MAE 158 2022
Recommended Homework 6

From Shevell, *Fundamentals of Flight*
Problems 15.2
From Anderson, Aircraft Performance and Design, Problems 5.2, 5.7, 5.9(b)

15.2. A two-place airplane is flying at a pressure altitude of 4000 ft at a speed of 120 mph. Outside air temperature is 50°F. The gross weight is 2000 lb. The rectangular wing has an area of 170 ft^2 with a span of 33.25 ft. Wing thickness is 14%. Wing parasite drag is 39% of the total parasite drag; 88% of the wing is exposed. Assuming a propeller (or propulsive) efficiency of 0.84, determine the required cruising brake horsepower.

Note, Brake Horsepower $= \text{BHP} = \frac{\text{Thrust}*\text{Velocity}}{550*\eta}$

The Bede BD-5J is a very small single-seat home-built jet airplane which became available in the early 1970s. The data for the BD-5J are as follows:

- Wing span: 17 ft
- Wing planform area: 37.8 ft^2
- Gross weight at takeoff: 960 lb
- Fuel capacity: 55 gal
- Power plant: one French-built Microturbo TRS 18 turbojet engine with maximum thrust at sea level of 202 lb and a specific fuel consumption of 1.3 lb/(lb·h)

We will approximate the drag polar for this airplane by

$$C_D = 0.02 + 0.062C_L^2$$

5.2 For the BD-5J calculate *analytically* (directly) (*a*) the maximum velocity at sea level and (*b*) the maximum velocity at 10,000 ft.

5.7 For the BD-5J, plot the power required and power available curves at sea level. From these curves, estimate the maximum rate of climb at sea level.

5.9 For the BD-5J use the analytical results to calculate directly
(*b*) Maximum climb angle at sea level and the velocity at which it occurs.

For Problem 15.1:

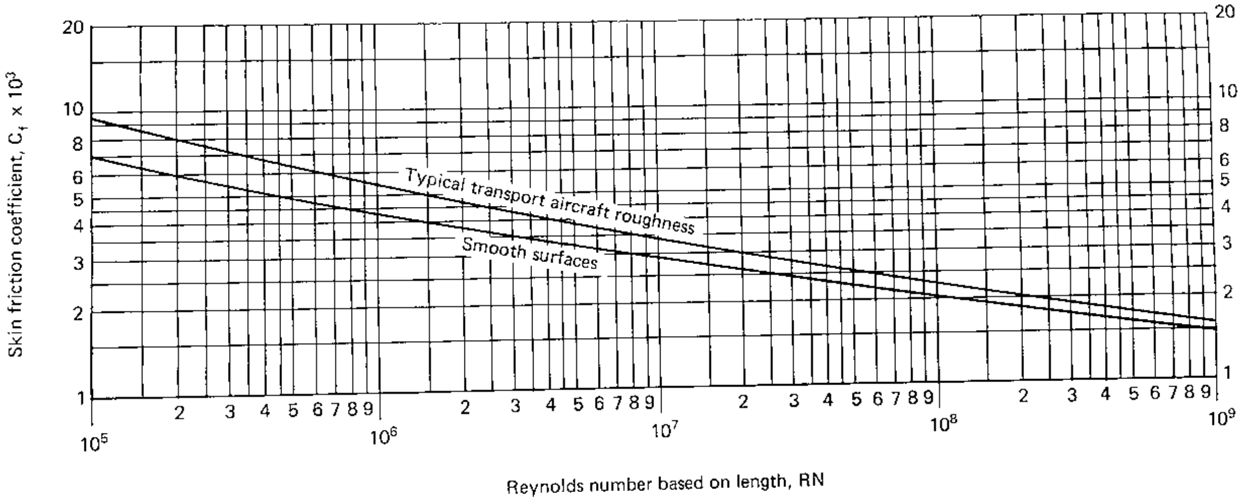

Figure 11.2 Flat-plate skin friction coefficient; turbulent boundary layer; $M = 0.50$.

$$M_0 = 0.5$$

$$K = [1 + Z(t/c) + 100(t/c)^4]$$

where

$$Z = \frac{(2 - M_0^2)\cos\Lambda_{C/4}}{\sqrt{1 - M_0^2\cos^2\Lambda_{C/4}}}$$

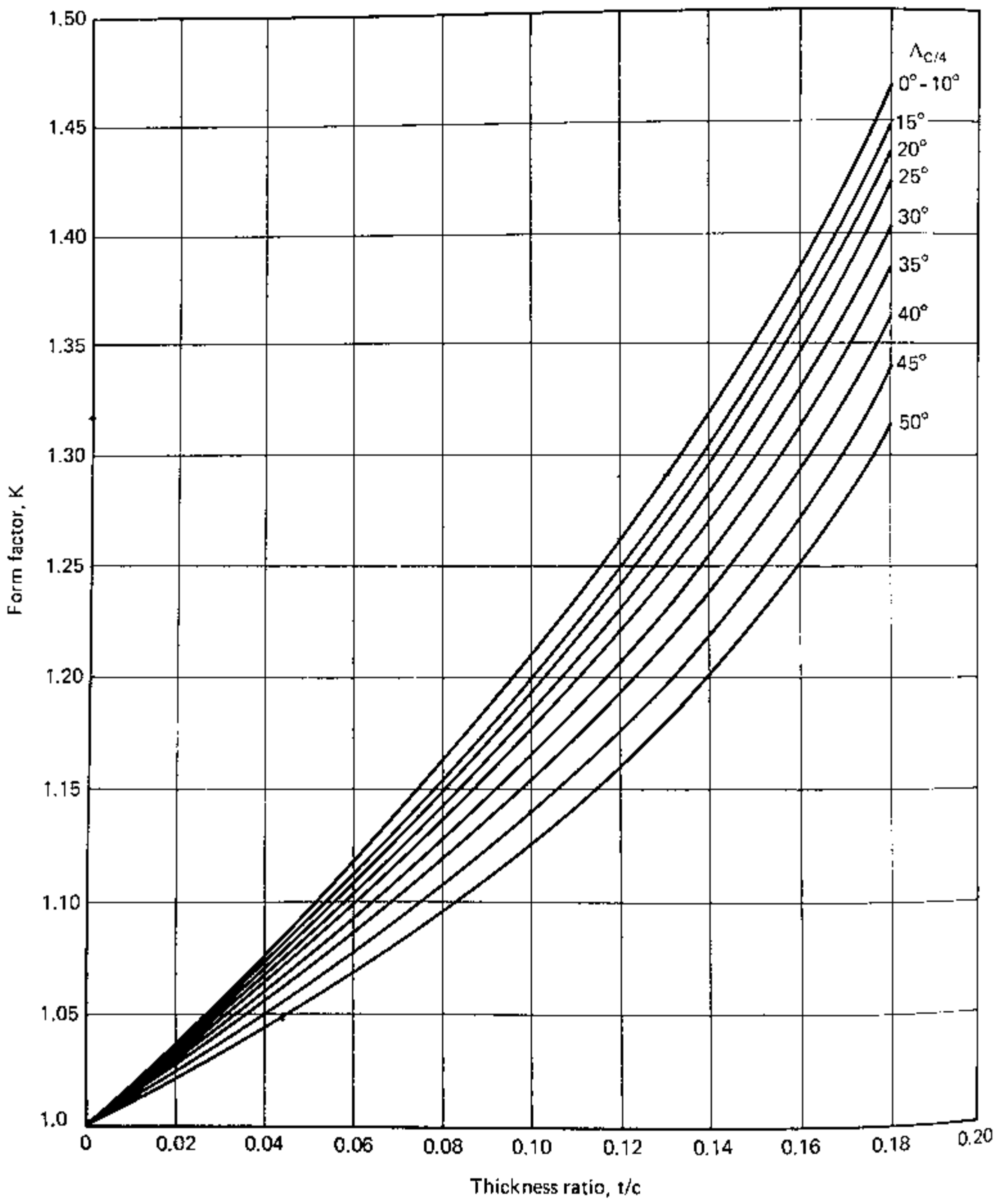

Figure 11.3 Aerodynamic surface form factor.

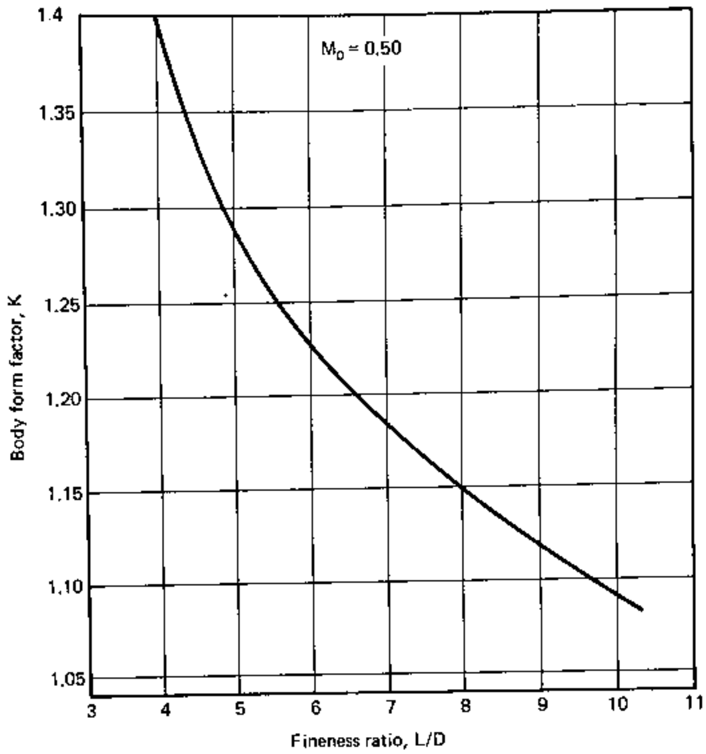

Figure 11.4 Effect of fineness ratio on body form factor.

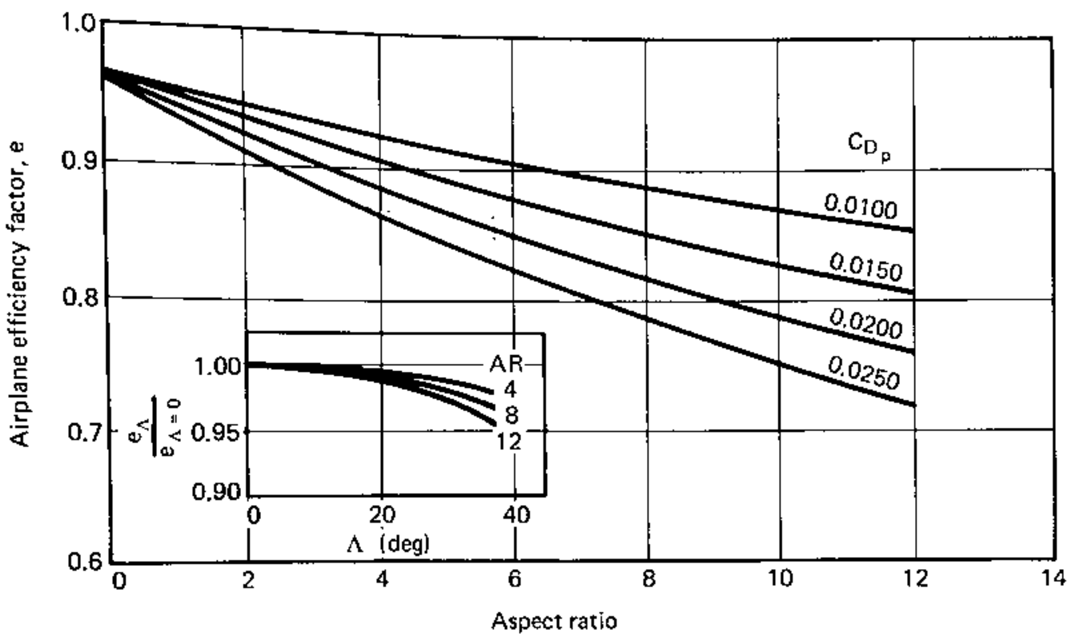

Figure 11.8 Airplane efficiency factor, *e*.