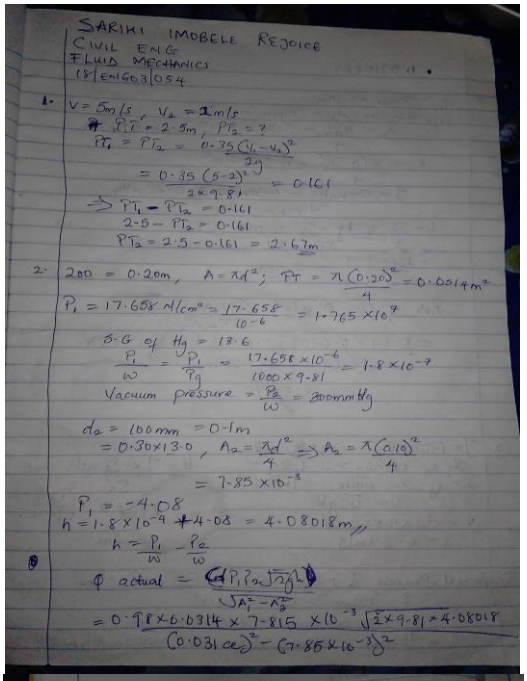
Sariki Imobele Rejoice

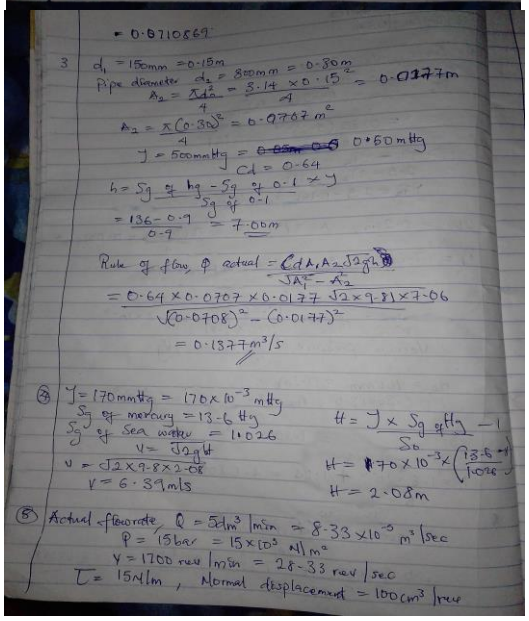
Civil engineering

18/ENG03/054


SARIKI IMOBELE REJOICE
CIVIL ENG
FLUID MECHANICS
18/ENG03/054

1. $V = 5m/s$, $V_2 = 2m/s$
$P_1 = 2.5m$, $P_{T_2} = ?$
$P_{T_1} = P_{T_2} = 0.35 \frac{(V_1 - V_2)^2}{2g}$
$= 0.35 \frac{(5-2)^2}{2 \times 9.81} = 0.161$
$\Rightarrow P_{T_1} - P_{T_2} = 0.161$
$2.5 - P_{T_2} = 0.161$
$P_{T_2} = 2.5 - 0.161 = 2.67m$

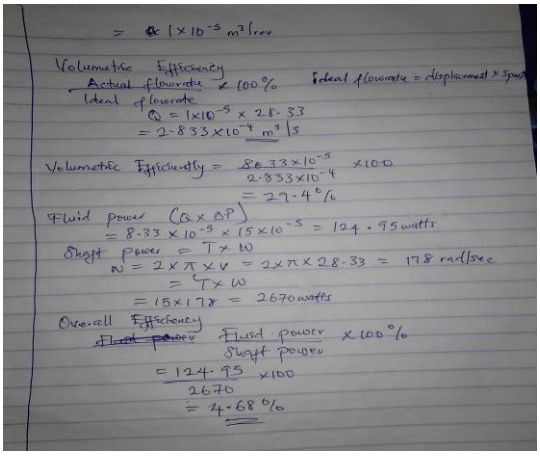
2. $200 = 0.20m$, $A = \pi d^2$; $P_T = \frac{\pi (0.20)^2}{4} = 0.0314m^2$
$P_1 = 17.658 N/cm^2 = \frac{17.658}{10^{-6}} = 1.765 \times 10^7$
S.G of Hg = 13.6
$\frac{P_1}{w} = \frac{P_1}{\rho g} = \frac{17.658 \times 10^{-6}}{1000 \times 9.81} = 1.8 \times 10^{-7}$
Vacuum pressure $= \frac{P_2}{w} = 300mm\,Hg$
$d_2 = 100mm = 0.1m$
$= 0.30 \times 13.0$, $A_2 = \frac{\pi d^2}{4} \Rightarrow A_2 = \frac{\pi (0.10)^2}{4}$
$= 7.85 \times 10^{-3}$
$P_1 = -4.08$
$h = 1.8 \times 10^{-4} + 4.08 = 4.08018m$
$h = \frac{P_1}{w} - \frac{P_2}{w}$
Φ actual $= \frac{C_d P_1 P_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$
$= \frac{0.98 \times 0.0314 \times 7.815 \times 10^{-3} \sqrt{2 \times 9.81 \times 4.08018}}{\sqrt{(0.031 m^2)^2 - (7.85 \times 10^{-3})^2}}$


$= 0.87105697$

3. $d_1 = 15mm = 0.15m$
Pipe diameter $d_2 = 300mm = 0.30m$
$A_2 = \frac{\pi d_2^2}{4} = \frac{3.14 \times 0.15^2}{4} = 0.0177m$
$A_2 = \frac{\pi (0.30)^2}{4} = 0.0707 m^2$
$y = 500mm\,Hg = 0.50m\,Hg$
$C_d = 0.64$
$h = \frac{Sg\ of\ hg - Sg\ of\ 0.1}{Sg\ of\ 0.1} \times y$
$= \frac{13.6 - 0.9}{0.9} = 7.00m$
Rule of flow, Φ actual $= \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$
$= \frac{0.64 \times 0.0707 \times 0.0177 \sqrt{2 \times 9.81 \times 7.06}}{\sqrt{(0.0708)^2 - (0.0177)^2}}$
$= 0.1377 m^3/s$

4. $y = 170mm\,Hg = 170 \times 10^{-3} m\,Hg$
Sg of mercury $= 13.6$ Hg
Sg of Sea water $= 1.026$
$V = \sqrt{2gh}$
$V = \sqrt{2 \times 9.8 \times 2.08}$
$V = 6.39 m/s$
$H = \frac{y \times Sg\ of\ Hg}{Sg\ of\ water} - 1$
$H = \frac{170 \times 10^{-3} \times 13.6}{1.026} - 1$
$H = 2.08m$

5. Actual flowrate $Q = 5dm^3/min = 8.33 \times 10^{-5} m^3/sec$
$P = 15bar = 15 \times 10^5 N/m^2$
$Y = 1700 rev/min = 28.33 rev/sec$
$T = 15Nm$, Normal displacement $= 100cm^3/rev$


$= 1 \times 10^{-5} m^3/rev$

Volumetric Efficiency
$\frac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100\%$ Ideal flowrate = displacement × speed
$Q = 1 \times 10^{-5} \times 28.33$
$= 2.833 \times 10^{-4} m^3/s$
Volumetric Efficiency $= \frac{8.33 \times 10^{-5}}{2.833 \times 10^{-4}} \times 100$
$= 29.4\%$
Fluid power $(Q \times \Delta P)$
$= 8.33 \times 10^{-5} \times 15 \times 10^{-5} = 124.95 watts$
Shaft power $= T \times w$
$w = 2 \times \pi \times v = 2 \times \pi \times 28.33 = 178 rad/sec$
$= T \times w$
$= 15 \times 178 = 2670 watts$
Overall Efficiency
$\frac{\text{Fluid power}}{\text{Shaft power}} \times 100\%$
$= \frac{124.95}{2670} \times 100$
$= 4.68\%$