December 6, 2013

NAME

Fluids-ID

Quiz 14. Suppose you buy a 1- by 1-ft sheet of plywood and put it on your roof rack of a toy car. You drive the toy car at 1 mi/h. Assuming the airflow ($\nu = 1.57 \times 10^{-4}$ ft^2/s and $\rho = 2.38 \times 10^{-3}$ slugs/ft^3) over the board is laminar and the board is perfectly aligned with the airflow, find (a) the boundary layer thickness δ, (b) the local friction coefficient c_f, and (c) the wall shear stress τ_w at the end of the board and (d) the friction drag coefficient C_f and (e) the friction drag D_f on the upper side of the plywood. (Note: 1 mi/h = 1.4667 ft/s and 1 lb = 1 slug·ft/s^2)

Boundary layer thickness:

$$\delta(x) = \frac{5x}{\sqrt{Re_x}}$$

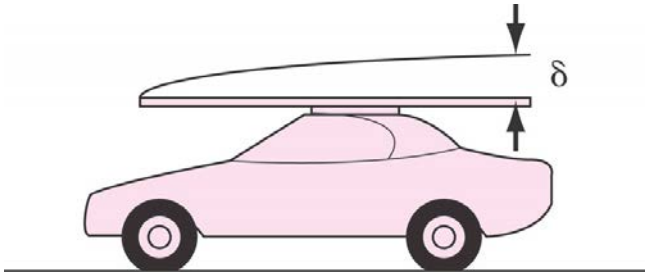
Local friction coefficient:

$$c_f(x) = \frac{\tau_w}{\frac{1}{2}\rho U_\infty^2} = \frac{0.664}{\sqrt{Re_x}}$$

Friction drag coefficient:

$$C_f = \frac{D_f}{\frac{1}{2}\rho U^2 A} = \frac{1.328}{\sqrt{Re_L}}$$

where, $Re_x = {U_\infty x}/{\nu}$ and $Re_L = {U_\infty L}/{\nu}$



Note: Attendance (+2 points), format (+1 point)