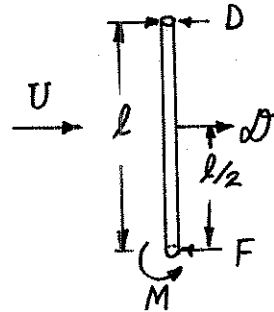


9.61

9.61 Determine the moment needed at the base of 20-m-tall, 0.12-m-diameter flag pole to keep it in place in a 20 m/s wind.



For equilibrium, $M = \frac{l}{2} D$ where

$$D = C_D \frac{1}{2} \rho U^2 l D$$

Since $Re = \frac{UD}{\nu} = \frac{(20 \frac{m}{s})(0.12 m)}{1.46 \times 10^{-5} \frac{m^2}{s}} = 1.64 \times 10^5$, it follows from Fig. 9.21

that $C_D = 1.2$

Thus, $D = 1.2 \left(\frac{1}{2} \right) (1.23 \frac{kg}{m^3}) (20 \frac{m}{s})^2 (20 m) (0.12 m) = 708 N$

Hence, from Eq. (1)

$$M = \frac{20 m}{2} (708 N) = \underline{\underline{7,080 N \cdot m}}$$