NOTE: The weight and balance records for a particular glider provide the empty weight and moment, as well as the information on the arm distance. *[Figure 5-20]*

Item	Weight (pounds)	Arm (inches)	Moment (inch·pounds)
Empty weight	600	+20	12,000
Front seat pilot	180	+30	+5,400
Rear seat pilot	200	–5	–1,000
	980 total weight	+16.73	+16,400 total moment

Figure 5-20. *Weight and balance: front and rear seat pilot weights and moments.*

In *Figure 5-20,* the weight of each pilot has been entered into the correct block in the table. For the front seat pilot, multiplying 180 pounds by +30 inches yields a moment of +5,400 inch·pounds. For the rear seat pilot, multiplying 200 pounds by –5 inches yields a moment of –1,000 inch·pounds. The next step is to find the sum of all weights (980 pounds) and record it. Then, find the sum of all moments (+16,400 inch·pounds) and record it. Now, find the arm (the CG position) of the loaded glider. Divide the total moment by the total weight to discover the CG of the loaded aircraft glider in inches from the datum:

+16,400 inch·pounds ÷ 980 pounds = +16.73 inches

The final step is to determine whether total weight and CG location values are within acceptable limits. The GFM/POH lists the maximum gross weight as 1,100 pounds. The operating weight of 980 pounds is less than the 1,100 pounds maximum gross weight. The GFM/POH lists the approved CG range as between +14.80 inches and +18.60 inches from the datum. The operating CG is +16.73 inches from the datum and is within these limits. The weight and balance are within operating limits.

Ballast

Ballast is nonstructural weight that is added to a glider. In soaring, ballast weight is used for two purposes. Trim ballast is used to adjust the location of the CG of the glider so handling characteristics remain within acceptable limits. Performance ballast is loaded into the glider to improve high-speed cruise performance.

Removable trim ballast weights are usually made of metal and are bolted into a ballast receptacle incorporated in the glider structure. The manufacturer generally provides an attachment point well forward in the glider cabin for trim ballast weights. These weights are designed to compensate for a front seat pilot who weighs less than the minimum permissible front seat pilot weight. The ballast weight mounted well forward in the glider cabin helps place the CG within permissible limits, which allows the maximum shift in CG with the minimum addition of weight.

Some trim ballast weights are in the form of seat cushions, with sand or lead shot sewn into the unit to provide additional weight. This type of ballast, which is installed under the pilot's seat cushion, is inferior to bolted-in ballast because seat cushions tend to shift position. Seat cushion ballast should never be used during acrobatic or inverted flight.

Sometimes trim ballast is water placed in a tail tank in the vertical fin of the fuselage. The purpose of the fin trim ballast tank is to adjust CG location after water is added to, or drained from, the main wing ballast tanks. Unless the main wing ballast tanks are precisely centered on the CG of the loaded aircraft glider, CG location shifts when water is added to the main ballast tanks. CG location shifts again when water is dumped from the main ballast tanks. Adjusting the amount of water in the fin tank compensates for CG shifts resulting from changes in the amount of water ballast carried in the main wing ballast tanks. Water weighs 8.35 pounds per gallon. Because the tail tank is located far aft, it does not take much water to have a considerable effect on CG location. For this reason, tail tanks do not need to contain a large volume of water. Tail tank maximum water capacity is generally less than two gallons of water.

Although some older gliders employed bags of sand or bolted-in lead weights as performance ballast, water is used most commonly to enhance high-speed performance in modern sailplanes. Increasing the operating weight of the glider increases the optimum speed to fly during wings-level cruising flight. The resulting higher groundspeed provides a very desirable advantage in cross-country soaring and in sailplane racing.

Water ballast tanks are located in the main wing panels. Clean water is added through fill ports in the top of each wing. In most gliders, the water tanks or bags can be partially or completely filled, depending on the pilot's choice of operating weight. After water is added, the filler caps are replaced to prevent water from sloshing out of the filler holes.

Drain valves are fitted to the bottom of each tank. The valves are controlled from inside the cockpit. The tanks can be fully or partially drained while the glider is on the ground to reduce the weight of the glider prior to launch, if the pilot so desires. The ballast tanks also can be partially or completely drained in flight—a process called dumping ballast. The long streaks of white spray behind a speeding airborne glider are dramatic evidence that the glider pilot is dumping water ballast, most likely to lighten the glider prior to landing. The filler caps are vented to allow air to enter the tanks to replace the volume of water draining from the tanks. It is important to ensure that the vents are working properly to prevent wing damage when water ballast is drained or jettisoned. *[Figures 5-21 and 5-22]*