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Paper : Hydrolics Engineering.

Ans: 1: A prototype ....
.... viscosity μ.

Sol.

The pressure drop ΔP is expected to depend upon the gate opening h. The overall depth d. the velocity V. dencity & viscosity μ.

The relevent variable.

$\Delta P, h, d, V, \rho, \mu$.

Dimension.

$\Delta P \quad ML^{-1}T^{-2}$

$h = L$

$d = L$

$V = LT^{-1}$

$\rho = ML^{-3}$

$\mu = ML^{-1}T^{-1}$

Number of variable $= n = 6$.

Number of independent diamension $M = 3$ (M, L & T).

Number of non-dimensional group $n - M = 3$.

Chose $M = 3$ scaling variable; geomatric (d): kinematic / time - dependent (V), dynamic / mass dependent (ρ).

From dimension less groul by non-dimenssionaling the remaing variable = ΔP = h & μ

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

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

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

$M = 0 = 1+c \Rightarrow c = -1$
$T = 0 = -2-b \Rightarrow b = -2$
$L = 0 = -1+a+b-3c \Rightarrow a = 1+3c-b = 0$.

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

Now $\pi_2 = \dfrac{l}{d}$ (by inspection, Since ~~\~~ the length.

$\pi_3 = \mu d^a v^b \rho^c$.

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

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

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

$\Rightarrow \pi_3 = \mu d^{-1} V^{-1} \rho^{-1} = \dfrac{\mu}{\rho V d}$.

Recognition of the Reyonrd number suggest that we replace π_3 by π_3^{-1} =

$$[\pi_3]^{-1} = \frac{\rho V d}{\mu}.$$

Hence dimensional Analysis yeild.

i-e $\Pi_1 = f(\Pi_2, \Pi_3)$.

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

Part a:

Dynamic similarity requires that all non-dimensional groups to be the same in model and prototype.

i-e

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

$$\Pi_2 \quad \left[\frac{h}{d}\right]_n = \left[\frac{h}{d}\right]_m$$ Similar shape i-e geometric similarity.

$$\Pi_3^{-1} \left[\frac{\rho V d}{\mu}\right]_P = \left[\frac{\rho V d}{\mu}\right]_m$$

from the last, we have a velocity ratio

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

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

Part : b:-

The ratio of the quantities of flow is:

$$\frac{Q_P}{Q_m} = \frac{(\text{Velocity} \times \text{area})_P}{(\text{Velocity} \times \text{area})_m} = \frac{V_P}{V_m}\left[\frac{d_P}{d_m}\right]^2 = 0.5 \times 5^{-2}$$
$$= 12.5.$$

Part : C:-

finaly for the Pressure drop.

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

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

Hence $V_{PP} = 0.2 \times \Delta P_m = 0.2 \times 60 = 12.0$ kpa.

Q.No: 2 : Design a Practical ....
.... one another.

Soln.-

T = 731 , G = 2.4 , Cu = 0.

1: Hominity = $\frac{6all}{\gamma w(G - Cu + 1)}$ = $\frac{120 \times 731 \times 1000}{1000(2.4 - 0 + 1)}$

25800 m.

Let Hw = 25000.
Thus 25800 > Hw 27000.

So it is low gravity.

2: Top width "a"
free board = 1.5 hwore = 1.5 × 25000

F.B = 37500.

Hight of Dam = H_D = Hw + F.B.

HD = 25000 + 37500

HD = 62500.

a = 14% of HD.

= 0.14 × 62500

a = 8750.

3: Base width "b" (with out off set).

i) for no sliding criteria.

$$b' = \frac{Hw}{\mu G} = \frac{25000}{0.7 \times 2.4} = 14880.95.$$

$$b' \approx 14880\ m.$$

ii) for non tension criteria

$$b' = \frac{Hw}{\sqrt{G}} = \frac{25000}{\sqrt{2.4}} = 16137.43$$

$$b' \approx 16137\ m.$$

4:- Depth of vertical Portion on U/s side.

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

$$h' = 2 \times 8750\sqrt{2.4 + 0}$$

$$h' = 27110.88$$

$$h' \approx 27110\ m.$$

5:- Up stream off set :-

$$\frac{a}{16} = \frac{8750}{16} = 546.87m$$

6:- Depth below the water level to the end of inclined portion in U/s : $3.14\, a \sqrt{G}$

$= 3.14\,(8750)\sqrt{2.4}$.

$= 42564.08\,m$.

7:- Total width of the base of the dam

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

$b = 16137 + \frac{8750}{16}$

$b = 16683.87$

8:- $\tan\theta = \frac{b'}{H} =$ [redacted] $\frac{16137}{25000}$

$\theta = \tan^{-1}\left(\frac{16137}{25000}\right)$

$\theta = 32.84°$.

9:- Depth of vertical Portion on D/s.

$\tan\theta = \frac{a}{d'} \quad \frac{8750}{d'}$

$\left(\frac{16137}{25000}\right) d' = 8750$.

$d' = \frac{8750 \times 25000}{16137} = 13555.80 m.$

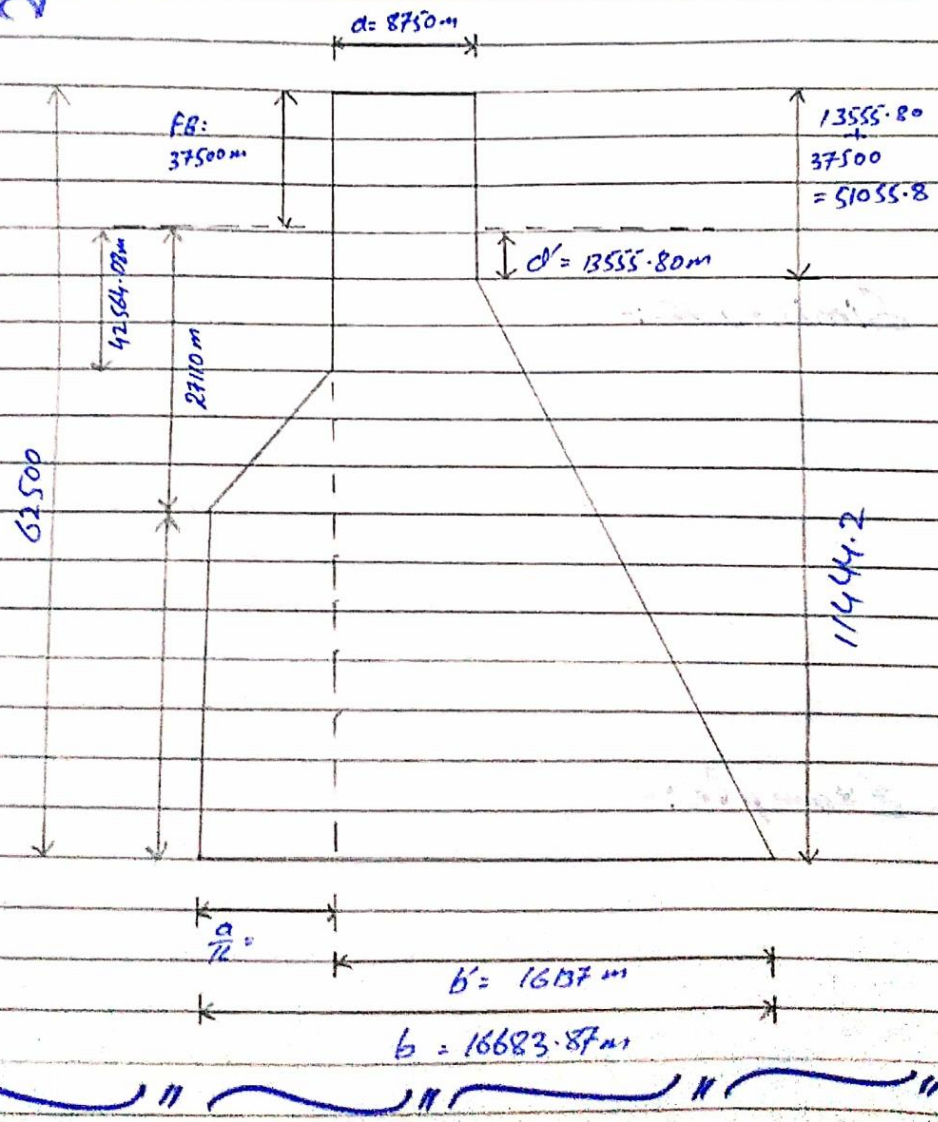
$d = 13555.80 m.$

depth of vertical portion.

$d = d' + FB$

$13555.80 + 37500 = 51055.8 m.$

Diagram:-



Q3:- Using any model . . . .
. . . . analysis.

Dimensional Analysis:-

In engineering and science dimensional analysis of the relationship between different physical quantities by identifying their base quantities. such as length mass, time and electric charge. and units.

The dimentional analysis or more specialy the factorlabel method also known as the unit factor method.

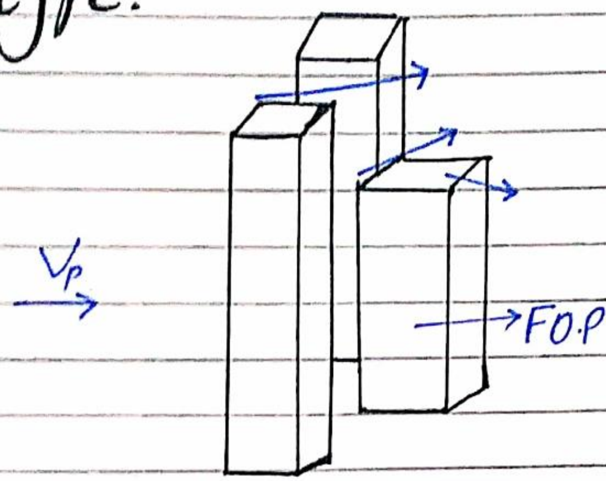
Similitude:-

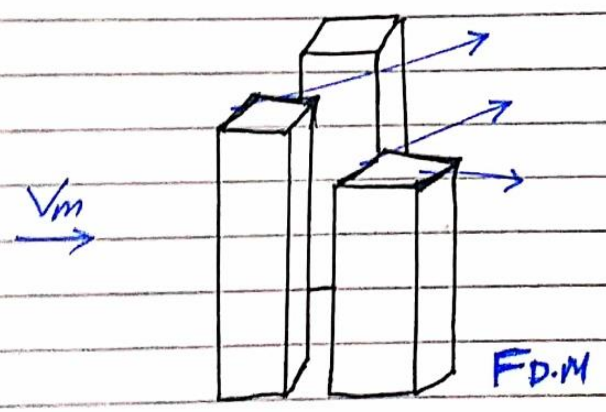
Similitude is a concept applicable to the testing of engineering modles. A modle is said to have similitude with the real application if the two sheare geomatric similarity, kinematic similarity and dynamic similarity. Similarity and similitude are interchangeable in this context.

Example:-

The velocity at any point in the model flow must be proportional (by a constant scale factor) to the velocity at the corresponding point in the prototype flow.
Similarly of motion.

Prototype:





Q4:- What will be the .... in detail.

Ans:- Particle diameter:-

The diameter of the particle is directly proportional to the fall velocity because grater the size of particle so it will tends to move faster as compared to the particle of small size thus there will be more gravitational force on practicle of grater size so it will fall quickly due to its weight.

Particle Density:-

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

Particle concenteration:-

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

Particle shape:-

Particle having regular shaps tends to be effected more then irregular shaps since regular shaps particles have even surfaces which offers very little or no ~~offers~~ 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.

Velocity of water:-

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

Turbulence of water:-

Turblance of water depends upon the different factor such as velocity. It will effect the velocity because of its zigzag motion thus the velocity varies at every point which is usly it effect the fall velocity moreover increase the kinetic energy tends to effect the fall velocity compared with steady flued.