CHAPTER 2
Components and Systems

Although gliders come in an array of shapes and sizes, the basic design features of most gliders are fundamentally the same. All gliders conform to the aerodynamic principles that make flight possible. When air flows over the wings of a glider, the wings produce a force called lift that allows the aircraft to stay aloft. Glider wings are designed to produce maximum lift with minimum drag.

Glider airframes are designed with a fuselage, wings, and empennage or tail section. Self-launch gliders are equipped with an engine that enables them to launch without assistance and return to an airport under engine power if soaring conditions deteriorate.

THE FUSELAGE

The fuselage is the portion of the airframe to which the wings and empennage are attached. The fuselage houses the cockpit and contains the controls for the glider, as well as a seat for each occupant. Glider fuselages can be formed from wood, fabric over steel tubing, aluminum, fiberglass, kevlar or carbon fiber composites, or a combination of these materials. [Figure 2-1]

WINGS AND COMPONENTS

Glider wings incorporate several components, which help the pilot in maintaining the attitude of the glider

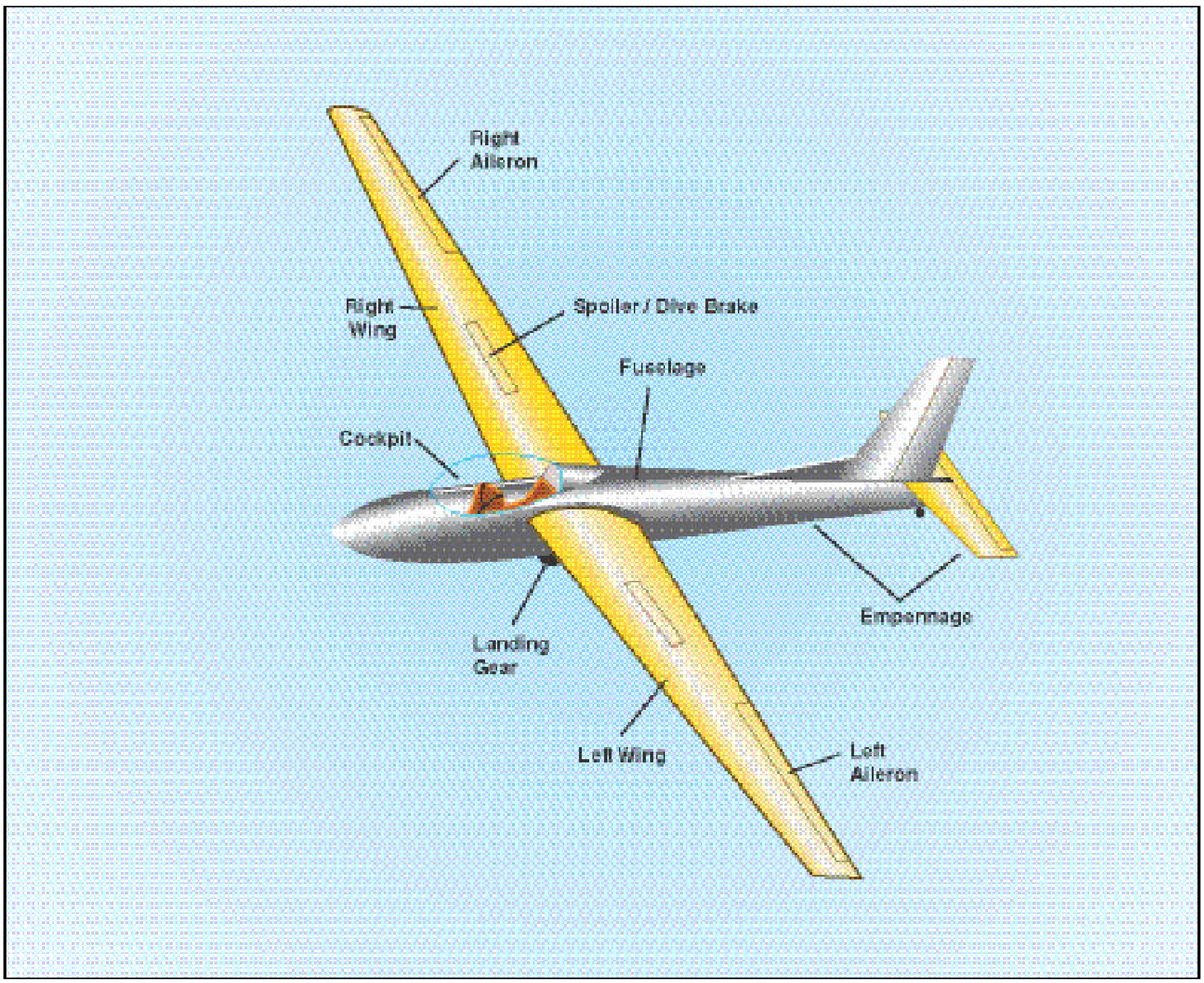

Figure 2-1. Components of a glider.

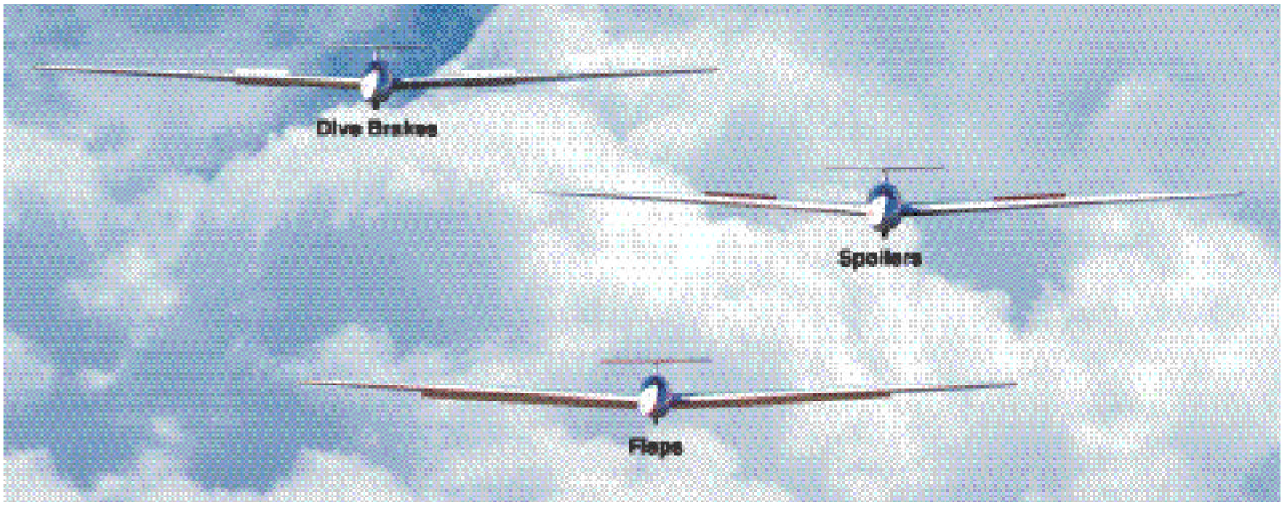

Figure 2-2. Types of lift/drag devices.

and controlling lift and drag. These include **ailerons**, as well as lift and drag devices, such as spoilers, dive brakes, and flaps.

The ailerons control movement around the longitudinal axis. This is known as roll. The ailerons are attached to the outboard tailing edge of each wing and move in the opposite direction from each other.

Moving the control stick to the right causes the right aileron to deflect upward and the left aileron to deflect downward. The upward deflection of the right aileron decreases the camber resulting in decreased lift on the right wing. The corresponding downward deflection of the left aileron increases the camber resulting in increased lift on the left wing. Thus, the increased lift on the left wing and decreased lift on the right wing causes the glider to roll to the right.

LIFT/DRAG DEVICES

Gliders are equipped with devices that modify the lift and drag of the wing. High drag devices include spoilers, dive brakes, and flaps. **Spoilers** extend from the upper surface of the wing interrupting or spoiling the airflow over the wings. This action causes the glider to descend more rapidly. Dive brakes extend from both the upper and lower surfaces of the wing and help to increase drag. [Figure 2-2]

Flaps are located on the trailing edge of the wing, inboard of the ailerons, and can be used to increase lift, drag, and descent rate. When the glider is cruising at moderate airspeeds in wings-level flight, the flaps are set to zero degree deflection and are in trail with the wing. When the flap is extended downward, wing camber is increased, and the lift and the drag of the wing increase.

There are several different types of flaps. [Figure 2-3] The plain flap is the simplest of the four types. When deflected downward, it increases the effective camber and changes the wing's chord line. Both of these factors increase the lifting capacity of the wing. The slotted flap is similar to the plain flap. In addition to changing the wing's camber and chord line, it also allows a portion of the higher pressure air beneath the wing to travel through a slot. This increases the velocity of the airflow over the flap and provides additional lift.

Another type of flap is the Fowler flap. When extended, it moves rearward as well as down. This rearward motion increases the total wing area, as well as the camber and chord line. Negative flap is used at high speeds where wing lift reduction is desired to reduce drag.

When the flaps are extended in an upward direction, or negative setting, the camber of the wing is reduced, resulting in a reduction of lift produced by the wing at a fixed angle of attack and airspeed.

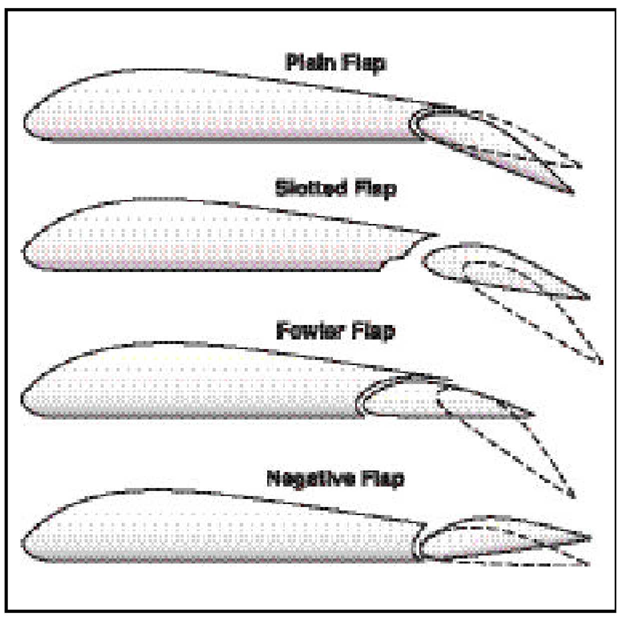

Figure 2-3. The four different types of flaps.

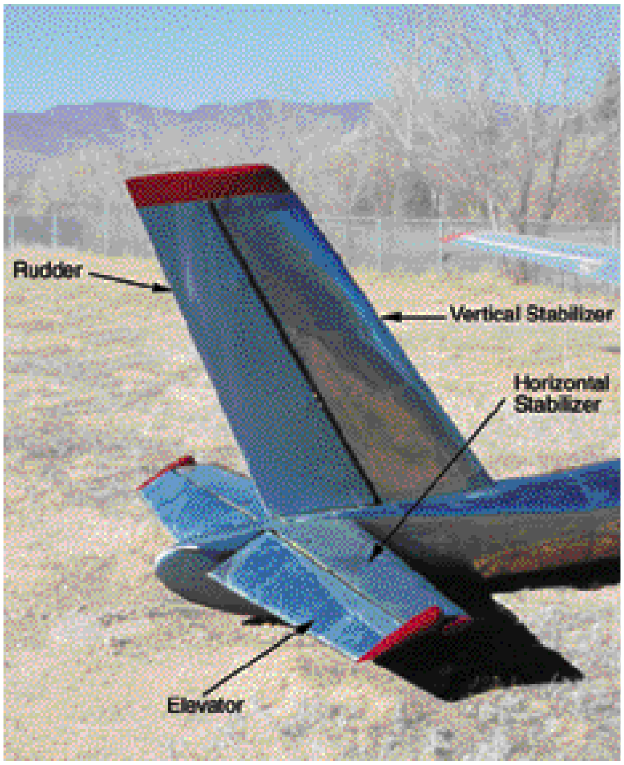

Figure 2-4. The empennage components.

THE EMPENNAGE

The **empennage** includes the entire tail section, consisting of fixed surfaces, such as the horizontal stabilizer and the vertical fin, or stabilizer. These two fixed surfaces act like the feathers on an arrow to steady the glider and help maintain a straight path through the air. The movable surfaces include the elevator and the rudder. [Figure 2-4]

The **elevator** is attached to the back of the horizontal stabilizer. The elevator controls movement around the lateral axis. This is known as pitch. During flight, the elevator is used to move the nose up and down, which controls the pitch attitude of the glider. The trim tab normally located on the elevator of the glider lessens the resistance you feel on the flight controls due to the airflow over the associated control surface.

The **rudder** is attached to the back of the vertical stabilizer. The rudder controls movement about the vertical axis. This is known as yaw. The rudder is used in combination with the ailerons and elevator to coordinate turns during flight.

Some gliders use a **stabilator**, which is a one-piece horizontal stabilizer used in lieu of an elevator. The stabilator pivots up and down on a central hinge point. When you pull back on the control stick, the nose of the glider moves up; when you push forward, the nose moves down. Stabilators sometimes employ an anti-servo trim tab to achieve pitch trim. The anti-servo tab provides a control feel comparable to that of an elevator. [Figure 2-5]

Trim devices reduce pilot workload by relieving the pressure required on the controls to maintain a desired airspeed. One type of trim device found on gliders is called an elevator trim tab. The elevator trim tab is a small, hinged, cockpit-adjustable tab on the trailing edge of the elevator. Other types of elevator trim devices include bungee spring systems and ratchet trim systems. In these systems, fore and aft control stick pressure is applied by an adjustable spring or bungee cord.

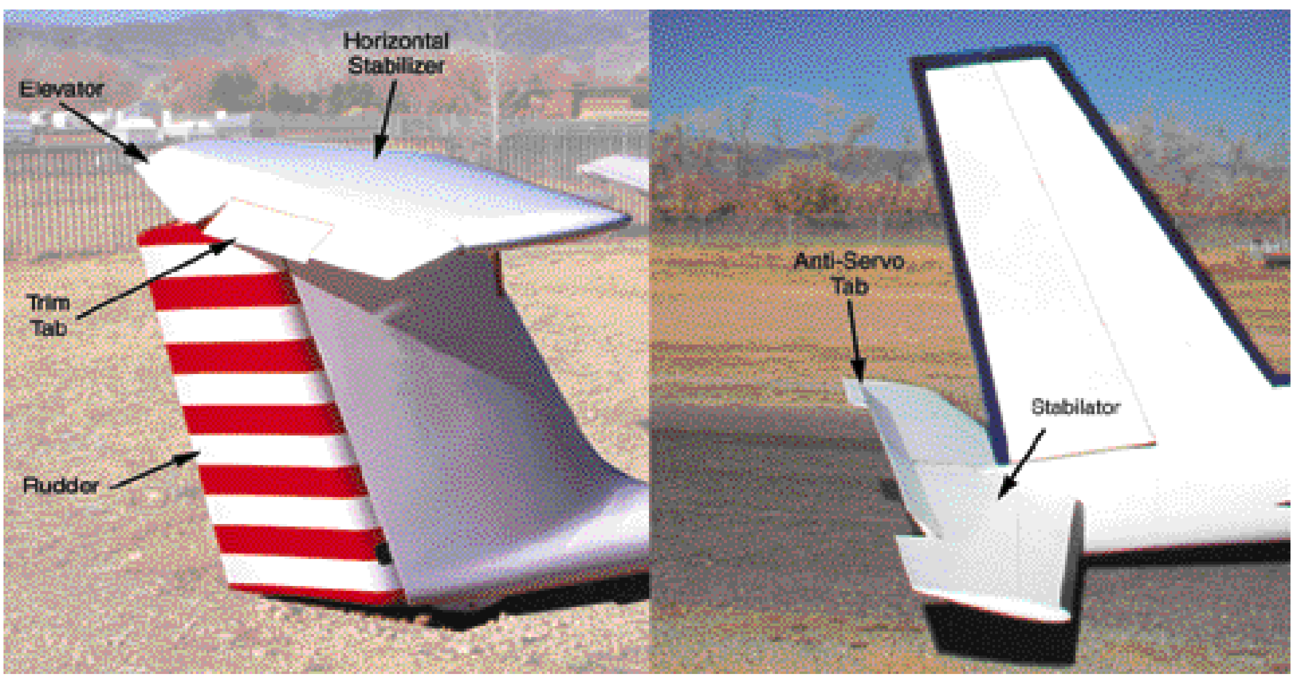

Figure 2-5. Empennage components and trim tabs.

Over the years, the shape of the empennage has seen different forms. Early gliders were most often built with the horizontal stabilizer mounted at the bottom of the vertical stabilizer. This type of tail arrangement is called the **conventional tail**. Other gliders were designed with a **T-tail**, and still others were designed with **V-tail**. T-tail gliders have the horizontal stabilizer mounted on the top of the vertical stabilizer, forming a T. V-tails have two tail surfaces mounted to form a V. V-tails combine elevator and rudder movements.

TOWHOOK DEVICES

An approved towhook is a vital part of glider equipment. The **towhook** is designed for quick release when the pilot applies pressure to the release handle. As a safety feature, if back pressure from either getting out of position during the tow or over running the towrope, the release will automatically open. Part of the glider pilot's preflight is to ensure the towhook releases properly with applied forward and back pressure.

The glider may have a towhook located on or under the nose and/or under the center of gravity (CG), near the main landing gear. The forward towhook is used for aerotow. The CG hook is used for ground launch. If the glider has only a CG hook, it may be approved for aerotow in accordance with the Glider Flight Manual/ Pilot's Operating Handbook. [Figure 2-6]

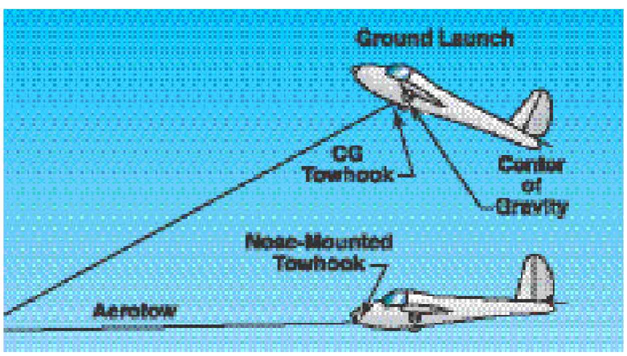

Figure 2-6. Towhook locations.

POWERPLANT

Self-launch gliders are equipped with engines powerful enough to enable them to launch without external assistance. The engines also may be used to sustain flight if the soaring conditions deteriorate. Self-launch gliders differ widely in terms of engine location and type of propeller.

Some are equipped with a fixed, nose-mounted engine and a full feathering propeller. On other types of self-launch gliders, the engine and propeller are located aft of the cockpit. When the engine and propeller are not in use, they are retracted into the fuselage, reducing drag and increasing soaring performance. These types of self-launch engines are usually coupled to a folding propeller, so the entire powerplant can be retracted and the bay doors closed and sealed. [Figure 2-7]

Some gliders are equipped with sustainer engines to assist in remaining aloft long enough to return to an airport. However, sustainer engines do not provide sufficient power to launch the glider from the ground without external assistance. A more detailed explanation of engine operations can be found in Chapter 7—Launch and Recovery Procedures and Flight Maneuvers.

LANDING GEAR

Gliders feature a nose skid or wheel, a swiveling tail wheel, and wheels or protective metal brackets at the wingtips. Gliders designed for high speed and low drag often feature a fully retractable main landing gear and a small break away tail wheel or tail skid. Break away tail skids are found on high performance gliders, and are designed to break off when placed under side loads. [Figure 2-8]

WHEEL BRAKES

The wheel brake, mounted on the main landing gear wheel, helps the glider slow down or stop after touchdown. The type of wheel brake often depends on the design of the glider. Many early gliders relied on friction between the nose skid and the ground to come to a stop. Current models of gliders are fitted with drum brakes, disc brakes, and friction brakes. The most common type of wheel brake found in modern gliders is the disc brake, which is very similar to the disc brake on the front wheels of most cars. Most glider disc brakes are hydraulically operated to provide maximum braking capability. Wheel brake controls vary from one glider type to another.

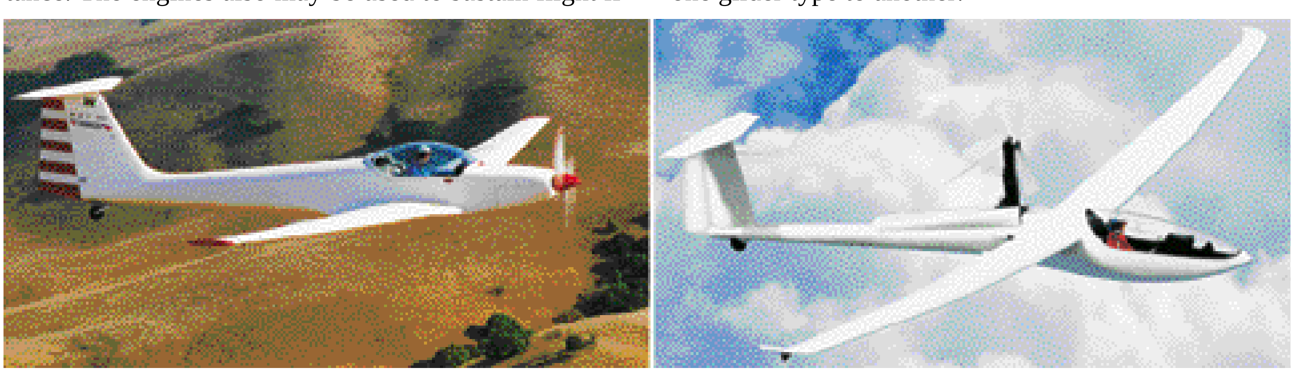

Figure 2-7. Self-launch gliders are different in performance, as well as appearance.

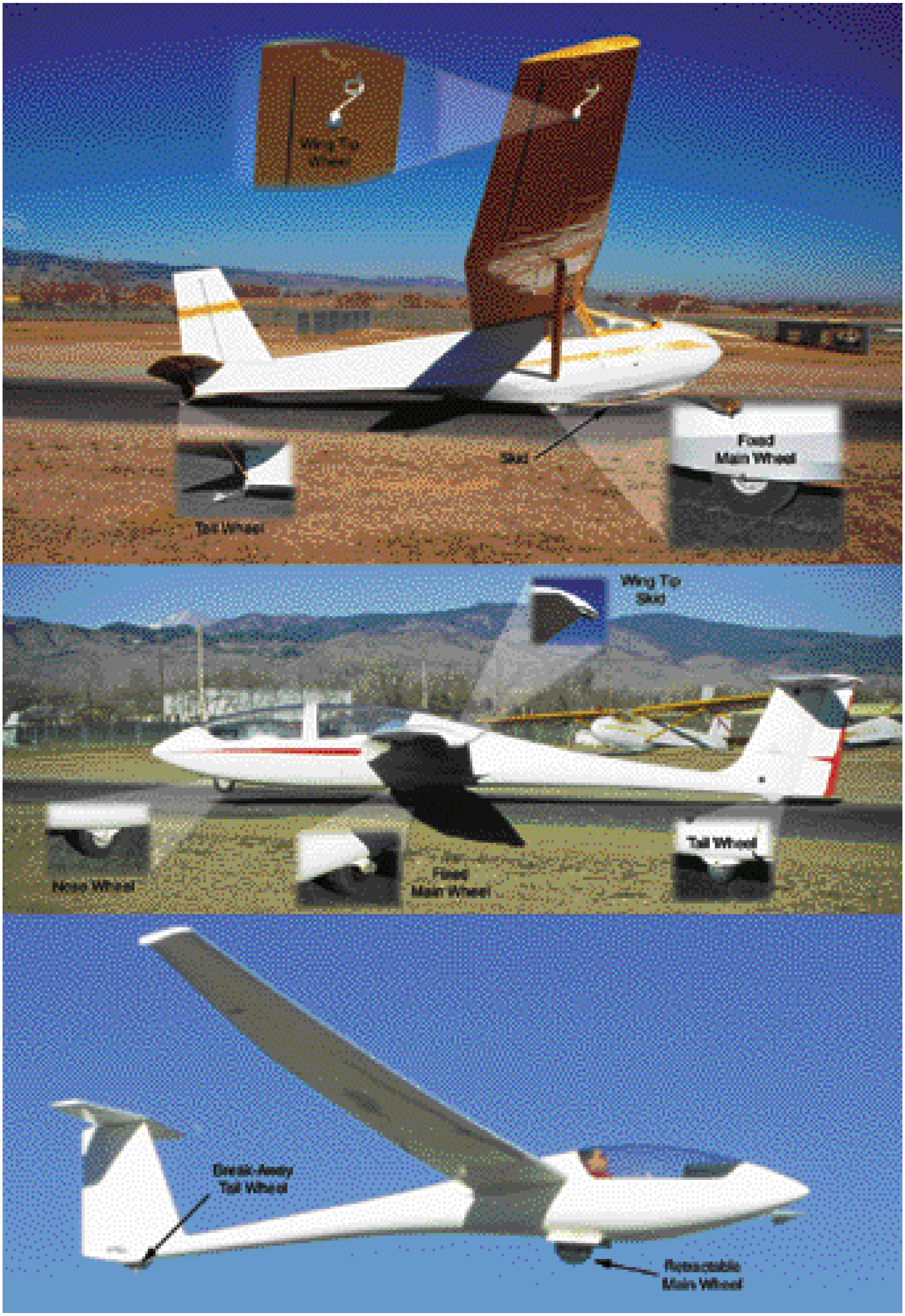

Figure 2-8. Some gliders have fixed main wheels, others have retractable main wheels. Nose skids, or nose wheels, tail wheels and wing tip wheels are found on many gliders.