pitch-up tendency and will require less elevator travel because of an increase in downwash at the horizontal tail.

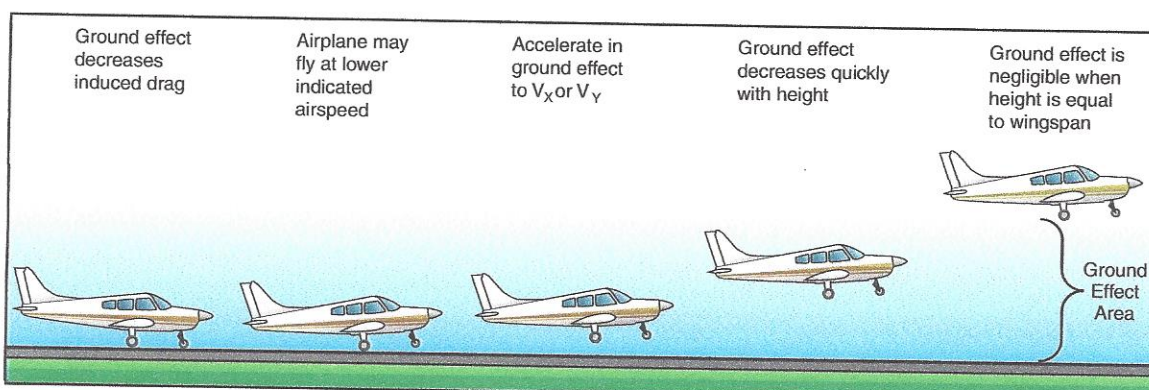

Figure 5-6. Takeoff in ground effect area.

- The airplane will experience a reduction in static source pressure as it leaves the ground effect area and a corresponding increase in indicated airspeed.

Due to the reduced drag in ground effect, the airplane may seem to be able to take off below the recommended airspeed. However, as the airplane rises out of ground effect with an insufficient airspeed, initial climb performance may prove to be marginal because of the increased drag. Under conditions of high-density altitude, high temperature, and/or maximum gross weight, the airplane may be able to become airborne at an insufficient airspeed, but unable to climb out of ground effect. Consequently, the airplane may not be able to clear obstructions, or may settle back on the runway. The point to remember is that additional power is required to compensate for increases in drag that occur as an airplane leaves ground effect. But during an initial climb, the engine is already developing maximum power. The only alternative is to lower pitch attitude to gain additional airspeed, which will result in inevitable altitude loss. Therefore, under marginal conditions, it is important that the airplane takes off at the recommended speed that will provide adequate initial climb performance.

Ground effect is important to normal flight operations. If the runway is long enough, or if no obstacles exist, ground effect can be used to an advantage by using the reduced drag to improve initial acceleration. Additionally, the procedure for takeoff from unsatisfactory surfaces is to take as much weight on the wings as possible during the ground run, and to lift off with the aid of ground effect before true flying speed is attained. It is then necessary to reduce the angle of attack to attain normal airspeed before attempting to fly away from the ground effect area.

SHORT-FIELD TAKEOFF AND MAXIMUM PERFORMANCE CLIMB

Takeoffs and climbs from fields where the takeoff area is short or the available takeoff area is restricted by obstructions require that the pilot operate the airplane at the limit of its takeoff performance capabilities. To depart from such an area safely, the pilot must exercise positive and precise control of airplane attitude and airspeed so that takeoff and climb performance results in the shortest ground roll and the steepest angle of climb. [Figure 5-7]

The achieved result should be consistent with the performance section of the FAA-approved Airplane Flight Manual and/or Pilot's Operating Handbook (AFM/POH). In all cases, the power setting, flap setting, airspeed, and procedures prescribed by the airplane's manufacturer should be followed.

In order to accomplish a maximum performance takeoff safely, the pilot must have adequate knowledge in the use and effectiveness of the best angle-of-climb speed (V_X) and the best rate-of-climb speed (V_Y) for the specific make and model of airplane being flown.

The speed for V_X is that which will result in the greatest gain in altitude for a given distance over the ground. It is usually slightly less than V_Y which provides the greatest gain in altitude per unit of time. The specific speeds to be used for a given airplane are stated in the FAA-approved AFM/POH. It should be emphasized that in some airplanes, a deviation of 5 knots from the recommended speed will result in a significant reduction in climb performance. Therefore, precise control of airspeed has an important bearing on the successful execution as well as the safety of the maneuver.

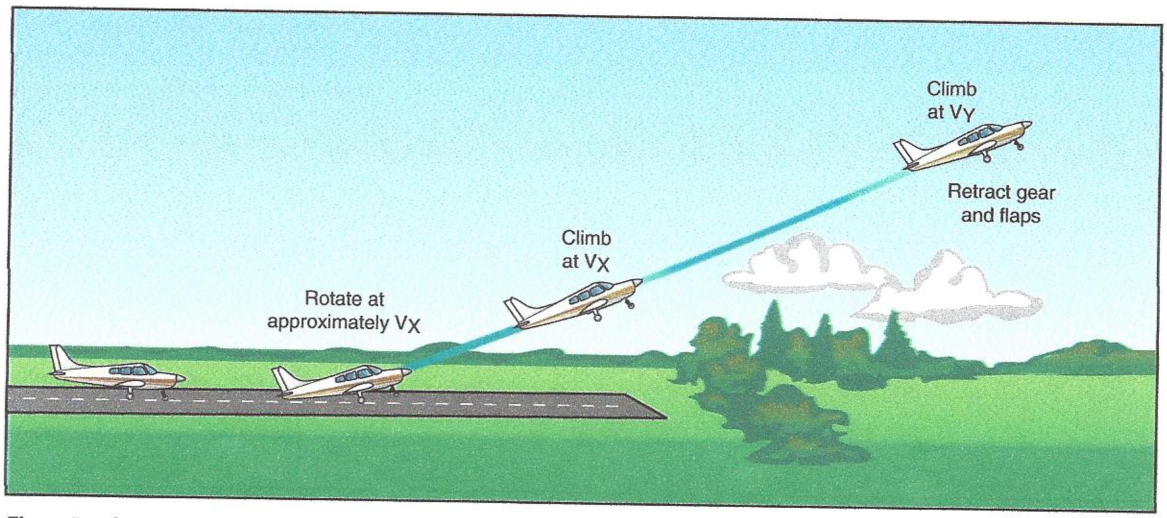

Figure 5-7. Short-field takeoff.