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ENG 214

# FLUID MECHANICS ASSIGNMENT 2

① $D_1$ of inlet $= 0.3m\ (300mm)$

$A_1$ of inlet $= \frac{\pi D_1^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.07m^2$

$D_2$ of throat $= 0.15m\ (150mm)$

$A_2$ of inlet $= \frac{\pi D_2^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.0176m^2$

Specific gravity $= 13.6$ (mercury)

Specific gravity $= 0.9$ (oil)

$y = 0.25m\ (250mm)$

$$h = \left(\frac{P_1}{w} + Z_1\right) - \left(\frac{P_2}{w} + Z_2\right)$$

$$= y\left[\frac{Sg}{Sg} - 1\right] = 0.25\left(\frac{13.6}{0.9} - 1\right) = 3.527m$$

∴ Discharge of oil $Q =$

$$Q = \frac{Cd \times A_1 A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$$

$$Q = \frac{0.98 \times 0.07 \times 0.0176 \times \sqrt{2 \times 9.81 \times 3.527}}{\sqrt{0.07^2 - 0.0176^2}}$$

$$Q = \frac{0.0012 \times 5.39}{0.0046} = \frac{0.0098}{0.0076} = 1.152$$

$$Q = \frac{1.207 \times 10^{-3} \times 8.31}{0.067} = \frac{0.01}{0.067} = 0.149m^3/s$$

1) Pressure difference.

$$h = \left(\frac{P_1}{w} + z_1\right) - \left(\frac{P_2}{w} + z_2\right) = 3.527$$

$$h = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) - (z_1 - z_2) = 3.527$$

$z_2 - z_1 = 0.3\text{m}\ (300\text{mm})$

$$\frac{P_1 - P_2}{w} - 0.3 = 3.527$$

$$\frac{P_1 - P_2}{w} = 3.527 + 0.3$$

$$\frac{P_1 - P_2}{w} = 3.827$$

$$P_1 - P_2 = 3.827w$$

$$P_1 - P_2 = 3.827 \times 9.81 \times 0.9$$

$$= 33.78\ \text{N/m}^2$$

(2) Specific gravity $= 0.8$, $D_1 = 150\text{mm} = 0.15\text{m}$

$D_2 = 95\text{mm} = 0.075\text{m}$

$z_2 - z_1 = 0.15\text{m}(150\text{mm})$, $Q = 40\text{l/s} = 0.04\text{m}^3/\text{s}$, $Cd = 0.96$

$$A_1 = \frac{\pi D_1}{4} = \frac{\pi \times 0.15^2}{4} = 0.0176\text{m}^2$$

$$A_2 = \frac{\pi D_2}{4} = \frac{\pi \times 0.075^2}{4} = 4.417 \times 10^{-3}\text{m}^2$$

$$Q = \frac{Cd\, A_1 A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$$

$$0.04 = \frac{0.96 \times 0.0176 \times 4.417 \times 10^{-3} \times \sqrt{2 \times 9.81 \times h}}{\sqrt{0.0176^2 - (4.417 \times 10^{-3})^2}}$$

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$$0.04 = 0.96 \times 4.57 \times 10^{-3} \times 4.429\sqrt{h}$$

$$h = \left( \frac{0.04}{0.96 \times 4.57 \times 10^{-3} \times 4.429} \right)^2 = 4.247$$

$$h = \left( \frac{P_1}{w} + Z_1 \right) - \left( \frac{P_2}{w} + Z_2 \right)$$

$$h = \left( \frac{P_1}{w} - \frac{P_2}{w} \right) + (Z_1 - Z_2)$$

$$4.247 + 0.15 = \frac{P_1 - P_2}{P_g}$$

$$P_1 - P_2 = (0.8 \times 1000 \times 9.81)(4.247 + 0.15)$$

$$P_1 - P_2 = 34.51 \text{ KN/m}^2$$