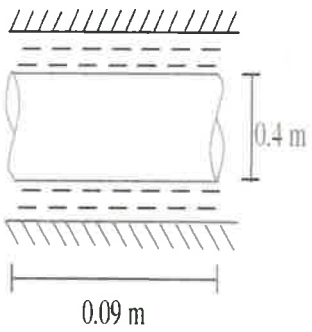
Q.P. Code 37184

Fluid Mechanics and Fluid Power Synoptic

May 2018

Q.2 c) 06



$\mu = 6P$

$= 0.6 \frac{Ns}{m^2}$

N = 190 rpm

Power lost = ?

$A = \Pi D L$

$= \Pi \times 0.4 \times 0.09 \qquad A = 0.11 m^2$

$Y = 1.5 \times 10^{-3} m$

03

$$U = \frac{\Pi DN}{60}$$

$$= \frac{\Pi \times 0.4 \times 190}{60}$$

$$U = 3.979 \text{ m/s}$$

$$\tau = \mu . \frac{U}{Y}$$

$$= 0.6 \times \frac{3.979}{1.5 \times 10^{-3}}$$

$$\tau = 1.592 \times 10^{3} \text{ N/m}^2$$

$$\frac{F}{A} = 1.59 \times 10^{3}$$

$$F = 1.591 \times 10^{3} \times 0.11$$

$$F = 175.01 \text{ N}$$

$$T = F \times R$$

$$= 175.01 \times 0.2$$

$$T = 35 \text{Nm}$$

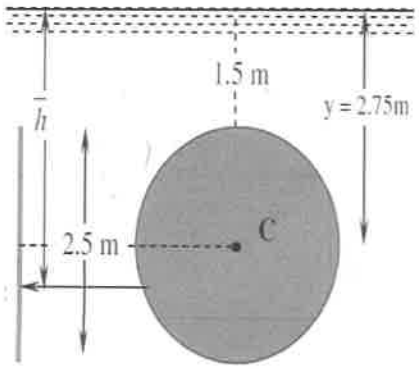
$$P = \frac{2\Pi NT}{60.000}$$

$$P = 0.6964 \text{KW}$$

$$P = 696.4 \text{W}$$

Q3

Q.3 c) 04



$$A = \frac{\pi \times D^2}{4} = \frac{\pi \times 2^2}{4} = 4.91\ \mathbf{m^2}$$

Assume

$\rho = 0.9X1000=900\ kg/m^3, g=9.8\ m/s^2$

$\gamma_{oil} = 900\ X\ 9.81 = 8829\ N/m^3$

$h_c = 2.75m$

We know that the total pressure force is given by 'F'

$F = \gamma_{oil}\ A\ h_c = 8829 \times 4.91 \times 2.75 = 238184\ N = 238.184\ kN$

Centre of Pressure:

The Centre of pressure is given by

$$h_{C.P.} = h_c + \frac{(I_c)_{x\,x}}{Ah_c}$$

$$I_g = \frac{\pi R^4}{4} = \frac{\pi \times 1.25^4}{4} = 1.9175\ \mathbf{m^4}$$

$$h_{C.P.} = 2.75 + \frac{1.9175}{4.91 \times 2.75} = 2.892\mathbf{m}$$

Q.5 c) Given: 04

Specific gravity of oil, $s_o = 0.8$

Specific gravity of mercury $s_h = 13.6$

Reading of differential manometer $x = 25cm$

Therefore difference of pressure head, $h = x\,[(s_h/s_o) - 1]$

$=25[(13.6/0.8) - 1]$ cm of oil $= 25[17-1] = 400$ cm of oil.

Dia at inlet, $d_1 = 20cm$

Area at inlet, $a_1 = (\pi d_1^2)/4 = (\pi 20^2)/4 = 314.16cm^2$

Similarly at throat, $d_2 = 10cm$

$a_2 = (\pi 10^2)/4 = 78.54cm^2$

$C_d = 0.98$ (given)

Therefore **discharge Q** is given by

$Q = C_d*(a_1a_2/(\sqrt{a_1^2 - a_2^2}))*(\sqrt{2gh})$

$=0.98*(314.16*78.54/(\sqrt{314.16^2 - 78.54^2}))*(\sqrt{2*9.81*400})$

$=21421375.68/ (\sqrt{98696-6168})$

$=21421375.68/304\ cm^3/s$

$=70465cm^3/s$

Q = 70.465 lit/s

Q.6 b) L=800m 05

L1=175m D1=0.3m
L2=200m D2=0.25m
L3=250m D3=0.20m
L4=175m D4=0.15m

For an equivalent pipe

$$\frac{L}{D^5}=\left\{\frac{L_1}{D_1^5}+\frac{L_2}{D_2^5}+\frac{L_3}{D_3^5}+\frac{L_4}{D_4^5}\right\}$$

$$D=\left\{\frac{L}{\frac{L_1}{D_1^5}+\frac{L_2}{D_2^5}+\frac{L_3}{D_3^5}}\right\}^{\frac{1}{5}}$$

$$\therefore D=\left\{\frac{800}{\left(\frac{175}{0.3^5}+\frac{200}{0.25^5}+\frac{250}{0.2^5}+\frac{175}{0.15^5}\right)}\right\}^{\frac{1}{5}}$$

D = Diameter of equivalent pipe = 0.189m less than or equal to 19cm.

c) 05

$(p_1 - p_2) = [128\mu qL/\pi D^4]$; $(p_1 - p_2) = \rho g q h_f$

$h_f = (p_1 - p_2)/\rho g = [128\mu qL/\rho g\pi D^4]$

$(\mu/\rho) = \nu = 6$ Stokes $= 6\times10^{-4}$ m^2/s; (Stoke = $1cm^2/sec.$)

Substituting,

$h_f = (128\times6\times10^{-4}\times0.03048\times2000)/(\pi\times9.81\times0.15^4)$

Loss of head (h_f) = 300 m