OBE CORNELIUS MBA
18/ENG06/049
MECHANICAL ENGINEERING
FLUID MECHANICS (ENG 214)
Document Assignment

1) $V_1 = 5ms^{-1}$
$V_2 = 2ms^{-1}$

P_H at smaller end = 2.5m

$h_f = \frac{(0.35(V^1 - V^2)^2}{2g}$

$L = 2.0m$

P_H at lower end

$L = Z_1 - Z_2 = 2m$

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

$= \frac{P_2}{w} = \frac{P_1}{w} + \frac{1}{2g}(V_1^2 - V_2^2) + (Z_1 - Z_2) - h_f$

$22.5 + 1.07 + 2 - 0.16055$

$P_2 = 5.409$ bar

∴ Pressure at lower end is 5.409 bar

2) Inlet diameter = 20cm
Throat diameter = 10cm
Pressure at Inlet = 17.658 N/cm
Vacuum pressure at Throat = 30cm of Mercury
$Cd = 0.98$

$A_1 = \frac{\pi d^2}{4} = \frac{\left(\frac{20}{100}\right)^2 \times \pi}{4}$

$A_1 = 0.0314m$

$A_2 = \frac{\pi d^2}{4} = \frac{\left(\frac{10}{100}\right)^2 \times \pi}{4}$

$A_2 = 7.853 \times 10^{-3} m$

$y = 30cm$ (0.3m of Mercury
Pressure at Inlet $P_1 = 17658$

$= \frac{17658}{10000} = 1.7658 \times 10^{-3}$ K/m

$\frac{P_1}{w} = \frac{1.7658 \times 10^{-3}}{9.81} = 1.8 \times 10^{-4} m$

$\frac{P_2}{w} = -0.3 \times 13.6 = -4.08$ of H_2O

$h = \frac{P_1}{w} - \frac{P_2}{w} = 1.8 \times 10^{-4} - (-4.08)$

$h = 4.08018m$

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

$Q = \frac{0.98 \times 0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.853 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 4.0818}$

$Q = \frac{0.000241}{0.0304} \times 8.947$

$= 0.0709 m^3/s$

3) $D_1 = 15cm$
$D_2 = 30cm$, 50cm of Mercury
$Q = ?$, $S.G = 0.9$, $C.d = 0.64$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi \times \left(\frac{15}{100}\right)^2}{4}$

$A_1 = 0.0176m$

$A_2 = \frac{\pi d^2}{4} = \frac{\pi \times \left(\frac{30}{100}\right)^2}{4}$

$A_2 = 0.0706m$

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

$h = 0.5\left[\frac{13.6}{0.9} - 1\right]$

$= 7.05$ of Oil

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

$$Q = \frac{0.64 \times 0.0176 \times 0.0706 \times \sqrt{2 \times 9.81 \times 9.05}}{\sqrt{(0.0706)^2 - (0.0176)^2}}$$

$$Q = \frac{9.35 \times 10^{-3}}{4.0112}$$

$$Q = 2.33 \times 10^{-3} m/s$$

4) Axis = 15m

170mm Of Mercury (0.17m)

S.G Of Mercury = 13.6

S.G Of Sea Water = 1.026

V = ?

$$h = y\left(\frac{Sh_1}{S_L} - 1\right)$$

$$h = 0.17\left(\frac{13.6}{1.026} - 1\right)$$

$$h = 2.083m$$

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

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

$$V = 6.39ms^{-1}$$

5) $0.05m^3/min$

$\Delta P = 15 bar$

speed Of rotation = 1700 rev/min

displacement = 100 m^3/rev

Torque Input = 15N/m

i) Volumetric efficiency

Flow rate = Normal Displacement × 1700

Flow rate = 0.05 × 1700

= $85m^3/min$

ii) Volumetric efficiency

$$= \frac{\text{Actual Flow}}{\text{Ideal Flow}} = \frac{10}{85} = 0.117$$

iii) $Q = \frac{0.05 \times 10^{-3}}{60} = 8.35 \times 10^{-7} m^3/sec$

$\Delta P = 15 \times 10^5 N/m^3$

Fluid power = $\Delta P \times Q$

$= 15 \times 10^5 \times 8.33 \times 10^{-7}$

= 1.2497 Watts

iv) Shaft power = $\frac{2\pi NT}{60}$

$= \frac{2\pi \times 1700 \times 15}{60} = 2670.35W$

v.) Overall efficiency = $\frac{\text{Fluid power}}{\text{Shaft power}}$

$$\frac{1.2495}{2670.35} = 0.046\%$$