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SECTION : B

SEMESTE : 6th

SUBJECT : HYDRULLIC Engg

INSTRUCTOR: SIR FAWAD.

# QUESTION - 1

## SOLUTION:-

The pressure drop $\Delta p$ is expected to depend upon the gates opening $h$, the overall depth $d$, the velocity $v$, density $\rho$ and velocity $\mu$

List the relevent variable

$\Delta p, h, d, v, \rho, \mu$

write down dimension

| | |
|---|---|
| $\Delta P$ | $ML^{-1}T^{-2}$ |
| $h$ | $L$ |
| $d$ | $L$ |
| $v$ | $LT^{-1}$ |
| $\rho$ | $ML^{-3}$ |
| $\mu$ | $ML^{-1}T^{1}$ |

No of varibles $n = 6$

No of independent diminsion group $= n-m = 3$

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Choose m(3) Scaling variable

Gemetric (d): Knitic / time - dependent (V):

dynamic / mass - dependent (P)

From dimension groups by non dimensioning the remaining variable : $\Delta P$, h and $\mu$

$$\pi = \Delta P d^a V^b P^c$$

$$M^0 L^0 T^0 = (ML^{-1} T^{-2}) (L)^a (LT^{-1})^b (ML^{-3})^c$$

$$= M^{3+c} L^{-1+a+b-3c} T^{-2-b}$$

M: $0 = 1 + c$ $\quad c = -1$

T: $0 = -2 - b$ $\quad b = -2$

L: $0 = -1 + a + b - 3c$ $\quad a = 1 + 3c - b = 0$

$$\Rightarrow \pi_1 = \Delta P V^2 P^{-1} = \frac{\Delta P}{P V^2}$$

$\pi_2 = \frac{h}{d}$ ( by inspection , since h is a Length )

$\pi_2 = \mu d^a V^b P^c$ ( probably obvious by now but here goes anyway.

$$M^0 L^0 T^0 = (ML^{-1}T^{-1})(L)^a(LT^{-1})^b(ML^{-3})^c$$

$$M^{1+c} L^{-1+a+b-3c} T^{-1-b}$$

$M: \quad 0 = 1 + c \quad \Rightarrow c = -1$

$T: \quad 0 = -1 - b + 0 \quad \Rightarrow b = -1$

$L: \quad 0 = -1 + a + b - 3c \quad \Rightarrow a = 1 + 3c - b = -1.$

$$\pi_3 = \mu d^{-1} v^{-1} \rho^{-1} = \frac{\mu}{\rho v d}$$

Recognition of the Rynold number suggest that we replace $\pi_3$ b

$$\pi_3 = (\pi_3)^{-1} = \frac{\rho v d}{\mu}$$

Hence diminsional analysis yields

$$\pi_1 = f(\pi_2, \pi_3)$$

i.e

$$\frac{\Delta P}{\rho v c} = f\left(\frac{h}{d}, \frac{\rho v d}{\mu}\right)$$

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(4)

a) Dynamic Similarities requires that all non-diminsional group be the same in model and prototype i.e

$$\Pi_1 = \left[\frac{\Delta P}{\rho V^2}\right] = \left[\frac{\Delta P}{\rho V^2}\right]_m$$

$$\Pi_2 = \frac{h}{d} = \left(\frac{h}{d}\right)_m$$

$$\Pi_3 = \left(\frac{\rho V d}{\mu}\right)_p = \left(\frac{\rho V d}{\mu}\right)_m$$

From the last we have velocity ratio

$$\frac{V_P}{V_m} = \frac{(\mu/\rho)_p}{(\mu/\rho)_m} = \frac{d_m}{d_p} = \frac{0.002/800}{1.0 \times 10^{-6}} \times \frac{1}{5}$$

$$= 0.5$$

Hence.

$$V_m = \frac{V_P}{0.5} = \frac{3.0}{0.5} = 6.0 \text{ m/s}.$$

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The ratio of Quantities flow in

$$\frac{Q_p}{Q_m} = \frac{(\text{Velocity} \times \text{area})_p}{(\text{Velocity area})_m} = \frac{V_p}{V_m}\left(\frac{d_p}{d_m}\right)^2$$

$\Rightarrow 0.5 \times 5^2$

$\Rightarrow \boxed{12.5}$

For pressure drop.

$$\pi_1 = \left(\frac{\Delta P}{\rho V^2}\right) = \left(\frac{\Delta P}{\rho V^2}\right) = \frac{(\Delta P)_p}{(\Delta P)_m}$$

$$\Rightarrow \frac{\rho_p}{\rho_m}\left(\frac{V_p}{V_m}\right)^2$$

$$= \frac{800}{1000} \times 0.5^2$$

$\Rightarrow 0.2$

$\Delta P_m = 0.2 \times 60$

$\Rightarrow 120$ KPa.

20 (6)

# QUISTION - 2

## DATA:-

Max length depth = 78m

Specific gravity = 2.4

$f_{av}$ = 788 T/m²

Hight of wave = 1.2m.

## SOLUTION:-

1) $$H - \text{Limiting} = \frac{f_{av}}{\gamma_w (G - \omega + 1)}$$

$$= \frac{788 \times 1000}{1000 (2.4 - 0 + 1)}$$

$$\Rightarrow 231.765$$

2> Top WIDTH: (a)

Free board = 1.5 x wave

= 1.5 x 1.2

= 1.8

Hight of dam = Hw + F.B

= 78 + 1.8

= 79.8

Hight of dam =

a = 14% H.D

= 0.14 x 79.8

= 11.17m

Base widlt

$$b = \frac{H.w}{\sqrt{G}}$$

$$= \frac{78}{0.7 \times 2.4}$$

= 46.42m ≅ 47m

4> For no tension Criteria

$$b' = \frac{H_w}{\sqrt{G}} = \frac{78}{\sqrt{2.4}}$$

$= 50.34$

5> Depth of vertical portion on U/s side

$$h' = 2a\sqrt{G \cdot \omega}$$

$= 2(11.17)\sqrt{2.4 - 0}$

$= 34.60$

$\simeq 35m$

upstream off set

$$\frac{a}{16} = \frac{11.17}{16}$$

$= 0.6$

Depth below the water level to the end of inclined portion u/s = $3.14\, a\sqrt{G}$

$3.14 \times 11.17 \sqrt{2.4}$

$\Rightarrow 54.33$

**Total width of the base of the dam**

$b = b' + \frac{a}{16}$

$\Rightarrow 50.34 + \frac{11.17}{16}$

$\boxed{b = 51.03}$

$\tan\theta = \frac{b'}{h} = \frac{50.34}{78}$

$\tan\theta = 0.64$

$\theta = \tan^{-1}(0.64)$

$\theta = 44.80^\circ$

**Depth of verticle portion on D/s (from WL on U/s side)**

$\tan\theta = \frac{a}{d'} = \frac{11.17}{d'}$

$d = 17.30\,m$

$\therefore \tan\theta \quad \frac{11.17}{d'}$

$\therefore \left(\frac{839}{1300}\right) \times d' = 11.17$

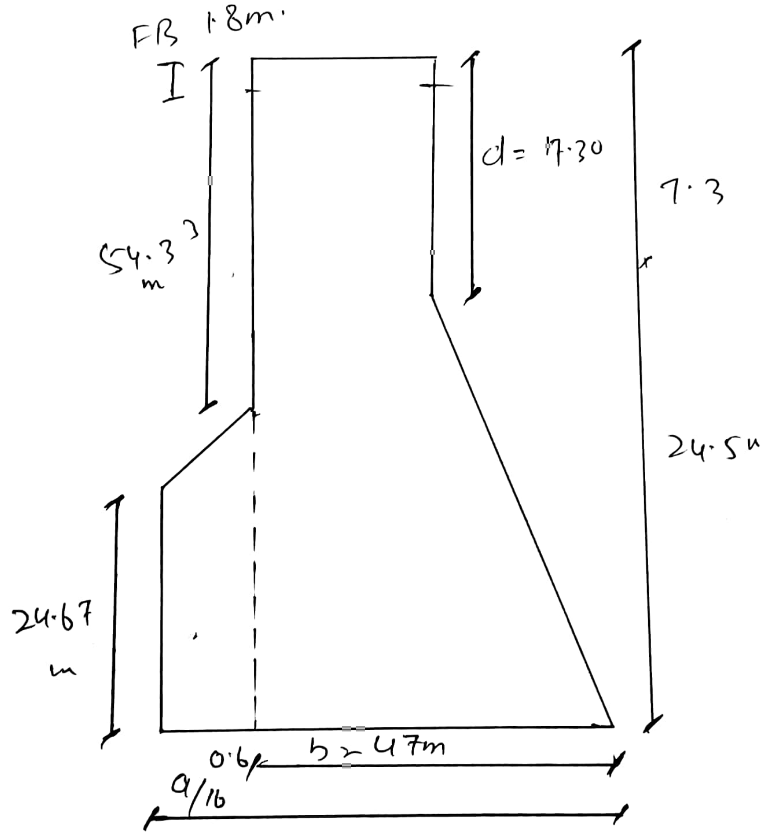
⑩ 2(5)

Depth of vertical portion

$d = d' + f \cdot b$

$= 17 + 30 \cdot 18$

$= 19 \cdot 1$



# QUISTION- 3

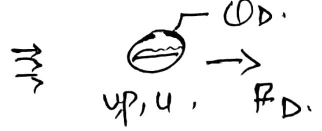
Finding π group for drg on sphare using step by step method.

## STATEMENT:

The drg FD of sphare in a fluid flowing past the sphare is function of the ~~velocity~~ vescocity ω, the mass density ρ, the velocity flow V. and the diameter of sphare. D. use steps to find π group.

## SITUATION:

Drag force (Sphare)




$FD = f(V, \rho, \omega, D)$

GOAL:-

Find π group (steps).

IDEA:-

① Apply π Buckingam theorem
② Follow process

ACTION:-

π - Buking ham.

$\# \pi's = \#VARS - \#\text{primary dimen}$

$= n - m$

$5 - 3 = 2.$

STEP BY STEP TABLE:.

π Buckingham.

$\# \pi's =$

# STEP BY STEP METHOD.

| | | | | | | |
|---|---|---|---|---|---|---|
| FD | $\frac{ML}{T^2}$ | FD/D | $M/T^2$ | $\frac{M}{T^2}$ | $\frac{F}{\rho D^4}$ | $\frac{F}{\rho D^2 V^2}$ |
| V | $\frac{L}{T}$ | $\frac{V}{D}$ | $1/T$ | $\frac{1}{T}$ | $\frac{V}{D}$ | |
| $\rho$ | $\frac{M}{L^3}$ | $\rho D^3$ | $\rho D^3$ | M | — | |
| $\mu$ | $\frac{M}{L \cdot T}$ | $\mu D$ | $\mu D$ | $M/T$ | $\frac{M}{\rho D^2} = \frac{1}{T}$ | $\frac{MD}{\rho D^2 V}$ |
| D | L | — | — | — | | |

$$\frac{F}{(\rho V^2) D^2} = f\left(\frac{\mu}{\rho D V}\right)$$

$$\Downarrow$$

$$C_D = f(R_e)$$

# QUESTION - 4

ANSWER:

## PARTICLE DIAMETER:

The diameter of particle is directly proportional to the fall velocity because greater the size of particle so greater will be moment. Thus There will be more gravitation force on particle of greater size so it will fall quickly due to it's weight.

## PARTICLE DENSITY:

Density of particle is directly proportional to fall velocity since The rate of fall particle with high density tends to settle down early comparing to low density particle.

4(2)

(15)

# PARTICLE CONCENTRATION:-

Concentration of particle size will considerably effect its fall velocity as the section having greater concentration will be settled down at the place. thus causing more fall velocity comparing with section of flow concentration.

# PARTICLE SHAPE:-

Particles having regular shape (having) tends to be affected more than irregular shape since regular shape particle have even surfaces which offer very little or no friction while particle with regular shape offer more friction as the particle with smaller surface area are more likely to be effected due to their less resistance.

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