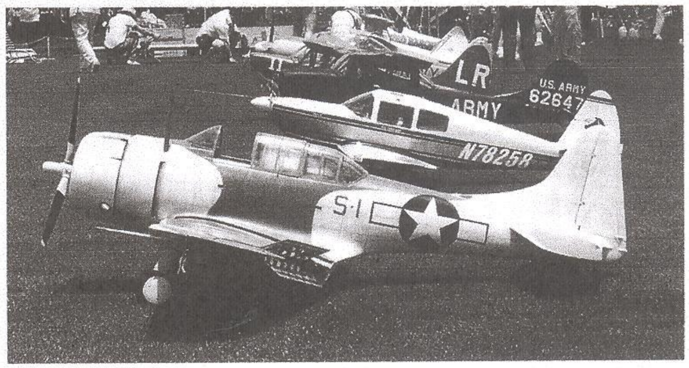
THINKING BIG | *by Gerry Yarrish*

Balance that big bird!

If you want to be successful when you test-fly a new model, remember three basic things: make sure the engine runs properly, check that the radio works correctly, and be *absolutely* certain that the model is balanced at the correct center of gravity (CG)! Nothing spoils your day at the flying field more than trying to sort out a tail-heavy model. I'd be willing to bet that the CG (or at least the wrong CG) is responsible for more broken airplanes than the other two points mentioned above put together. Let's take a look at the method of balancing and determining the CG.

All models have one thing in common: they fly poorly if they aren't balanced properly. Proper CG is perhaps the most important consideration when you fly a new model.



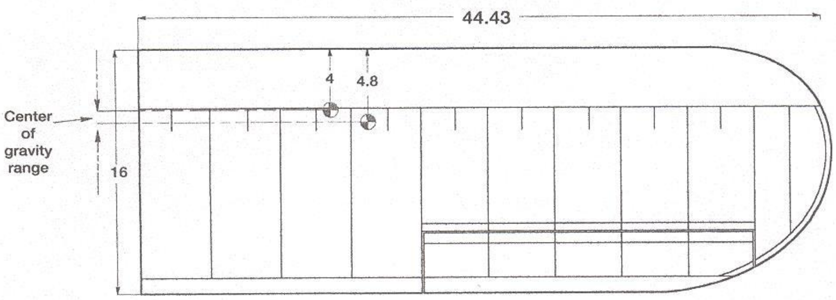


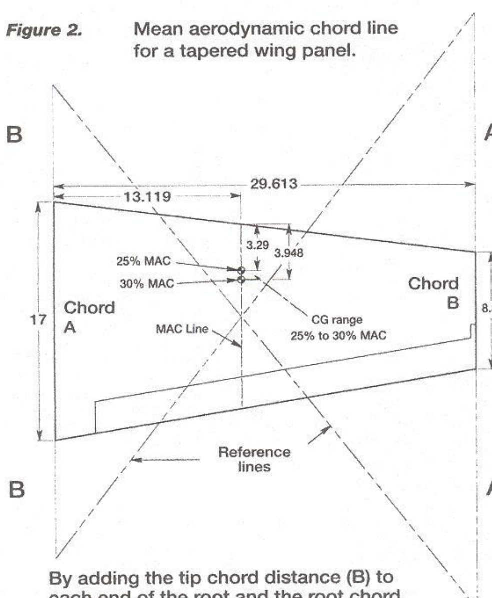
Figure 1. **Typical constant-chord wing should be balanced somewhere between the 25-percent and the 30-percent chord length range.**

First, I qualify my statements by saying that these are good estimations that will get your model balanced "in the ballpark" and within acceptable CG ranges making it safe to fly. I do not take into account lifting tail surfaces or other unusual configurations. For more detailed, aerodynamic principles, check out Andy Lennon's book, "RC Model Aircraft Design," listed in the "Pilots' Mart" section.

When you balance your model, use the location indicated on your model's plans along the wing's mean aerodynamic chord (MAC) line. If you don't have this information, you will have to figure it out yourself. On *most* models, the balance point falls between 25 and 30 percent of the MAC; 27 to 28 percent seems to be the average. On a constant chord wing, such as on a Piper Cub, the MAC line is the wing's chord line. On a tapered or swept wing, you must determine the MAC line position (see Figures 1 and 2).

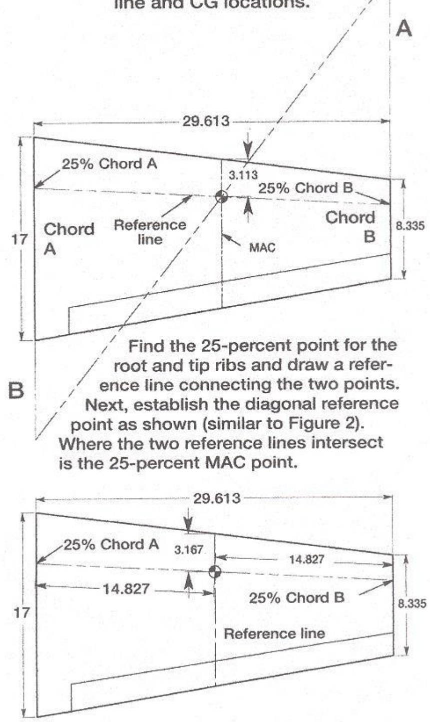
Figure 3 shows two common variations of finding the MAC line for tapered wing panels. The important thing here is to get

Figure 2. **Mean aerodynamic chord line for a tapered wing panel.**



By adding the tip chord distance (B) to each end of the root and the root chord distance (A) to each end of the tip, then drawing lines as shown, we find the MAC at the intersection of the reference lines.

Figure 3. **Variations of finding MAC line and CG locations.**

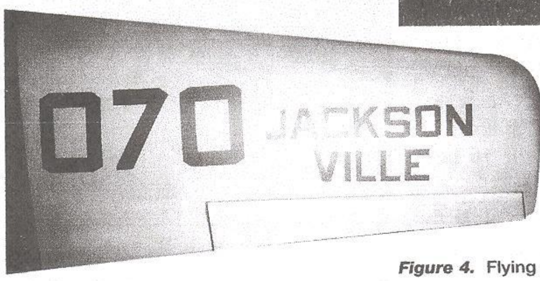


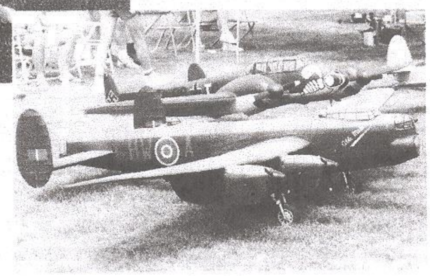
Find the 25-percent point for the root and tip ribs and draw a reference line connecting the two points. Next, establish the diagonal reference point as shown (similar to Figure 2). Where the two reference lines intersect is the 25-percent MAC point.

Simply take the 50% point of the reference line drawn from the 25% root and tip locations and use that as your 25% MAC location.

the balance point somewhere in the CG range of 25 to 30 percent of the MAC. Once this has been done, your model might still be slightly nose- or tail-heavy, but at least you know it will act normally once it leaves the ground. From here, by the way it flies, you can let the model tell you what's needed to fine-tune the balance. Please note that by using three methods of finding the MAC and CG in Figures 2 and 3, the 25-percent MAC locations differ by only 0.177 inches, or roughly less than 3⁄16 inch. My point is that regardless of the method you use to find the MAC and the balance point, it will be roughly in the correct place well within acceptable limits—like using three equations to come up with roughly the same value. Now let's go flying!

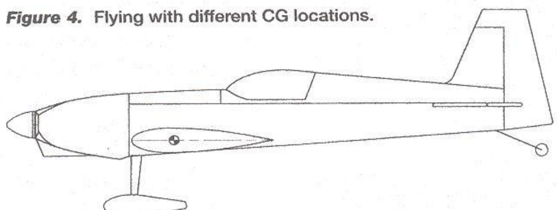
The tried and true Piper Cub is a good example of a model with a constant chord wing. Balance it anywhere along the panel, and you'll get it right on the MAC.



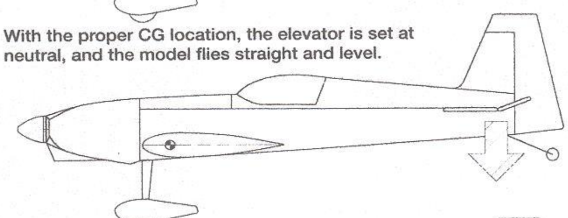


Left: for a tapered wing panel, finding the MAC takes a little calculation. But make sure you get it right. Right: big models, especially multi-engine bombers, appeal to modelers. Balancing them correctly is a good way to protect your investment.

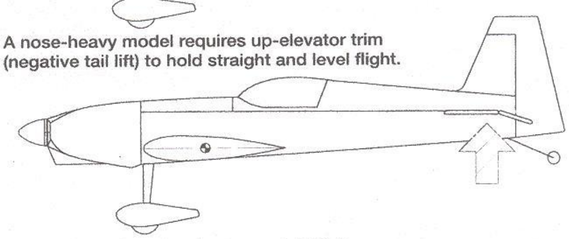
Figure 4. Flying with different CG locations.



With the proper CG location, the elevator is set at neutral, and the model flies straight and level.



A nose-heavy model requires up-elevator trim (negative tail lift) to hold straight and level flight.



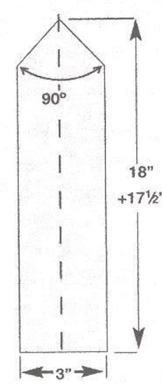
A tail-heavy plane requires more tail lift (down-trim) to fly straight and level.

FLYING THE CG

With our CG in the safe balance range, we can take off and sort things out on the first nerve-racking flight. Fly the model at about ¾ throttle, and set the trims for straight and level flight. After landing and checking the trim-lever locations, typically we adjust the clevises so we can return the trims to neutral and have the model fly normally, not climb or dive with application of power. Take a closer look at elevator trim. Is there a lot of added up- or down-trim? This is a good CG indicator. A lot of up-trim tells you that the CG is too far forward (nose-heavy); a lot of down-trim indicates an aft CG (tail-heavy). Shifting the battery forward or adding some nose weight fixes the tail-heavy condition.

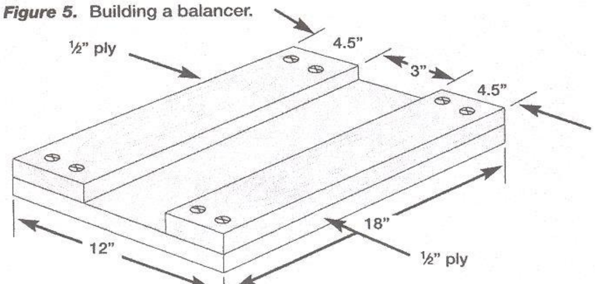
BIG BALANCER

Large and giant-size airplanes are at best difficult to balance; that is to say, you can't just pick them up, hold them under the wing with your fingertips and eyeball the situation. You need a good, solidly built balance fixture that will pin-



Balance point
Make two from ¾" thick pine one 18" and one 17½" long

Figure 5. Building a balancer.



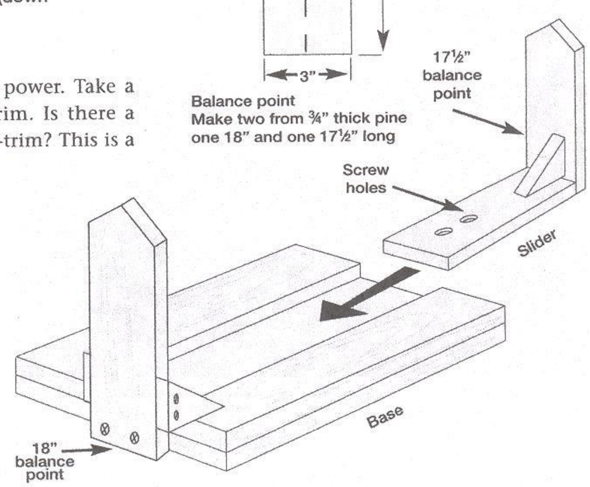
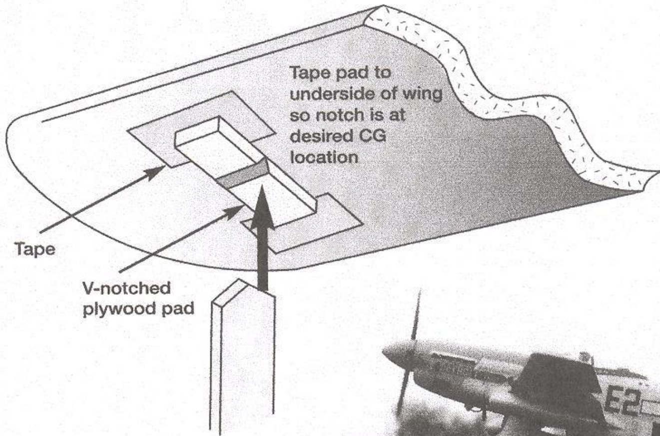


Figure 6. **Preparing the wing before balancing.**

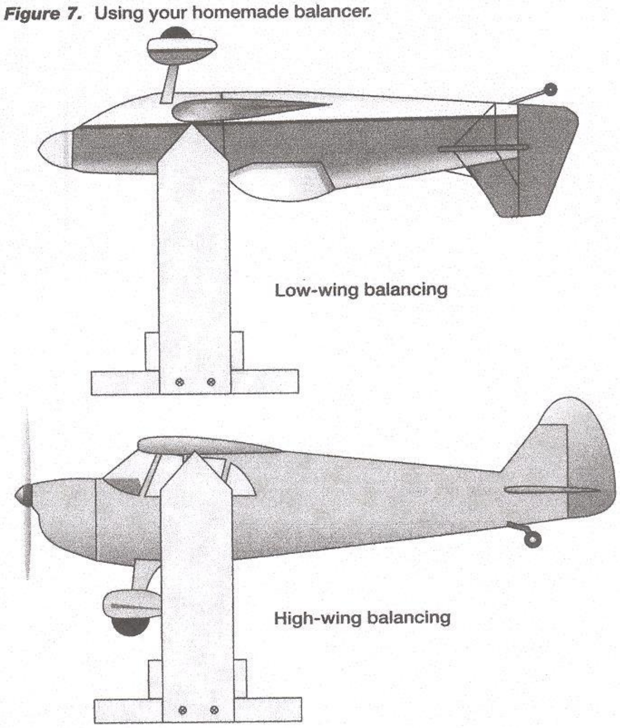


Warbirds especially need to be balanced correctly. Trying to sort out a tail-heavy fighter is like swimming up river; sooner or later, you lose!

point the model's CG and not damage the wing in the process.

Figures 5, 6 and 7 show what I use to balance my big birds. To make a balancer, I use ¾-inch pine boards and some plywood. The fixture is nothing more than two pointed upright boards supported by a plywood base that's large enough to safely support the model. I custom-make the balancer to accommodate whatever type of model I build. Sheetrock screws hold the balancer together, and the entire building job takes about 2 or 3 hours.

Figure 7. **Using your homemade balancer.**



The secret of using this type of balancer without damaging your model's wing is to use two thin plywood pads (one under each panel) with a V-notch cut into them. I measure the position of the CG and mark it on the wing. I then tape the two plywood pads into place while aligning the V-notch with the marks. I then place the plane on the pointed vertical boards (placing the pointed ends of the boards into the notches) and balance the plane.

One-sixteenth-inch plywood pads are good for models of up to 10 pounds, and for heavier ones, I use 3/32- or ⅛-inch plywood. Make the pads about 2 inches wide by 4 inches long, and use masking tape to secure them in place. This balancer works really well, but help from a friend makes the job easier and safer for the model.

The best insurance policy for your model is to have it as close as possible to the correct CG before flying. "Feeling" what the model tells you when it is flying helps to fine-tune its balance. Some basic calculations before that first flight will help keep your model whole. No amount of math after a model is broken will repair it. ✈