QNO1:-
Numerical:-
sol:- As

⇒ The pressure drop ΔP is expected to depend upon the gate opening h, the overall depth d, the velocity V, density ρ and viscosity μ.

⇒ The relevant variables is
ΔP, h, d, v, ρ, μ,

The dimension is

ΔP	$ML^{-1}T^{-2}$
h	L
d	L
v	LT^{-1}
ρ	ML^{-3}
μ	$ML^{-1}T^{-1}$

numbers of variables $n = 6$
number of independent dimension:
$m = 3$ (M, L and T)
number of non-dimensional groups: $n - m = 3$
$6 - 3 = 3$

choosen m (=3) scaling variable
geometric (d)
kinematic / time-dependent (v)
dynamic / mass dependent (ρ).

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Form dimensionless groups by non-dimensionalising the remaining variables Δp, h and μ.

$$\pi_1 = \Delta p\, d^a v^b \rho^c$$

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

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

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

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

$$\Rightarrow \pi_1 = \Delta p\, v^{-2}\rho^{-1} = \frac{\Delta p}{\rho v^2}$$

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

$$\pi_3 = \mu d^a v^b \rho^c$$ (probably obvious by now)

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

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

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

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

Recognition of the Reynolds number suggests that we replace π_3 by

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

Hence, dimensional analysis yield

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

i.e $$\frac{\Delta p}{\rho v^2} = f\left(\frac{h}{d}, \frac{\rho v d}{\mu}\right)$$

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A)

⇒ Dynamic similarity requires that all non-dimensional groups be the same in model and prototypes i.e

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

$$\pi_2 = \left(\frac{h}{d}\right)_p = \left(\frac{h}{d}\right)_m$$

∴ If shape is similar i.e geometric similarity.

$$\pi_3' = \left(\frac{\rho v d}{H}\right)_p = \left(\frac{\rho v d}{H}\right)_m$$

From the lasts we have a velocity ratio

$$\frac{v_p}{v_m} = \frac{(H/\rho)_p}{(H/\rho)_m} \frac{d_m}{d_p} = \frac{0.002/800}{1.0\times10^{-6}} \times \frac{1}{5}$$

$$= 0.5$$

Hence $$v_m = \frac{v_p}{0.5} = \frac{3.0}{0.5} = 6.0\,ms^{-1}$$

(B)

⇒ The ratio of the quantities of flow is

$$\frac{Q_p}{Q_m} = \frac{(\text{velocity} \times \text{area})_p}{(\text{velocity} \times \text{area})_m}$$

$$= \frac{v_p}{v_m}\left[\frac{d_p}{d_m}\right]^2 = 0.5 \times 5^2 = 12.5$$

c)

⇒ Finally the pressure drop,

$$\pi_1 = \left(\frac{DP}{\rho v^2}\right)_p = \left(\frac{DP}{\rho v^2}\right)_m$$

$$= \frac{(DP)_p}{(DP)_m} = \frac{\rho_p}{\rho_m}\left[\frac{v_p}{v_m}\right]^2$$

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

$$= 0.2$$

Hence

$$DP_p = 0.2 \times DP_m$$

$$= 0.2 \times 60$$

$$\boxed{= 12.0 \text{ kPa}}.$$

QNO 2:- Numerical

Given:-

⇒ maximum depth of water in the reservoir = H = 77 m.

⇒ specific gravity of Dam material = G = 3

⇒ allowable compressive stress for the dam masonary σ_{all} = 779 T/m².

⇒ Height of wave H_W = 1.5 m

⇒ μ = 0.7

⇒ C4 = 0

Sol:- As

1) $H_{limiting} = \dfrac{\sigma_{all}}{\gamma_w (G-(C4+1))}$

$= \dfrac{779 \times 1000}{1000(3-0+1)}$

$H_{limiting} = 194.75\ m > H_W = 77$

so it is a low gravity dam.

2) Top width 'a'.

Free board = 1.5 h_{wave}

= 1.5 × 1.5

F.B = 2.25 m

Height of Dam =

HD = Hw + F.B

= 77 + 2.25

HD = 79.25 m

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$H = 14\%$ of HD

$H = 0.14 \times 79.25$

$H = 11.095\ m$

3) Base width 'b' without offset

i) For no sliding criteria

$$b' = \frac{HW}{\mu G} = \frac{77}{0.7 \times 3}$$

$b' = 36.67\ m$

ii) - For no tension criteria

$$b' = \frac{HW}{\sqrt{G}} = \frac{77}{\sqrt{3}}$$

$b' = 44.45\ m$

$b' = 44.45\ m$

4) Depth of vertical portion on u/s side

$h' = 2a\sqrt{G - C}$

$h' = 2 / 11.095 \sqrt{3 - 0}$

$h' = 32.49\ m$

5) upstream offset $= \frac{a}{16}$

$= \frac{11.09}{16} = 0.69 m$

6) Depth below the water level to the end of inclined portion in U/S =

$3.14\, a \sqrt{G}$

$= 3.14 \times 11.09 \times \sqrt{3}$

$= 60.31$ m.

7) Total width of the base of the dam

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

$= 44.45 + 0.69$

$\boxed{b = 45.14 \text{ m}}$

8) $\tan\varphi = \frac{b'}{H} = \frac{44.45}{77}$

$\tan\varphi = \frac{44.45}{77}$

$\varphi = \tan^{-1}(0.577)$

$\boxed{\varphi = 29.98^\circ}$

9) Depth of vertical portion on D/S (from WL on U/S side)

$\tan\varphi = \frac{a}{d'} = \frac{11.09}{d'} = \tan\varphi = \frac{11.09}{d'}$

$\frac{44.45}{77} d' = 11.09$

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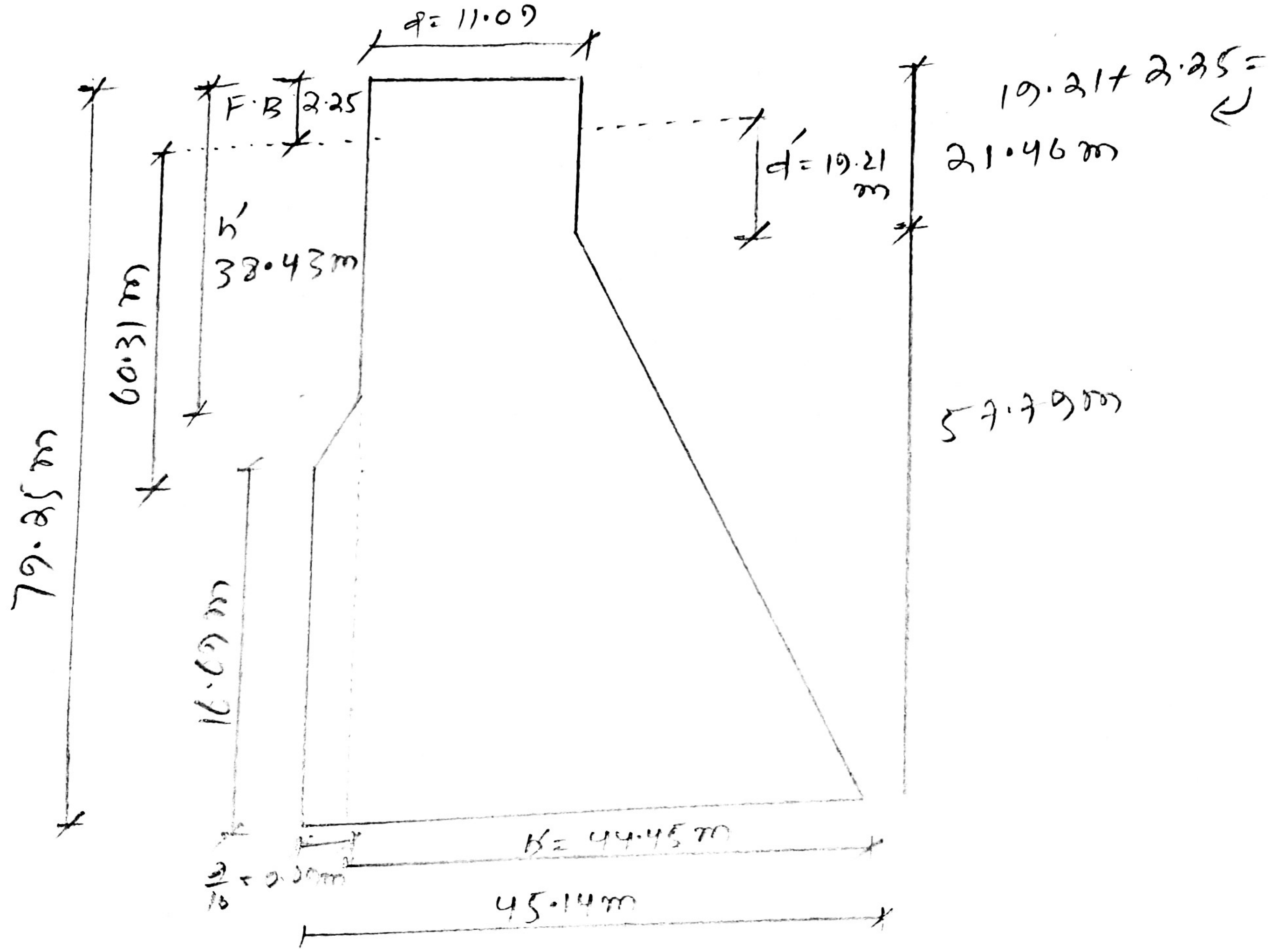
$d' = \frac{11.09 \times 77}{44.45}$ = $d' = 19.21$ m

depth of vertical portion

$d = d' + FB$

$= 19.21 + 2.25$

$d = 21.46$ m



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QNO 3:-
ANS #3:-

Dimensional analysis and similitude:-

=> **Dimensional analysis:-**

=> Dimensional analysis means that the dimensions of each term in an equation on both sides are equal.

=> Such equations are independent of system of units.

Similitude:-

=> The concept of similitude is often used so that measurement made on one system (laboratory) can be used to describe the behavior of other system (out side of laboratory).

=> Many practicles engineering problem can be solved by equation. only few problem can be solve by analytical produre.

Example:-

If we construct a huge project like dam first we made a model. And from this we studies emperical formulations. and apply all forces which act as a dam. and then develope a relationship btw. the laboratory model and the out side system or other system.

QNo 4:-

ANS:-

Fall velocity:-

When a grain falls down in still water it obtain a constant velocity when the upward fluid drag force on the grain is equal to the downward submerged weight of the grain, This constant velocity is defined as the fall velocity of the grain.
This is also known as setting velocity.

Factors depends:-

1) particles diameter:-

As fall velocity of sediment is given by

$$W_s = \sqrt{\frac{4gd}{3C_D}\left(\frac{\rho_s - \rho}{\rho}\right)} \rightarrow *$$

As $W_s \propto d$

From the above equation Fall velocity of the sediment is directly proportion to the diameter of the particles.

2) particles density:-

From equation *

$W_s \propto \rho_s$

P.T.O

where W_s = fall velocity
and ρ_s = Density of sediment.

so fall velocity of the sediment is directly proportional to density of sediment.

III particles shape:-

smooth particles will sit quickly, so the fall velocity for such particles will be more. And for angular shape particles the fall velocity will be less because such particles will sit slowly.

IV particles concentration:-

velocity of fall is directly proportional to particles concentration so by increasing the concentration of particles the fall velocity also increases.

V) Temperature:-

lower temperatures will increase viscosity decreasing the fall velocity.

VI) Turbulence:-

Because of turbulence, coarser particles fall more slowly than predicted.