

Name: Nnamah Oyinike
 Dept: Biomedical Engineering
 Mat No: 18EN908/01

ENG 214

1) Gravity - SP
 Diameter = 150mm²
 0.15m

Diameter z = 75mm = 0.075m

$z_2 - z_1 = 1500\text{mm} = 0.015\text{m}$

$Q = 40\text{ litres/sec} = 0.04\text{m}^3/\text{s}$

$C_d = 0.96$

$$A_{c1} = \frac{\pi d_1^2}{4}$$

$$= \frac{\pi (0.15)^2}{4}$$

$$= 0.0177\text{m}^2$$

$$A_{c2} = \frac{\pi d_2^2}{4}$$

$$= \frac{\pi (0.075)^2}{4}$$

$$= 4.418 \times 10^{-3}\text{m}^2$$

Recall,

$$Q = C_d \times A_1 A_2 \times \sqrt{2gh}$$

$$0.04 = 0.96 \times 0.0177$$

$$\times 4.418 \times 10^{-3} \times \sqrt{2 \times 9.8 \times h}$$

$$\sqrt{(0.0177)^2 - (4.418 \times 10^{-3})^2}$$

$$0.04 \times 17.502 \times 10^{-5} \times 4.429 \sqrt{h}$$

$$0.0117$$

$$0.04 = 0.0196 \sqrt{h}$$

$$0.04 = \sqrt{h}$$

$$0.0196$$

$$(2 \times 0.04)^2 = (A_1)^2 + (\text{square sides})$$

$$\approx 4 \times 0.16 \approx 4.2$$

$$h \approx 4.2\text{m}$$

$$h = \left(\frac{P_1 + Z_1}{w} \right) - \left(\frac{P_2 + Z_2}{w} \right)$$

$$h = \left(\frac{P_1}{w} - \frac{P_2}{w} \right) - (Z_1 - Z_2)$$

$$4.2 = \left(\frac{P_1 - P_2}{\rho g} \right) - 0.15$$

$$4.2 + 0.15 = \frac{P_1 - P_2}{\rho g}$$

$$4.35 \rho g = P_1 - P_2$$

$$P_1 - P_2 = (0.8 \times 1000 \times 9.8) \times 4.35$$

$$P_1 - P_2 = 34.104\text{KN/m}^2$$

2) Diameter of inlet

$D_1 = 300\text{mm} = 0.3\text{m}$

$$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi (0.3)^2}{4}$$

$$\approx 0.07\text{m}^2$$

Diameter of throat

$D_2 = 150\text{mm} = 0.15\text{m}$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi (0.15)^2}{4}$$

$$A_2 = 0.0177\text{m}^2$$

Note: $S_f = 13.6$

$S_p = 0.9$

Differential manometer

$y = 250\text{mm} = 0.25\text{m}$

Differential h w

$$h = \left(\frac{P_1 + Z_1}{w} \right) - \left(\frac{P_2 + Z_2}{w} \right)$$

Result

$$y = \left(\frac{S_b - 1}{S_p} \right)$$

$$= 25 \left(\frac{13.6}{0.9} - 1 \right)$$

$= 3.53 \text{ m of oil}$

$$= C_d \times A_1 \times A_2 \times \sqrt{2gh}$$

$$\sqrt{(A_1)^2 - (A_2)^2}$$

$$= 0.48 \times (0.007 \times 0.0166)$$

$$\times \sqrt{2} \times 9.8 \times 3.53$$

$$\sqrt{(0.007)^2 - (0.0166)^2}$$

$$= 3.53 \times 10^{-3}$$

$$= 0.006 \text{ m}$$

$$= 0.1489 \text{ m}^3/\text{s}$$

(b) Pressure difference between entrance and throat section

$$h_2 \left(\frac{\rho_1 + \rho_2}{\rho} \right) - \left(\frac{\rho_2 + \rho_2}{\rho} \right)$$

$$h_2 = \left(\frac{\rho_1 - \rho_2}{\rho} \right) - (z_1 - z_2)$$

$$z_2 = 2 \text{ m} = 200 \text{ mm} = 0.2 \text{ m}$$

$$\therefore h = 0.3 = 308 \text{ mm}$$

$$h = 308 \text{ mm}$$

$$\frac{P_1 - P_2}{\rho} = 308 \text{ mm}$$

$$P_1 - P_2 = 308 \text{ mm}$$

$$P_1 - P_2 = 308 \text{ mm} \times 9.81 \times \rho$$

$$P_1 - P_2 = 3308 \text{ N/m}^2$$