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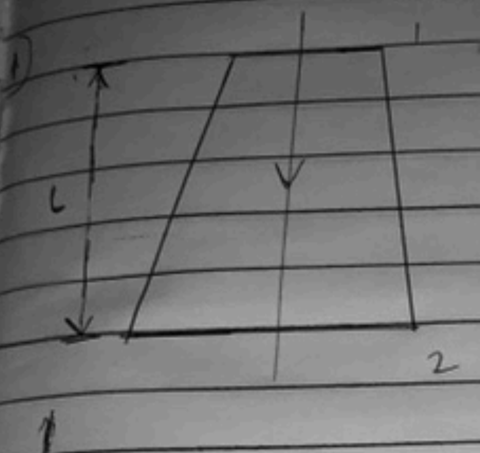
18/ENG06/040
Mechanical ENgineering
Fluid Mechanics ENG 214

1)



Length = 2m

Velocity Flow at end $= V_1 = 5$ m/s

$V_2 = 2$ m/s

Pressure = 2.5m of liquid

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

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

$$P_x = 3$$

Using Bernoulli's equation

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2 + h$$

where $P_s = \frac{P_1}{\rho g}$ and $P_L = \frac{P_2}{\rho g}$

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

Subbing Values into the equation

$$2.5 + \frac{5^2}{2 \times 9.81} + 2 = P_L + \frac{2^2}{2 \times 9.81} + 0.161$$

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

$$2.5 + \frac{25}{19.62} + 2 - \left(\frac{4}{19.62} + 0.161\right) = P_2$$

$$5.774 - 0.365 = P_2$$

$\therefore P_2 = 5.409$m of Fluid.

(2)

2) $D_1 = 20cm$

$D_2 = 10cm$

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

$A_2 = \frac{\pi D_2^2}{4} = \frac{\pi (10)^2}{4} = 78.54 cm^2$

$\rho = 1000 kg/m^3$

Pressure $= 17.658 N/cm^2$ or $17.658 \times 10^4 N/m^2$

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

$\frac{P_2}{\rho g} = -30 cm$ of mecury, S.g Hg $= 13.6$ $= -30 \times 10^{-2} \times 13.6$

$= -4.08m$

$H = \frac{P_1}{\rho g} - \frac{P_2}{\rho g}$

$= 18 - (-4.08)$

$= 18 + 4.08 = 22.08 m \times 100$

$H = 2208 cm$

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

$= \frac{0.98 \times \sqrt{2 \times 981 \times 2208} \times 314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.54)^2}}$

$= \frac{0.98 \times 2081.37 \times 24674.1264}{304.184112}$

$= 165455.278 cm^3/s$

$= \frac{165455.278}{1000} = 165.455 lit/sec.$

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3) $D_1 = 30cm$

$$A_1 = \frac{\pi d_1}{4} = \frac{\pi(30)^2}{4} = 706.5cm^2$$

$D_2 = 15cm$

$$A_2 = \frac{\pi d_2}{4} = \frac{\pi(15)^2}{4} = 176.625cm$$

$S_o = 0.9$

$S_{hg} = 13.6$, $x = 50$cm of mercury (manometer reading)

$C_d = 0.64$

$$H = x\left(\frac{S_{hg}}{S_o} - 1\right)$$

$$H = 50\left(\frac{13.6}{0.9} - 1\right)$$

$H = 705.56$ cm of oil

To get rate of flow,

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

$$Q = \frac{0.64 \times \sqrt{2 \times 981 \times 705.56} \times 706.86 \times 176.72}{\sqrt{706.86^2 - 176.72^2}}$$

$Q = 137443.29 cm^3/s$

$$Q = \frac{137443.29}{1000}$$

$= 137.44 lit/s$

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

$S_g = 13.6$

$S_o = 1.026$

$V = ?$

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

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

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

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

5) $Q = 0.05m^3$

$P_o = 15bar = 15 \times 100000 = 15 \times 10^5 N/m^2$

Speed $= 1700 rev/min$

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

(a) Volumetric Efficiency $= \frac{\text{Actual flow rate}}{\text{Ideal flow rate}}$

Ideal flow rate = Nominal flow rate × Speed

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

$= 17000 cm^3/min$

Ideal flow rate $= \frac{17000}{1000000} = 0.017m^3/min$

Actual Flow rate $= 0.05 m^3/min$

Vol Effi $= \frac{0.05}{0.017} = 2.949 = 294\%$

(b) Fluid power $= P \times Q$

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

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

Fluid power $= 15 \times 10^5 \times 8.33 \times 10^{-4}$

$= 15 \times 10^5 \times 83.3 \times 10^{-5}$

$= 1249.5 \times 10^0$

Fluid Power $= 1249.5$ watts

$A_1 = \frac{\pi d_1}{4}$

$D_2 = 15c$

$A_2 = \frac{\pi d_2}{4}$

$S_o =$

$S_{mg} =$

$C_d =$

$H =$

$H =$

H