Problem 6.79

Given: Oil with specific gravity of 0.90 is flowing down through venturi metter (fig 6.33) $h = 28^{in}$.

Find: volume flow rate of oil

Solution:

$D_A = 4in \quad D_B = 2in \quad h = 28^{in} \quad Sg_{oil} = 0.90 \quad Sg_{Hg} = 13.54$
$\gamma_{water} = 9.81 \frac{KN}{m^3}$

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2 \qquad eq\,1$$

$$Q = V \cdot A \qquad eq\,2$$

$$\frac{P_2 - P_1}{\gamma} + (z_2 - z_1) = \frac{V_1^2}{2g} - \frac{V_2}{2g} \qquad eq\,1$$

$$V = \frac{Q}{A} \qquad eq\,2$$

$$\frac{P_2 - P_1}{\gamma} + (z_2 - z_1) = \frac{Q^2}{2g}\left(\frac{1}{A_1^2} - \frac{1}{A_2^2}\right) \qquad eq1 + eq2$$

$$Q = \sqrt{\frac{2g\left(\frac{P_2 - P_1}{\gamma} + (z_2 - z_1)\right)}{\frac{1}{A_1^2} - \frac{1}{A_2^2}}} \qquad eq\,3$$

$$\frac{P_2 - P_1}{\gamma} = z_1 - z_2 + \left(1 - \left(\frac{Sg_{Hg}}{Sg_{oil}}\right)\right)h \qquad eq4$$

$$Q = \sqrt{\frac{2g\left(1 - \frac{Sg_{Hg}}{Sg_{oil}}\right)h}{\frac{1}{A_1^2} - \frac{1}{A_2^2}}} \qquad eq\,3 + eq4$$

$$A_1 = \frac{\pi}{4} D_1^2 = \frac{\pi}{4}(4^{in})^2 = 12.56^{in^2} = 0.0873^{ft^2}$$

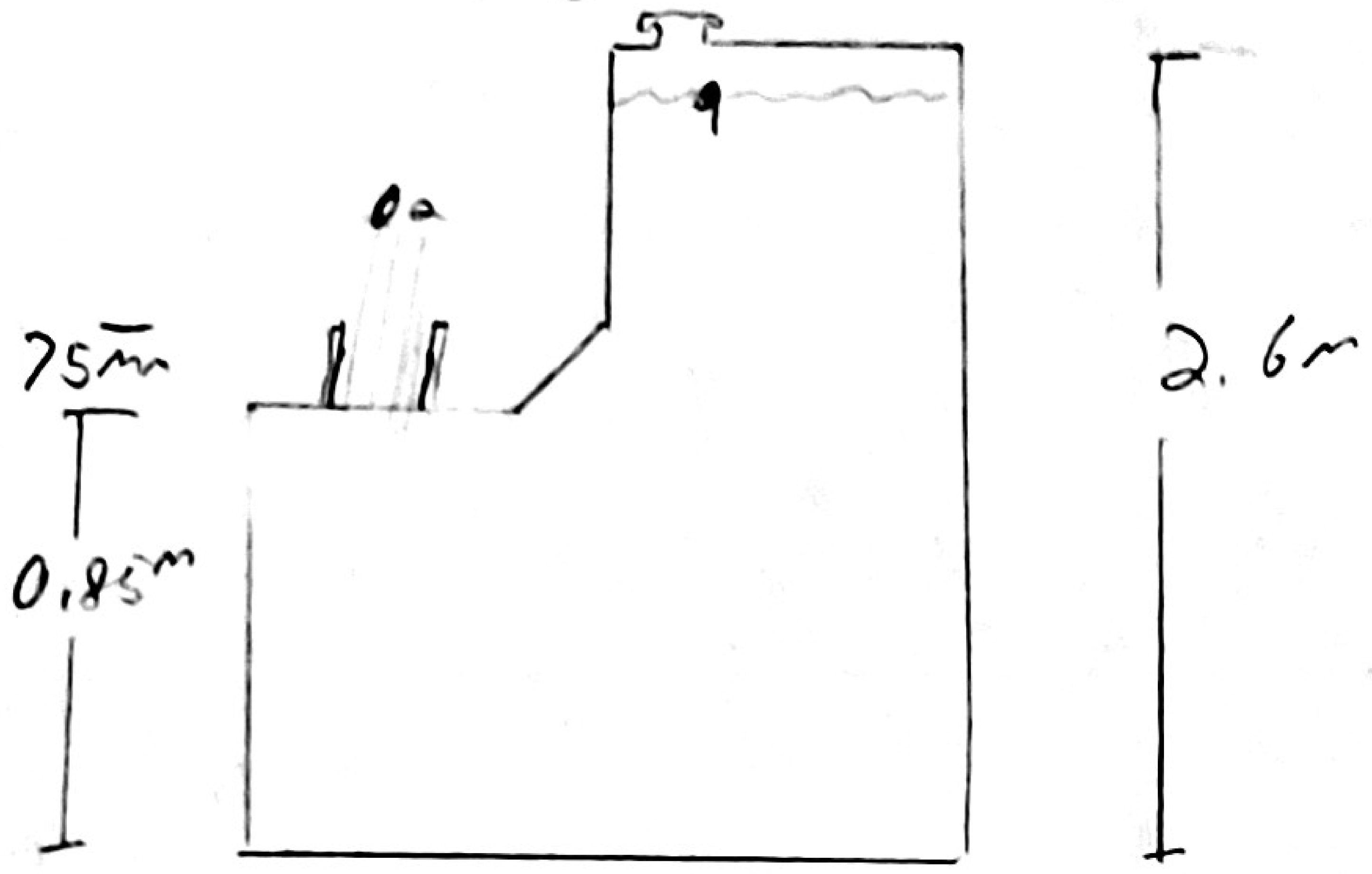
$$A_2 = \frac{\pi}{4} D_2^2 = \frac{\pi}{4}(2^{in})^2 = 3.14^{in^2} = 0.0218^{ft^2}$$

$$Q = \sqrt{\frac{2 \cdot 32.2 \frac{ft}{s^2}\left(1 - \frac{13.54}{0.9}\right) \cdot \frac{28}{12}^{ft}}{\frac{1}{(0.0873 ft^2)^2} \quad \frac{1}{(0.0218 ft^2)^2}}}$$

$$\underline{\underline{Q = 1.034 \frac{ft^3}{s}}}$$

Problem 6.91

Given: figure 6.39



Find: height of jet

Solution:

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2$$

I want to find z_2 ∴ $z_2 = \frac{P_1 - P_2}{\gamma} + \frac{V_1^2 - V_2^2}{2g} + z_1$

$$z_2 = \frac{0-0}{\gamma} + \frac{0+0}{2 \cdot 9.81 \frac{m}{s^2}} + z_1$$

$z_2 = z_1$

$\underline{\underline{z_2 = 2.6^m}}$