OBEMBE TOMILAYO 18/ENG06/050 MECHANICAL

1 $L = 2.0m$

$V_1 = 5 m/s$

$P_1/\rho g = 2.5 m$ of liquid (Pressure Head 1)

$V_2 = 2 m/s$

Loss of head $= h_L = \frac{0.35(V_1 - V_2)^2}{2g} = \frac{0.35[5-2]^2}{2 \times 9.81} = 0.6m$

$P_2/\rho g$ = (Pressure head 2) ∴ Using Bernoulli's equation

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

Let the datum line passes through section (2) Then $Z_2 = 0$

$Z_1 = 2.0$

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

$$\therefore \frac{P_2}{\rho g} = (2.5 + 1.27 + 2.0) - (0.203 + 0.16)$$

$= 5.407m$

2 $d_1 = 20cm$

$a_1 = \pi/4 \times (20)^2 = 314.16 cm^2$ (1) at inlet

$d_2 = 10cm$

$a_2 = \pi/4 \times 10^2 = 78.74 cm^2$

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

$= 1000 kg/m^3$ & $P_1/\rho g = \frac{17.658 \times 10^4}{9.81 \times 1000} = 18m$ of water

P for water

$\frac{P_2}{\rho g} = -30cm$ of mercury

$= -0.30m$ of mercury $= -0.30 \times 13.6 = -4.08m$ of water

$\frac{P_2}{\rho g} = -30cm$ of mercury

$= -0.30m$ of mercury $= -0.30 \times 13.6 = -4.08$

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

$= 18 + 4.08 = 22.08m$ of water $=$

2208 cm of water

$$\therefore Q = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

$$= \frac{0.98 \times 314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.74)^2}} \times \sqrt{2 \times 981 \times 2208}$$

$$= \frac{50328837.2}{304} \times 165555 cm^3/s = 165.555 l/s$$

3 $Q = C_d A \sqrt{2gh}$

$Q = 0.64 \times \frac{\pi}{4} \times 0.15^2 \times \sqrt{2 \times 0.9 \times 0.5}$

$= 0.64 \times \frac{\pi}{4} \times 0.15^2 \times \sqrt{2 \times 0.9 \times 0.5}$

~~$= 0.0107$~~

$= 0.010789$

$Q = 0.010729 \div 10^{-3}$

$= 10.7$ litre per second

4 Manometer Reading of Mercury = 200mm

Specific gravity of mercury = 13.6 (S_1)

Specific gravity of water = 1.026 (S_2)

$$\therefore h = y\left[\frac{S_1}{S_2} - 1\right]$$

Head

~~$h = 0.18\left[\frac{13.6}{1.026} - 1\right] = 2.2083$~~

Velocity of Submarine

~~$V = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.2083}$~~ –

HEAD

$h = 0.17\left[\frac{13.6}{1.026} - 1\right] = 2.083$

∴ VELOCITY

$V = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.083}$

$= 40.87\ m/s^2$

5 VOLUMETRIC EFFICIENCY : $\eta_V = Q_T/Q_A \times 100$

$V_E = \frac{10 \times 10^{-6} \times 1700}{0.05} \times 100 = 34\%$

MECHANICAL $\frac{T_A \times 2\pi}{P_n\ D_n}$

$= \frac{15 \times 2\pi}{15 \times 10^5 \times 10 \times 10^{-6}}$

$= 6.28 \times 100$

$= 62.8\%$

$= 0.34 \times 0.62 \times 100$

$= 21\%$

FLUID POWER : $P_f = Q \cdot dp$

$\Delta P = 15\ bar$

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

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

$P_f = 1249.5$ watts