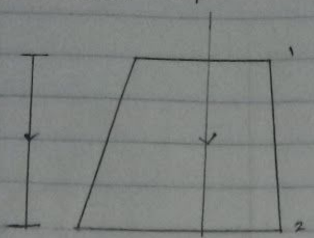
FIDELIS GODFREY MAMZA 18/ENG04/040 ELECT.
ELECT / ELET.
ENG 214

1.



$L = 2.0m$

$V_1 = 5m/s$

$V_2 \quad 2m/s.$

$P_1 = 2.5m$

$$H_L = \frac{0.35(V_1 - V_2)^2}{2g}.$$

$$\frac{0.35(5-2)^2}{2 \times 9.81} = 0.161m$$

$P_2 = ?$

Applying Bernoulli's equation

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

$$P_1 = \frac{P_1}{\rho g} \quad \text{and} \quad P_2 = \frac{P_2}{\rho g}$$

$$Z_1 = 2.0 \text{ and } Z_2 = 0$$

$$\therefore 2.5 + \frac{5^2}{2 \times 9.81} + 2.0 = P_2 + \frac{2^2}{2 \times 9.81} + 0 + 0.161$$

$$2.5 + \frac{25}{19.62} + 2 = P_2 + \frac{4}{19.62} + 0.161$$

$$2.5 + \frac{25}{19.62} + 2 - \left(\frac{4}{19.62} + 0.161\right) = P_1$$

$$5.774 - 0.365 = P_2$$

$$P_2 = 5.409m$$

2. $D_1 = 20cm$

$D_2 = 10 cm.$

$A_1 = \frac{\pi D_1^2}{4} = \frac{\pi (20)^2}{4} = 314.16cm^2$

$A_1 = \frac{\pi D_2^2}{4} = \frac{\pi (10)^2}{4} = 78.54cm^2.$

Density of water $\rho = 1000kg/m^3.$

$P_1 = 17.658 N/cm^2 = 17.658 \times 10^4 N/m^2.$

$\frac{P_1}{\rho g} = \frac{17.658 \times 10^4}{1000 \times 9.81} = 18m$

$\frac{P_2}{\rho g} = -30cm$ mercury, S.Hg = 13.6.

$\frac{P_2}{\rho g} = -30 \times 10^{-2} \times 13.6 = 4.08m.$

$h = \frac{P_1}{\rho g} - \frac{P_2}{\rho g} = 18 - (-4.08)$

$= 18 + 4.08 = 22.08m \times 10 = 2208cm.$

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

$\frac{0.98 \times \sqrt{2 \times 9.81 \times 2208} \times 314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.54)^2}}$

$\frac{0.98 \times 2081.37 \times 24674.1264}{304.18411^2}$

$= 165455.3 cm^3/s$

$\frac{165455.3}{1000} = 165.455 L/s$

3. $d_1 = 30\,cm$ = Pipe.

$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi(30)^2}{4} = 706.86\,cm^2$.

$d_2 = 15\,cm$ orifice.

$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi(15)^2}{4} = 176.7\,cm$.

$S_o = 0.9$.

$S_{Hg} = 13.6$.

$x = 50\,cm$ Hg.

$cd = 0.64$.

$h = x\left(\frac{S_{Hg}}{S_o} - 1\right) = 50\left(\frac{13.6}{0.9} - 1\right)$.

$h = 705.56\,cm$.

$$Q = \frac{cd\sqrt{2gh} \cdot A_1 A_2}{\sqrt{A_1^2 - A_2^2}}$$

$$Q = \frac{0.64 \times \sqrt{2 \times 9.81 \times 705.56} \times 706.86 \times 176.72}{\sqrt{(706.86)^2 - (176.72)^2}}$$

$Q = 137443.29\,cm^3/s$.

$Q = \frac{137443.29}{1000} = 137.44\,l/s$

4. $x = 170\,mm = 170 \times 10^{-3} = 0.17\,m$.

$S_{Hg} = 13.6$

$S_1 = 1.026$.

$V = ?$.

$V = \sqrt{2gh}$, $h = ?$

$h = x\left(\frac{S_g}{S_o} - 1\right] = 0.17\left(\frac{13.6}{1.026} - 1\right) = 2.0834\,m$

$V = \sqrt{2 \times 9.81 \times 2.0834} = 6.393\,m/s$

$V = \frac{6.393 \times 60^2}{1000} = 23.01\,km/hr$

5 $Q = 0.05 m^3 = 50 dm^3$

$P = 15$ bar $= 15 \times 10^5 N/m^2$

speed $= 1700$ rev/min

$T = 15 Nm$. $ND = 10 cm^3/rev$

i. Volumetric efficiency $= \frac{\text{Actual flow rate}}{\text{ideal flow rate}}$.

$\therefore$ Ideal flow rate = Nominal flow rate × speed.

$10 cm^3/rev \times 1700 rev/min = 17000 cm^3/min$.

$= \frac{17000}{1000000} = 0.017 m^3/min$.

Actual flow rate $= 0.05 m^3/min$.

Volumetric efficiency $= \frac{0.05}{0.017} = 2.94\%$ ~~2.94~~

ii. fluid power $= P \times Q$

$P = 15 \times 10^5 N/m^2$.

$Q = 0.05 m^3/min = \frac{0.05}{60} = 8.33 \times 10^{-4} m^3/s$

$\therefore fp = P \times Q = 15 \times 10^5 \times 83.3 \times 10^{-5} = 1249.5$ watts.

iii. shaft power $= \frac{2\pi NT}{60}$ $\therefore \frac{2\pi \times 1700 \times 15}{60} = 2670.35$ watts.

iv. Overall efficiency $= \frac{\text{fluid power}}{\text{shaft power}}$.

$= \frac{1249.5}{2670.35} = 0.468$.

$0.468 \times 100 = 46.8\%$