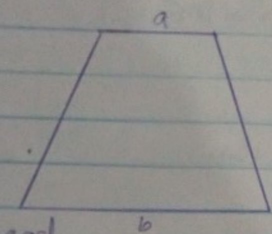
OMENOKU PERPETUAL ISHIOMA
18ENG06I060
MECHANICAL ENGINEERING

1.) $V_1 = 5m/s$ $V_2 = 2m/s$

$t = 2.0m$ $P_1 / \rho g = 2.5m$



let smaller side be called (a)
bigger side be called (b)

loss of head

$= h_l = \frac{0.35(V_1 - V_2)^2}{2g} = \frac{0.35(5-2)^2}{2 \times 9.81} = 0.16m$ //

Pressure head $\frac{P_2}{\rho g} = x$

Using bernoulli's equation at (a) and (b)

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

where $Z_1 = 2.0$ and $Z_2 = 0$,

$\therefore 2.5 + \frac{(5)^2}{2 \times 9.81} + 2.0 = \frac{P_2}{\rho g} + \frac{(3)^2}{2 \times 9.81} + 0 + 0.16$

~~8.1274 +2 8.124~~ $5.77 = \frac{P_2}{\rho g} + 0.203 + 0.16$

$\frac{P_2}{\rho g} = 5.77 - (0.363)$

$\frac{P_2}{\rho g} = 5.407 m$ of fluid //

2) Inlet diameter (D_1) = 20 cm = 0.2 m

throat diameter (D_2) = 100 = 0.10 m

Area of D_1 = $\pi/4 \times (0.2)^2$ = $0.03146 m^2$

Area of D_2 = $\pi/4 \times (0.10)^2$ = $0.007854 m^2$

Cd = 0.98

Pressure (P_1) = $17.685 \times 10^4 N/m^2$

ρ = 10 000 kg/m³

$\therefore$ $P_1/\rho g = \frac{17.685 \times 10^4}{9.81 \times 1000} = 18m$

$P_2/\rho g$ = 30 cm of mercury

= -30 cm of mercury = $-0.3 \times 13.6 = -4$

differential head

$h = P_1/\rho - P_2/\rho = 18 - (-4) = 22.08 m$

$$Q = \frac{Cd \times a_1 a_2 \sqrt{2gh}}{\sqrt{(a_1)^2 - (a_2)^2}}$$

$$Q = \frac{0.98 \times 314.16 \times 0.007854 \times \sqrt{2 \times 9.81 \times 22}}{\sqrt{(314.16)^2 - (0.007852)^2}}$$

$$Q = \frac{50328887.21 \times 165655}{304}$$

Q = 165.56 lit/s

3)

3) Orifice diameter - 15cm
Pipe " = 30 cm
Coefficient of discharge of meter = 0.64
flow of oil of specific gravity = 0.9

$A_o = \pi/4 . (15)^2 = 176.714 cm^2$
$A_p = \pi/4 (30)^2 = 706.858 cm^2$
$H = \left[\frac{13.6}{0.9} - 1\right] \times 50cm$ of Oil

$H = 705.55$

$\therefore Q = \frac{C_d A_o A_p \sqrt{2gh}}{\sqrt{(A_p)^2 - (A_o)^2}} = \frac{0.64 \times 176.71 \times 706.81}{\sqrt{(706.85)^2 - (176.74)^2}} \times \sqrt{2 \times 9.81 \times 70.0555}$

$Q = 137414.25 cm^3/sec$
Litres = 137.41425 lit/sec
Rate of flow of Oil = 137.414 lit/sec.//

4)

Difference of mercury level, $x = 170mm = 0.17m$

Sp g of mercury = 13.6

Sp of Seawater = 1.026

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

$$H = 2.0834 \, m$$

$$V = \sqrt{2gh}$$

$$= \sqrt{2 \times 9.81 \times 2.0834} = 6.39 \, m/s$$

$$= \frac{6.39 \times 60 \times 60}{1000} = 23.004 \, km/hr$$

$\therefore$ Speed of Submarine = 23.004 km/hr

5. Rate of pump = $0.05 m^3/min$ = $500 cm^3/min$

Pressure change = 15 bar

Speed of rotation = 1700 rev/min

normal displacement = $10 cm^3/rev$

torque Input = 15 N/m

flow rate = Normal displacement × speed

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

$15 \times 1700 = 25,500 \ cm^3/min$

$= 25.5$

Volumetric efficiency = $\frac{\text{Actual flow}}{\text{Ideal flow}} = \frac{500}{25.5} = 19.60$

$Q = \frac{(500 \times 10^{-3})}{60 \ m^3/s} = 83.3 \times 10^{-4} \ m^3/s$

Fluid power $= Q\Delta P = 83.3 \times 10^{-4} \times 100 \times 10^5 = 83300 kJ$

$\Delta p = 100 \times 10^5 \ N/m^2$

Shaft power

$= \frac{2\pi NT}{60} = \frac{2\pi \times 1700 \times 25.5}{60} = 4541.4 \ N/m$

Overall efficiency

$\frac{\text{fluid power}}{\text{shaft power}} = \frac{83300}{4541.4} = 18.342$ or 1834.2%