Ron Van Putte on Canards

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In finding the proper center of mass, the first consideration is the location of the aerodynamic center of the wing. There are all sorts of "cookbook" techniques to do this, but the best I've found is the X equation of Figure 1.

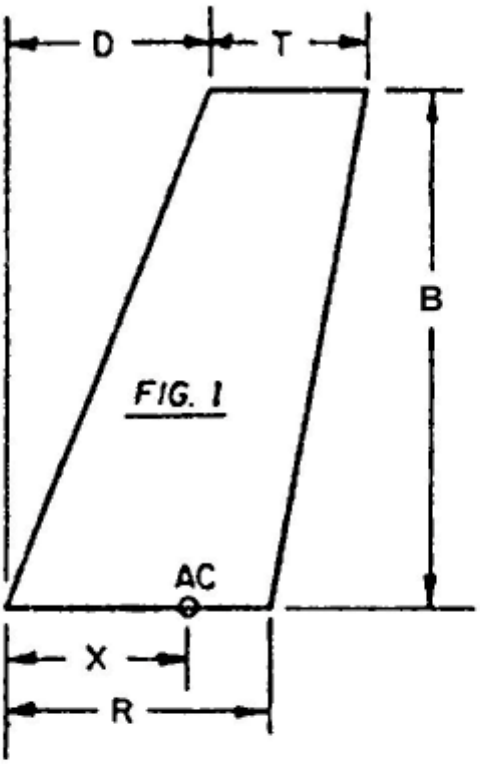
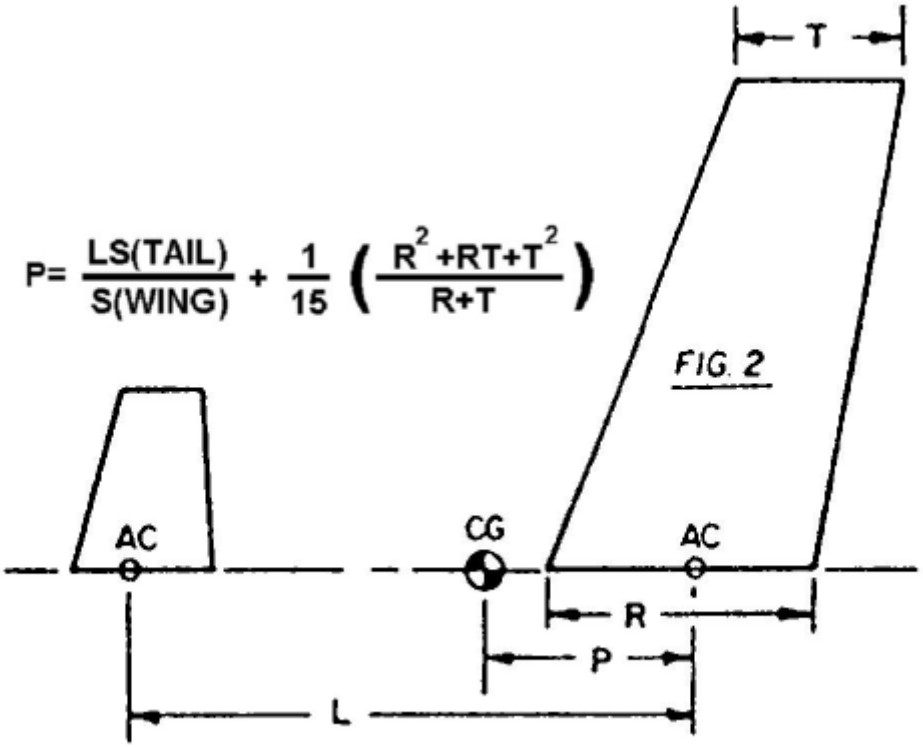


FIG. 1

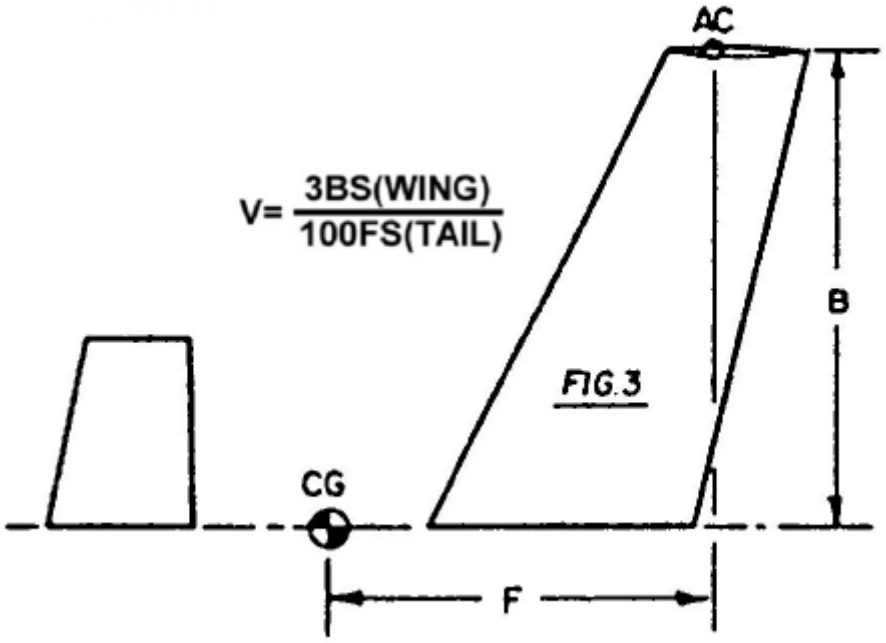
$$X = \frac{1}{6}\left(\frac{R^2+RT+T^2}{R+T}\right) + \frac{D}{3}\left(\frac{R+2T}{R+T}\right)$$

$$S = \frac{B}{2}(R+T)$$

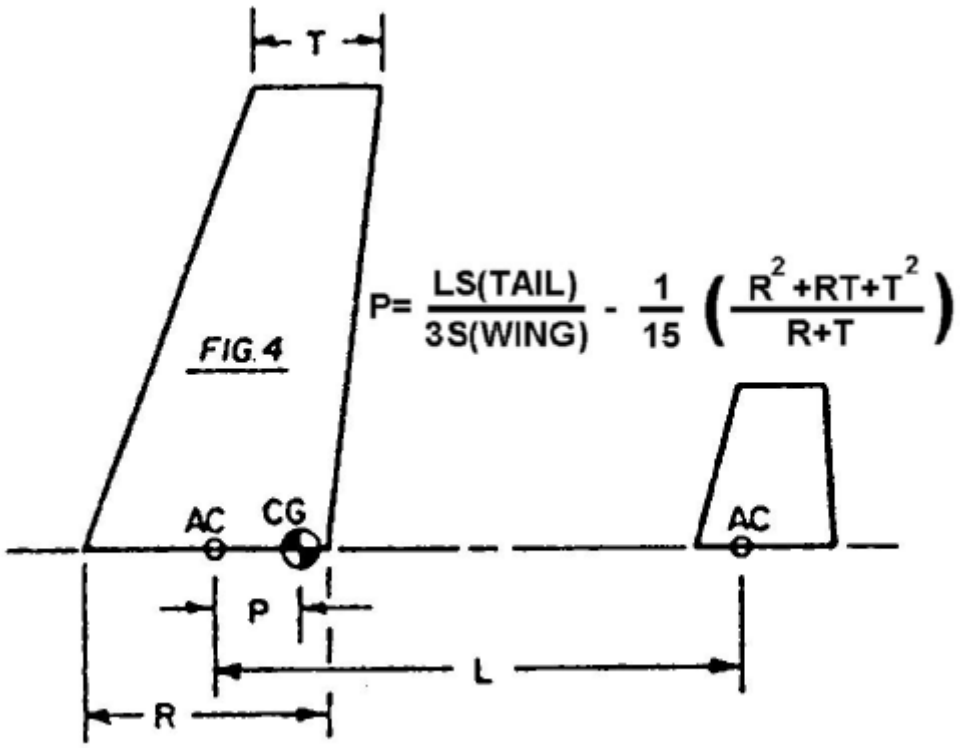
Also, calculate S, the wing panel area, for later use. Next, the aerodynamic center of the horizontal stabilizer is determined in the same way, using Figure 1 again, with numbers corresponding to the stabilizer. Again, calculate S, this time being the stabilizer panel area. You will note that no mention has been made so far that this is a canard design being considered. In fact, at the end of this discussion you will have two techniques for center of mass calculation corresponding to either a conventional or a canard aircraft. The only difference between the two equations will be a single minus sign on one term and a factor of three in another term. Determine the distance between the aerodynamic centers of the wing and horizontal stabilizer and locate the proper center of mass as shown in Figure 2 by using the P equation.



This center of mass location guarantees that the aircraft will basically stable in pitch. After test flights have been made, it may be desirable to move the center of mass toward the rear of the airplane in order to improve the pitch response of the aircraft.
The second part of successful canard aircraft design is to provide adequate directional stability On canard aircraft, it is often desirable to put vertical fins on the tips of relatively long, swept wings rather than installing a large vertical fin on the fuselage. Again using Figure 1, the aerodynamic center location of the vertical fin is calculated. Also determine S, now being the vertical fin area. The V equation in Figure 3 will tell you if the vertical fins are the right size. If V is about equal to one you're in be. However, there's nothing new about that situation for conventional airplanes, either.



For those of you who are not really interested in canard design, but who are interested in determination of the proper center of mass location for a conventional aircraft, I have a treat for you. If you make the calculations for the wing and horizontal stabilizer using Figure 1, you can go directly to the calculation of the proper center of mass of a conventional aircraft by using Figure 4.



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