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Q#01:

A prototype gate . . . .
. . . . . . 1.0×10⁻⁶ m²/s"

The pressure drop . . . . . velocity v
density ρ and viscosity μ.

Solution:

- Pressure drop, ΔP is expected to depend upon the gate opening h, the average depth d, the velocity v, density ρ and viscosity μ.

Dimension:

Pressure drop, $\Delta P = ML^{-1}T^{-2}$
Gate opening, $h = L$
depth, $d = L$
velocity, $V = LT^{-1}$
Density, $\rho = ML^{-3}$
Viscosity, $\mu = ML^{-1}T^{-1}$

→ Total number of varibles, $n = 6$
→ Number of independent dimension, $m = 3 (M, L, T)$
→ Number of Non-dimensional group, $n - m = 3$

→ Choose m (=3) Scaling variables:

- Geometric (d)
- Kinematic / Time-dependent (V)
- dynamic / mass dependent (ρ)

↳ From dimensionless Group by non-dimensionalising variables: Δp, h and μ

* $\Pi_1 = \Delta p d^a V^b \rho^c$

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

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

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

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

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

$\Pi = \Delta p V^{-2} \rho^{-1} = \Delta P / \rho V^2$

$\Pi_2 = h/d$

By inspection, since "h" is a length

$\Pi_3 = \mu d^a V^b \rho^c$ (probably obvious by now, but here goes anyway..)

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

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

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

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

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

$$\Rightarrow \Pi_3 = \mu d^{-1}v^{-1}\rho^{-1} = \mu/\rho v d$$

Recognition of the Reynolds Number suggests what that we Replace Π_3 by.

$$\Pi' = (\Pi_3)^{-1} = \frac{\rho v d}{\mu}$$

Dimensional Analysis yields.

$$\Pi_1 = f(\Pi_2, \Pi_3')$$

i-e

$$\Delta P/\rho v^2 = f\left(h/d, \frac{\rho v d}{\mu}\right)$$

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(a) Dynamic Similarity Requires that all non-dimensional Groups be same in model & prototype: i.e.

$$\Pi_1 = \left(\Delta p/\rho v^2\right) = \left(\Delta p/\rho v^2\right)$$

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

(automatic of Similar Shape i.e geometric Similarity)

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

From the last, we have a velocity Ratio

$$V_p/V_m = \frac{(\mu/\rho)_p \, d_m}{(\mu/\rho)_m \, d_p} = \frac{0.002/800}{1.0\times10^{-6}} \times 1/5$$

$$= 0.5$$

Hence,

$$V_m = V_p/_{0.5} = 3.0/_{0.5} = 6.0 m/s.$$

b) The Ratio of the quantities of flow is

$$Q_p/_{Q_m} = \frac{(\text{velocity} \times \text{Area})_p}{(\text{velocity} \times \text{Area})_m}$$

$$= \frac{V_p}{V_m}\left(\frac{d_p}{d_m}\right)^2 = 0.5 \times 5^2 = 12.5$$

c) finally, for the pressure drop.

$$\Pi_3 = \left(\Delta P/_{\rho V^2}\right)_p = \left(\frac{\Delta P}{\rho V^2}\right)_m$$

$$\Rightarrow \frac{(\Delta P)_p}{(\Delta P)_m} = \frac{\rho_p}{\rho_m}\left(\frac{V_p}{V_m}\right)^2$$

Hence

$$\Delta P_p = 0.2 \times \Delta P_m = 0.2 \times 60 = 12 kPa$$

Q#02

Design Practical . . . .

. . . . . . another

Given data:

Maximum depth of water in Reservoir, H = 78

Specific Gravity of Dam Material = G = 1.9

Allowable Compressive Strength for the dam masonry. σ_{all} = 780 T/m²

Height of wave (hw) = 1.5

$\mu = 0.7$

$C_u = 0$

Solution:

①

$$H_{limit} = \frac{\sigma_{all}}{\gamma_w(G - C_u + 1)} = \frac{780 \times 1000}{1000(1.9 - 0 + 1)}$$

$$H_{limit} = 268.96 > H_w$$

So it is low Gravity dam

(2)

* Top width "a"

free board = $1.5 \times h_w$

$= 1.5 \times 1.5 = 2.25$

Height of dam = $H_D = H_w + f.B$

$= 78 + 2.25 = 80.25m$

let $a = 14\%$ of H_D

$\Rightarrow a = 0.14 \times 80.25 = 11.23m$

(3) * Base width "b"

→ for sliding Criteria.

$b' = H_w / \mu G = \frac{78}{0.7 \times 1.9} = 58.64m$

$\Rightarrow b' \simeq 59m$

→ for Tension Criteria.

$b' = H/\sqrt{G} = \frac{78}{\sqrt{1.9}} = 56.58$ or $\simeq 57m$

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(4) * depth of vertical portion on u/s side.

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

$\Rightarrow h' = 2(11.23)\sqrt{1.9 - 0} = 30.95$ or $31m$

(5) * upstream of set $= a/16$

$= \frac{11.23}{16} = 0.70m$

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

$= 3.14 \times (11.23)\sqrt{1.9}$

$= 48.60m$

(7) Total width of base of the dam

$b = b' + a/16 = 59 + \frac{11.23}{16}$

$= 59.70m$

(8) $\tan\theta = b'/H = 59/78$

$\theta = \tan^{-1}(59/78) = 37.10°$

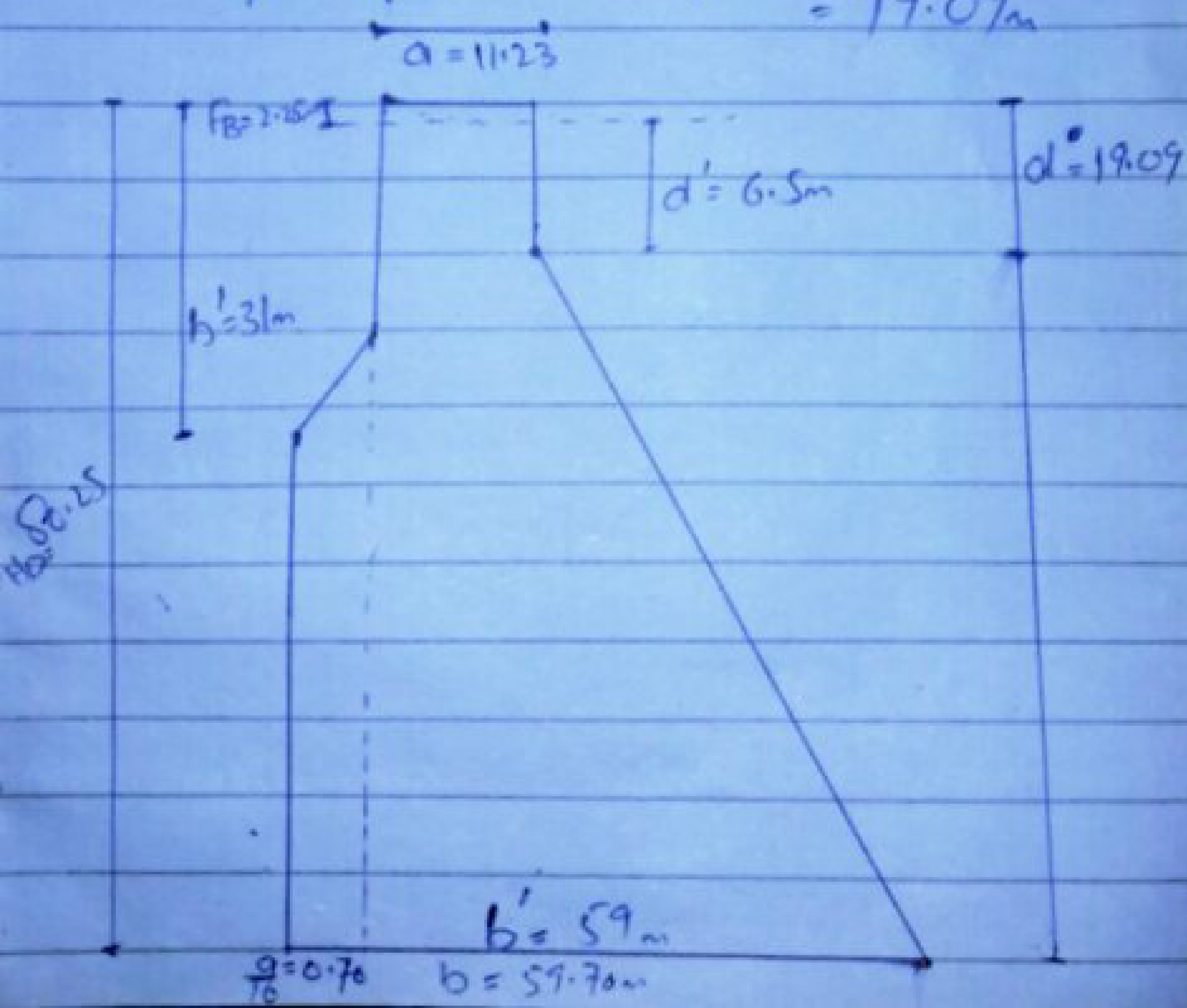
(9) depth vertical portion on D/S

$$\tan\theta = \frac{a}{d'} = \frac{11.23}{d'}$$

$\Rightarrow \frac{2}{3}d' = 11.23$

$$\Rightarrow d' = \frac{11.23 \times 3}{2} = 16.84\,m$$

depth of vertical depth = 16.84 + 2.25
= 19.09 m



Q#03:
Using any hydraulic . . .
. . . . . . Analysis?

Ans:-
→ Dimensional Analysis:

In dimensional Analysis, one first predicts the physical parameters that will influence the flow and then by grouping these parameters in dimensionless combinations a better understanding of the flow phenomenon is made possible.

→ Objective:

→ To obtain scaling laws so that prototype performance can be predicted from model performance

→ To predict in the Relationship between parameter.

→ To generate nondimensional parameter that help in the design of experiment and reporting of Results.

→ **fundamental dimension:**
There are the basic quantities. for example
Time, T, distance, L & Mass, m

→ **Secondary dimension:**
These quantity which posses more then one fundamental dimension velocity, L/T, Acceleration L/T and Density, m/L^3

→ **Similitude:**
It is defined as similarity b/w the model and prototype is every respect which mean model and prototype have similar properties or model

and prototype are completely similar. It is used in testing engineering models.

Example:

Consider a submarine model at 1/40th scale. The application operate in sea water at 0.5°C moving at 5m/s. The model will be tested in fresh water at 25°C

Q#04:
what will be . . . .
. . . . . detail.

Solution: Effect of Sediment
→ particle diameter.
→ particle density
→ particle concentration
→ particle shape.
→ Viscosity of water
→ Turbulence.

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

2- Particle density:

* Particle density is also directly proportional to the rate of fall velocity since particle with high density tends to settle down early compared with particle of low density
→ Particle density is directly effected to the fall velocity

3. Particle Concentration:

Particle Concentration 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 concentration.

→ **Particle Shape:**

Particle Shape effect The sediment but there is no direct quantitative way to measure shape and its effects.. Mc Nown (1951) suggested the factor of Shape = $c/\sqrt{ab}$

→ **Viscosity:**

The effect of the viscosity of the sediment of fluid dry coefficient. enters Through the Reynolds number. However, when dealing with suspension it may be necessary to consider the effective viscosity of suspension rather then that of the fluid.

→ A decrease the viscosity therefore increase the velocity of a compared Through porous media.

Turbulance of water:

Turbulance of water effect the fall velocity of water in reservior because the non-linearity and zig zag path effect the flow of water and cause the variation in the flow