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18/ENG02/031
COMPUTER ENG.
ENG 214 ASSIGNMENT

1. $D_1 = 300mm = 0.3m$

$Area(A_1) = \frac{\pi}{4} \times 0.3^2 = 0.07m^2$

$D_2 = 150mm = 0.15m$

$Area(A_2) = \frac{\pi}{4} \times 0.15^2 = 0.01767m^2$

Specific gravity of mercury $(S_{HL}) = 13.6$
Specific gravity of Oil $(S_p) = 0.9$
Reading on Manometer $(y) = 250mm = 0.25m$

∴ the differential head in this case is given by

$$y\left[\frac{S_{HL}}{S_p} - 1\right] = 0.25\left[\frac{13.6}{0.9} - 1\right]$$

$h = 3.53m$ of oil

i) Discharge of Oil

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

$$Q = 0.98 \times \frac{0.07 \times 0.01767}{\sqrt{0.07^2 - 0.01767^2}} \times \sqrt{2 \times 9.81 \times 3.53}$$

$$= 0.1489 m^3/s$$

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

$$\frac{P_1 - P_2}{w} - 0.3 = 3.53$$

$$P_1 - P_2 = 3.83 \times w$$

$$w = (9.81 \times 0.9) = 8.829$$

$$\therefore P_1 - P_2 = 3.83 \times 8.829 = 33.8 \, KN/m^2$$

2. Sp. gravity = 0.8
$D_1 = 150mm = 0.15m$
$D_2 = 75mm = 0.075m$
$Z_1 - Z_2 = 150mm = 0.15m$
$Q = 40 litres/sec = 0.04 m^3/s$

$$A_1 = \frac{\pi}{4} \times 0.15^2 = 0.1767 m^2$$

$$A_2 = \frac{\pi}{4} 0.075^2 = 0.00442 m^2$$

$$Q = C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh} \quad \text{(Using this to find h)}$$

$$0.04 = 0.96 \times \frac{0.01767 \times 0.00442}{\sqrt{0.01767^2 - 0.00442^2}} \times \sqrt{2 \times 9.81} \times \sqrt{h}$$

$$0.04 = 0.96 \times 0.004565 \times 4.429\sqrt{h}$$

$$\sqrt{h} = \frac{0.04}{0.96 \times 0.004565 \times 4.429}$$

$$\sqrt{h} = 2.0608$$

$$h = 2.0608^2$$

$$\therefore h = 4.247\,m$$

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

~~$(P_1 - P_2) =$~~

$$4.247 = \left(\frac{P_1 - P_2}{w}\right) - 0.15$$

$$\left(\frac{P_1 - P_2}{w}\right) = 4.247 + 0.15 = 4.397$$

$$\therefore (P_1 - P_2) = 4.397 \times w$$

$$= 4.397 \times (0.8 \times 1000 \times 9.81)$$

~~$34.5115\,kN/m^2$~~

~~$= 34.46\,kN/m^2$~~

$$= 34.51\,kN/m^2$$

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