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Q:No:01

Sol: The pressure drop ΔP is expected to depend upon the gate opening h, the overall depth d, the velocity v, density & viscosity μ

-> List the relevant variable.

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

Dimension

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

Number of variable $= n = 6$

Number of Independent dimension $m = 3$ (M, L & T)

Number of non-dimensional group $n - m = 3$

-> Choose $m = 3$ scaling variable; geometric (d); kinematic / time-dependent (v), dynamic/mass dependent (ρ).

Form dimension less group by non-dimensionalising the remaining variable : ΔP, h & μ

$\pi_1 = \Delta P \, d^a V^b \rho^c$

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

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

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

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

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

$\rightarrow \pi = \Delta P V^{-2} \rho^{-1} = \dfrac{VP}{\rho V^2}$

Now $\pi_2 = \dfrac{h}{d}$ (by inspection, since h is the length

$\pi_3 = \mu d^a V^b \rho^c$

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

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

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

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

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

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

Recognition of the Reynold number suggest that we replace π^3 by $\pi_3' = (\pi_3)^{-1} = \frac{\rho V d}{\mu}$

Hense dimensional Analysis yield

i.e $\pi_1 = f(\pi_2, \pi_3')$

$$\frac{DP}{\rho V^2} = f\left(\frac{h}{d}, \frac{\rho V d}{\mu}\right)$$

d) Dynamic similarity reauires that all non-dimensional group to be the same in model and prototype.

i.e $\pi_1 = \left(\frac{\Delta P}{\rho V^2}\right)_P = \left(\frac{\Delta P}{\rho V^2}\right)_M$

$\pi_2 \quad \left(\frac{h}{d}\right)_P = \left(\frac{h}{d}\right)_M$ (similar shape i-e geometric similarity)

~~$\pi_3 = \rho$~~

$\pi_3' \quad \left(\frac{\rho V d}{\mu}\right)_P = \left(\frac{\rho V d}{\mu}\right)_M$

From the last, we have a velocity ratio.

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$$\frac{V_P}{V_m} = \frac{(\mu/\rho)_P}{(\mu/\rho)_m} \frac{d_m}{d_P} = \frac{0.002/800}{1.0\times10^{-6}} \times \frac{1}{5} = 0.5$$

Thus; $V_m = \frac{V_P}{0.5} = \frac{3.0}{0.5} = 6\ m/s$

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 for the pressure drop

$$\pi_1 = \left[\frac{\Delta P}{\rho V^2}\right]_P = \left[\frac{\Delta P}{\rho V^2}\right]_m \Rightarrow \frac{(\Delta P)_P}{(\Delta P)_m} = \frac{\rho_P}{\rho_m}\left[\frac{V_P}{V_m}\right]^2$$

$$= \frac{800}{1000} \times 0.5^2 = 0.2$$

Hense $\nabla P_P = 0.2 \times \Delta P_m = 0.2 \times 60 = 12.0\ kPa.$

Q:No::02

Sol:: $T = 788$;: $G = 2.4$, $Cu = 0$

1) $H_{umiting} = \frac{C_0 a U}{\delta w(G - Cu + 1)} = \frac{120 \times 788 \times 1000}{1000(2.4 - 0 + 1)}$ =

27811.76M

let Hw 27000

Thus 27811.76 > HW 27000

soities low gravity

2) TOP width "0"

Free board = 1.5 hwave = 1.5 × 27000

F.B = 40500

Height of Dam = $H_D = Hw + F.B$

= H_D = 27000 + 40500

HD = 67500

a = 14% of HD

= 0.14 × 67500

a = 9450

3) Base width; "b" (without offset)

i) For no sliding criteria

$$b' = \frac{Hw}{\mu G} = \frac{27000}{0.7 \times 2.4} = 16071.42$$

$$\boxed{b' \approx 16071\ m}$$

ii) For non tension criteria

$$b' = \frac{Hw}{\sqrt{G}} = \frac{27000}{\sqrt{2.4}} = 17428.42$$

$$\boxed{b' \approx 17428\ m}$$

4) Depth of vertical portion on U/S side

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

$$h' = 2 \times 9450\sqrt{2.4 - 0}$$

$$h' = 29279.75$$

$$\boxed{h' \approx 29279\ m}$$

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5) UP stream off set:

$$\frac{a}{16} = \frac{9450}{16} = \boxed{590.62\,m}$$

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

$$= 3.14(9450)\sqrt{2.4}$$

$$\boxed{= 45969.21\,m}$$

7) Total width of the base of the dam

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

$$= 17428 + \frac{9450}{16}$$

$$\boxed{b = 18018.62}$$

8) $\tan\phi = \frac{b'}{H} = \frac{17428}{27000}$

$$\phi = \tan^{-1}\left(\frac{17428}{27000}\right)$$

$$\boxed{\phi = 32.84^{\circ}}$$

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9 Depth of vertical portion on D/S

$$\tan\theta = \frac{a}{d'} = \frac{9450}{d'}$$

$$\left(\frac{17428}{27000}\right) d' = 9450$$

$$d' = \frac{9450 \times 27000}{17428} = 14640.23\,m$$

$$\boxed{d' = 14640.23\,m}$$

depth of vertical portion

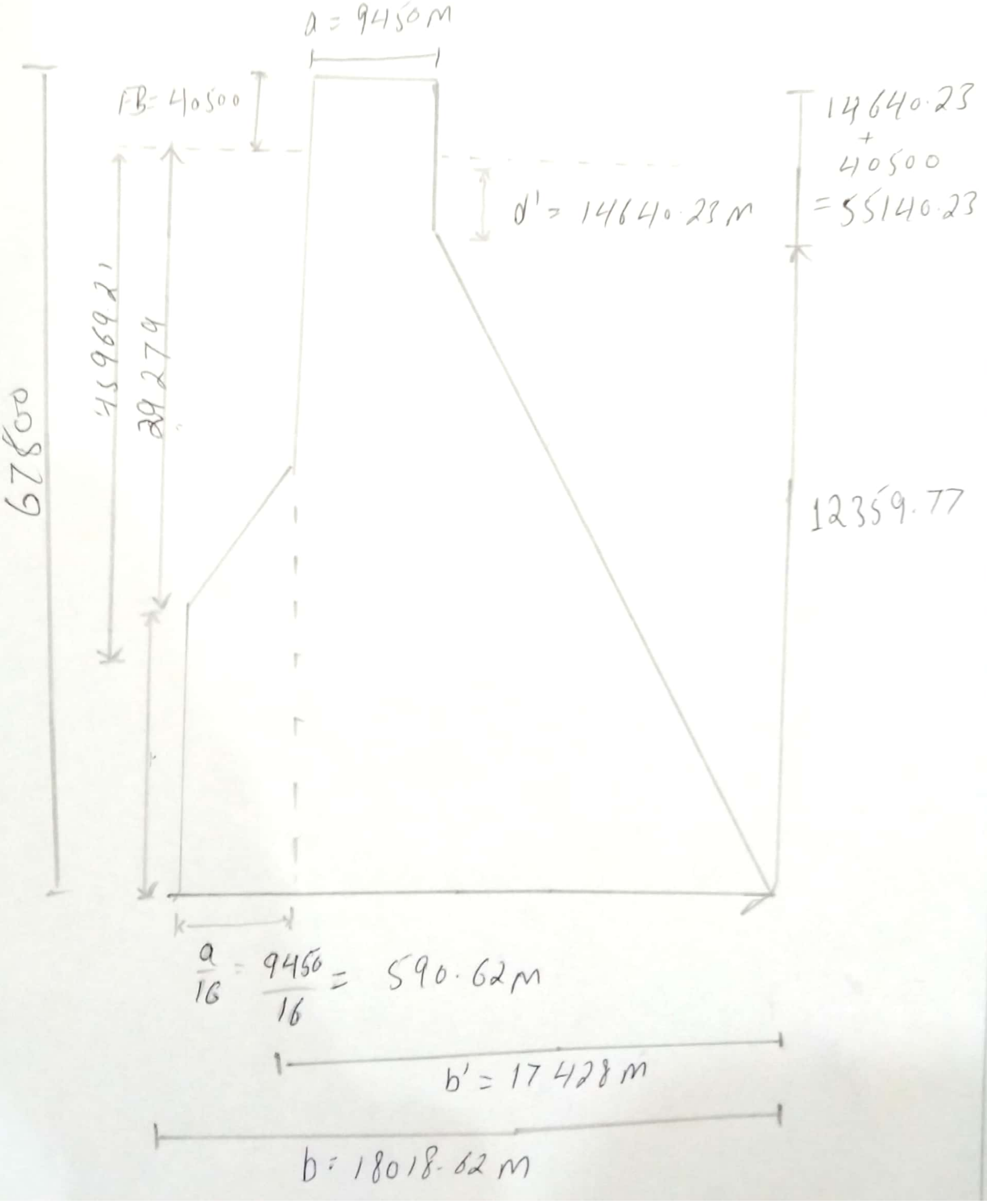
$$d = d' + F.B$$

$$= 14640.23 + 40500$$

~~[illegible]~~

$$\boxed{d = 55140.23}$$

Diagram:


a = 9450 m
FB = 40500
d' = 14640.23 m
14640.23
+
40500
= 55140.23
45969.21
29279
67800
12359.77
a/16 = 9450/16 = 590.62 m
b' = 17428 m
b = 18018.62 m

Q:: NO::03

Ans: Dimension analysis is a mathematical the technique making use of study of dimension.

→ **Purpose of dimension analysis:**

- To obtain scaling laws so that Prototype Reinforcement can be Predicted from model Performance.
- To Predict in the relationship between Parameter.
- To generate non dimensional Parameter that help in the design of experiment and in reporting of results.

→ **Fundamental dimension::**

These are the basic quantities.

For Example

Time, T, Distance, L, Mass, M.

→ **Secondary Dimension:**

Those quantity which posses more then one fundemental dimension

velocity, L/T Acceleration, L/T, Density, M/L^3

- **Similitude:**

It is defined as similarity b/w the model and Prototype in every respect which mean model and Prototype have similar Properties or model and Prototype are completely similar.

- It is used in testing engineering model.

Example:

Consider a submarine modeled at $1/40^{th}$ scale. The application operate in sea water at 0.5°C moving at 5m/s. The model will be tested in fresh water at 20°C

Q:- No:- 04

Ans: 1" Particle diameter":

The diameter of the Particles is directly Proportional to the fall velocity because greater the size of Particles So it will tends to move faster as compared to the Particles of small size thus there will be more gravitational force on Particles of greater size so it will fall quickly due to its weight

2) " Particle density:

Density of the Particles is directly Proportional to the rate of fall velocity since particle with high density tends to settle down early compared with Particle of low density.

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3) "Particle concentration:-

Consentration 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 low concentration.

4) Particle shape:-

Particles having regular shapes tends to be effected more than irregular shapes since regular shapes particles have oven surfaces which offers very little or no friction while particles with irregular shape offers more friction, as the particle with smaller surface area are more likely to be effected due to their less resistance.

5) "Viscosity of water:

From the experimental study we can be see that parameter such as temperature and pressure changes the magnitude of viscosity so the section of water having more temperature and Pressure will fall Objectively more due to increase in the kinetic energy So fall velocity will be more.

6) Turbulence of water:

Turbulence of water depends upon the different factor such as velocity It will effect the fall velocity because of it's zigzag motion thus the velocity varies at every Point which is why it effects the fall velocity, moreover increase in the kinetic energy tends to effect the fall velocity compared with steady fluid.