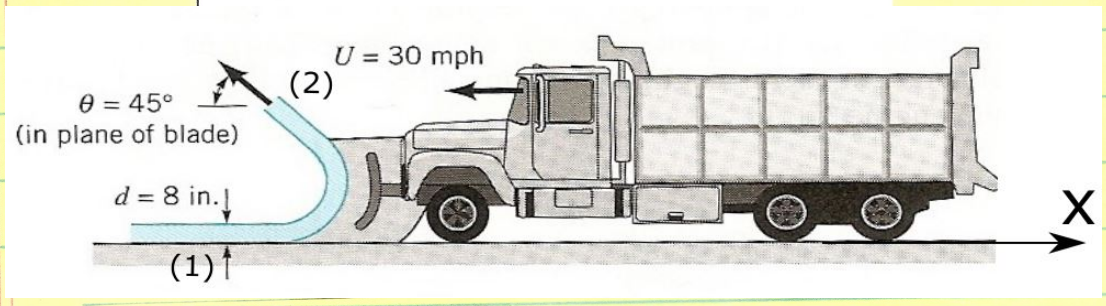
5.80 A snowplow mounted on a truck clears a path 12 *ft* through heavy wet snow, as shown in Figure P5.83. The snow is 8 *in.* deep and its density is 10 *lbm/ft*^{3}. The truck travels at 30 *mph*. The snow is discharged from the plow at an angle of 45° from the direction of travel and 45° above the horizontal, as shown in Figure P5.70. Estimate the force required to push the plow.



$$-\dot{m}_1 + \dot{m}_2 = 0$$

$$\rho A_1 V_{R_1} = \rho A_2 V_{R_2} \qquad V_R = V - V_s = -V_s = U$$

$$\frac{V_{R_1}^2}{2g} + \frac{p_1}{\gamma} + z_1 = \frac{V_{R_2}^2}{2g} + \frac{p_2}{\gamma} + z_2 \qquad p_1 = p_2 = 0, \quad z_1 \sim z_2$$

$$V_{R_1} = V_{R_2} = V_R$$

$$A_1 = A_2 = A$$

$$\Sigma F_x = -F_x = -\dot{m}_1 V_{R_1} + \dot{m}_2 (-V_{R_2} \cos 45°)$$

$$F_x = \rho A V_R^2 (1 + \cos 45°)$$

$$F_x = \frac{10 \times \frac{8}{12} \times 12}{32.2} \times \left(30 \times \frac{5280}{3600}\right)^2 (1 + .707)$$

$$= 8220 \text{ lb}$$