Balancing Your Model

ESTABLISHING THE MAC

GEOMETRIC METHOD FOR ESTABLISHING THE MEAN AERODYNAMIC CHORD ON ANY PLATFORM

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In discussing model airplane design with many model enthusiasts it is apparent that only a few persons understand the procedure for balancing a model. The Aerodynamic Center of a wing is a point located on the Mean Aerodynamic Chord (MAC) through which the major forces and moments operating on the airplane can be thought of as acting. Figure 1 illustrates this condition. This short article will describe a simple geometric method for establishing the MAC on any common wing planform.

In most airfoils the Aerodynamic Center through which the wing forces act, is located somewhere between 25% and 30% of the MAC measured from -the leading edge. This is the within which the model should be balanced. Do not confuse the MAC with the average chord which is only, as the name implies, the average of the tip and root chord lengths.

Figure 2 illustrates the geometric construction required to arrive at the MAC. Draw the planform of your wing to any scale desired. Divide the root and tip chord in half and connect a line from the midpoint of the root to the midpoint of the tip,, A to B. Now extend the root chord forward the length of the tip chord to ppoint C and extend the tip chord aft the length of the root chord to point D. Connect a line between points C and D. The point at which this line CD intersects line AB is the location of the MAC. Scale the length of the MAC, multiply by .25, lay out this distance measuring aft from the leading and you you have located the approximate Aerodynamic Center of the wing. Project this point inboard to the center line and balance your model by locating the center of gravity at or just forward of this point. This method will work for all tapered wings with straight planforms with, or without, sweep. Slightly curved wing tips can be treated as straight tips. Highly curved tips can be treated as shown in Figure 3, locating the tip chord at a point where the area A, and A, are approximately equal to A,. For those who are mathematically inclined the equations for determing the MAC are presented in Figure 4.

The lift due to the, horizontal tail has been purposely neglected because on the usual R/C model it has only a very slight effect. The lift on the horizontal tail surface tends to move the combined wing and tail Aerodynamic Center aft of the Aerodynamic Center of the wing only. This factor will add a slight amount of stability to a model balanced forward of the wing 25% MAC location. Investigation of the better flying R/C gliders indicate that most of them are balanced at or near the 30% MAC point.

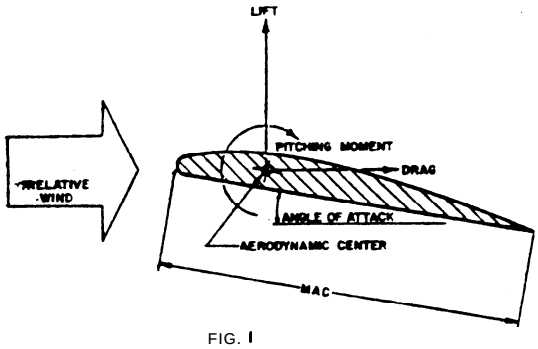


FIG. 1

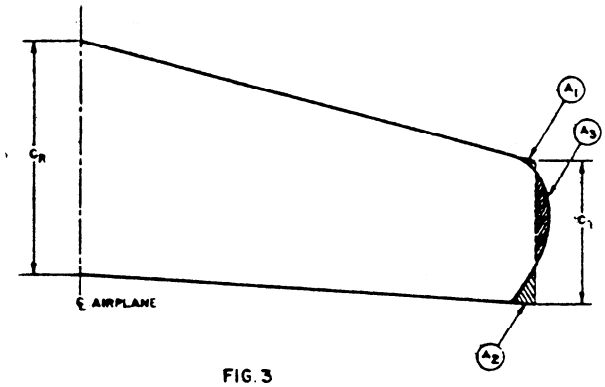


FIG. 3

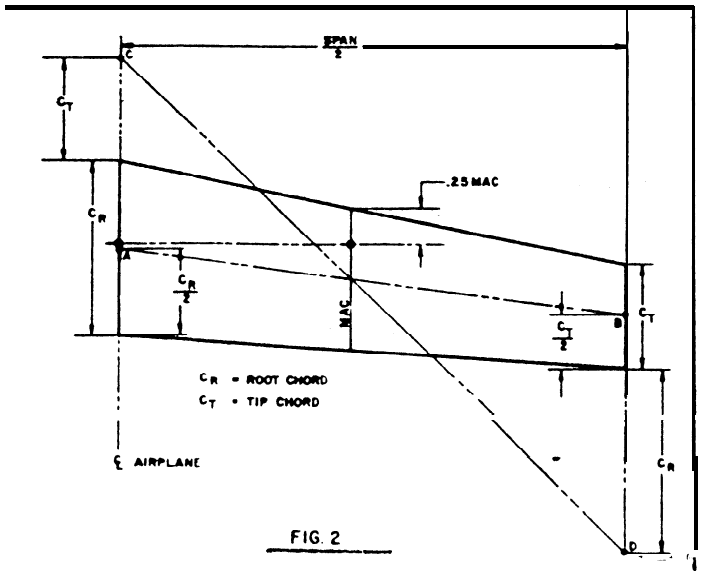
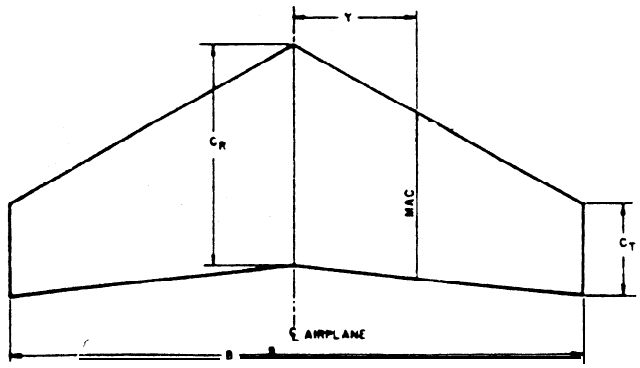


FIG. 2



$$\frac{MAC}{\frac{B}{2}} = \frac{2}{3}\left(\frac{C_R + C_T - \frac{C_R C_T}{C_R + C_T}}{1}\right)$$

WHERE C_R = ROOT CHORD
C_T = TIP CHORD

$$\frac{Y}{\frac{B}{2}} = \frac{1}{3}\left(\frac{C_R + 2C_T}{C_R + C_T}\right)$$

WHERE Y = SPANWISE LOCATION OF MAC
B = WING SCAN

FIG. 4