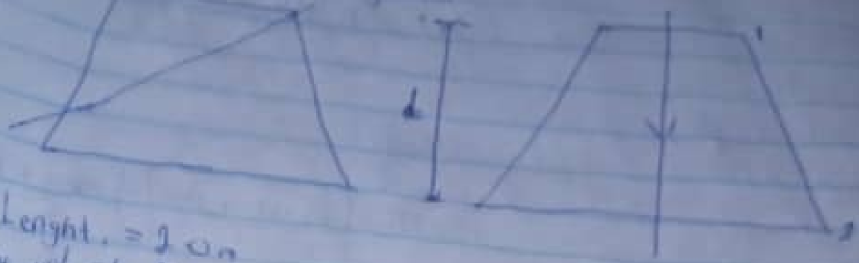
Dibogbo Laura Sairesh
16/ENG04/026
Elect/Elect
Fluid Mechanics Assignment



Lenght. = 2.0 m
The velocity flow at Smaller end = V_1 = 5m/s
The Velocity flow at lower end = V_2 = 2m/s
pressure head at the Smaller end = P_S = 2.5m of liquid
let the loss of head = H_L = $0.35 \frac{[V_1 - V_2]^2}{2g}$

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

$= 0.161m$

pressure head at the lower end = P_2 = ?
Applying Bernoulis 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 $P_2 = \frac{P_2}{\rho g}$

$Z_1 = 2.0$ and $Z_2 = 0$

∴ Inputing values into Equation

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

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

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

$$5.774 - 0.365 = P_2$$

$P_2 = 5.409m$ of fluid.

(2) Inlet diameter $= D_1 = 20cm$
thread Diameter $= D_2 = 10cm$
let inlet area $= A_1 = \frac{\pi D_1^2}{4} = \frac{\pi (20)^2}{4}$
$= 314.16cm^2$.

let thread area $= A_2 = \frac{\pi D_2^2}{4} = \frac{\pi [10]^2}{4}$
$= 78.54cm^2$

Density of water, $\rho = 1000 kg/m^3$
pressure at inlet $= 17.658 m/cm^2 = 17.658 \times 10^4 N/m$

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

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

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

Let Differential head $= Hd = \frac{P_1}{\rho g} - \frac{P_2}{\rho g}$

$$= 18 - (-4.08)$$
$$= 18 + 4.08$$
$$= 22.08m \times 100$$
$$H_d = 2208cm$$

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

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

$$= \frac{0.98 \times 2081.12 \times 24874.1204}{304.18412}$$

$= 165465.3 \, cm^3/s$

$$= \frac{166455.3}{1000} = 166.455 \, lit/sec$$

3 Diameter pipe $= d_1 = 30cm$

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

Diameter of orifice, $d_2 = 15cm$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi (15)^2}{4} = 176.72 cm^2$$

Specific gravity of oil, $S_o = 0.9$

Specific gravity of mercury, $S_g = 13.6$

Differential manometer mercury, $x = 50cm$ of mercury

Coefficient of discharge, $C_d = 0.64$

Differential head, $h = x\left[\frac{S_g}{S_o} - 1\right]$

$$h = 50\left[\frac{13.6}{0.9} - 1\right]$$

$h = 705.56cm$ of oil

The rate of flow of oil is

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

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

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

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

4) The difference of mercury level, x = 170mm = 170×10^{-3} = 0.17m
The Specific gravity of mercury, S_g = 13.6
The Specific gravity of sea water, S_o = 1.026
The Speed, V = ?

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

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

$= 2.0834m$

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

I.s km/hr

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

5) $Q = 0.05m^3/min = 50dm^3/min$

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

Speed = 1700rev/min

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

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

Ideal flow rate = Normal flow rate × speed

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

$= 0.017m^3/mins$

Ideal flow rate = $\frac{17000}{1000000}$

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

Volumetric flow rate.

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

= 294 %

(ii) Fluid power = P x Q

P = 15×10^5 N/m²

Q = 0.05 m³/min = $\frac{0.05}{60}$ = 8.33×10^{-4} m³/s

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

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

= $1249.5 \times 10^{5-5}$

Fluid power = 1249.5 watt

(iii) Shaft power = $\frac{2\pi N T}{60}$ = $\frac{2\pi \times 1200 \times 15}{60}$

Shaft power = 2610.35 watt

(iv) overall efficiency = $\frac{\text{Fluid power}}{\text{Shaft power}}$

$\frac{\text{Fluid power}}{\text{Shaft power}}$ = $\frac{1249.5}{261035}$

= 0.468

overall efficiency = 0.468 x 100

= 46.8%