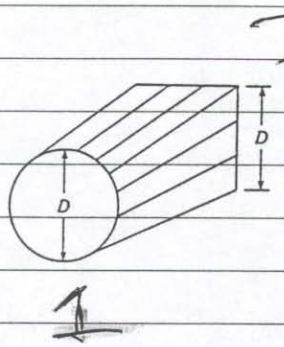
A circular duct of diameter D is connected to a square duct with sides of length D, as shown. Air flows in the circular duct at 100 ft./sec. There is no elevation difference between the circular and square section. Assume the flow is steady, inviscid, and incompressible. The specific weight of air is 0.075 lbf/ft³ Find the pressure change between the circular and square section.



$\gamma = .075 \text{ lbf/ft}^3$

$\rho = \gamma/g = .00233 \frac{\text{lbf}\cdot\text{s}^2}{\text{ft}^4}$

slug/ft^3

$\text{slug} = \frac{\text{lbf s}^2}{\text{ft}}$

$$p_1 + \frac{\rho}{2} V_1^2 = p_2 + \frac{\rho V_2^2}{2}$$

$$p_1 - p_2 = \frac{\rho}{2}\left(V_2^2 - V_1^2\right)$$

$$Q_1 = Q_2$$

$$V_1 A_1 = V_2 A_2$$

$$V_2 = V_1 \frac{A_1}{A_2} = 100 \times \frac{\frac{\pi D^2}{4}}{D^2} = \frac{\pi}{4} \times 100$$

$$= 78.54 \text{ ft/s}$$

$$\Delta p = \frac{.00233}{2}\left(78.54^2 - 100^2\right)$$

$$= -4.46 \frac{\text{lbf}}{\text{ft}^2}$$