NAME :- QAISER SIDDIQUE

ID :- 7863

SECTION :- "B"

SUBJECT :- Hydraulic Engg.

SEMESTER :- 6th

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SUBMITTED TO :- "ENGR. FAWAD Ahmed"

Q No. I :-

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

⇒ List the relevent 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	$ML^{-1}T^{-1}$

→ No of variable = $n = 6$

→ No of independent dimension $m = 3$

→ No of non-dimension group $n - m = 3$

⇒ Chose $m = 3$ scaling variable : geometric (d); kinametic/Time - dependant v; dynmci/mass → dependent (ρ)

Form dimension less groups by non-dimen-sionaling the remaining variables : ΔP, h and μ

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

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

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

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

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

$$\pi_1 = \Delta p V^{-2} \rho^{-1} = \frac{\Delta p}{\rho V^2}$$

Now; $\pi_2 = h/d$ (By inspection, since h is the length)

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

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

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

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

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

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

$\Rightarrow$ Regnation of the Reynold number suggest that we replace π_3 by $\pi_3' = (\pi_3)^{-} = \frac{\rho V d}{\mu}$

$\Rightarrow$ Hence dimensional Analysis Yields.

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

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

(A) Dynamic similarity requires that all non-dimensional groups be the same in model and prototype i.e

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

$$\pi_2 = (h/d)_p = (h/d)_m$$ (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 ration

$$\frac{v_p}{v_m} = \frac{(\mu/\rho)_p}{(\mu/\rho)_m} \frac{d_m}{d_p} = \frac{0.002/800}{1.0 \times 10^{-6}} \times 1/5 = 0.5$$

Thus;

$$v_m = v_p/0.5 = 6 \text{ m/s}$$

(B) The ratio of the quantaties of flow is;

$$Q_p/Q_m = \frac{(\text{Velocity} \times \text{Area})_p}{(\text{Velocity} \times \text{Area})_m} = v_p/v_m \left(\frac{d_p}{d_m}\right) = 0.5 \times 5^2$$

$$= 12.5.$$

(C) Finally for the pressure drop is

$$\pi_1 = \left(\frac{\Delta p}{\rho v^2}\right)_p = \left(\frac{\Delta p}{\rho v^2}\right)_m \Rightarrow \frac{(\Delta p)_p}{(\Delta p)_m} = \frac{\rho_p}{\rho_m}\left(\frac{v_p}{v_m}\right)^2$$

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

Thus

$$\Delta p_p = 0.2 \times \Delta p_m = 0.2 \times 60$$

$$\Delta p_m = 12.0 \text{ kPa}.$$

Q No. 2

Solution:-

T = 786

G = 2.4

C4 = 0

1 ⇒) $H_{limiting} = \frac{6\ all}{\gamma w(G-\omega+1)} = \frac{120 \times 786 \times 1000}{1000(2.4-0+1)} = 27741.1764$

let

$H_w = 26500$ m

Thus 27741.17647 > H_w = 26500

So it is low gravity dam

2 ⇒) Top width "a"

Free board = 1.5 hwave = 1.5 × 26500

F.B = 39750

Hight of Da = HD = HW + F.B = 26500 + 39750

= 66250

a = 14% of HD ⇒ 0.14 × 66250

⇒ a = 9275

3 ⇒) Based width "b" (without offset)

(i) For no sliding criteria :-

$b' = \frac{HW}{\mu G} = \frac{26500}{0.7 \times 2.4} \times 15773.80$

$b' \approx 15773.80$

(ii) For no. tension criteria:-

$b' = \frac{HW}{\sqrt{G}} = \frac{26500}{\sqrt{2.4}}$

$b' \approx 17105.67$

4 ⇒ Depth of vertical portion on u/s side

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

$h' = 2 \times 9275\sqrt{24 - 0}$

$h' = 28737.53$

$h' = 28737\,m.$

5 ⇒ Upstream of set $= a/16 = \frac{9275}{16} = 579.687$

6 ⇒ Depth below the water level to the end of inclined portion in u/s $= 3.14\,a\sqrt{q} = 95117.93\,m.$

7 ⇒ Total width of the Base of the dam.

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

$= 17105 + \frac{9275}{16}$

$b = 17684.68$

8 ⇒ $\tan\theta = \frac{b'}{H} = \frac{17105}{26500}$

$\theta = \tan^{-1}\left(\frac{17105}{26500}\right)$

$\theta = 32.84$

9 ⇒ Depth of vertical portion on D/s

$\tan\theta = \frac{a}{d'} = \frac{9275}{d'}$

$\left(\frac{17105}{26500}\right) d' = 9275$

$$d' = \frac{9275 \times 26500}{17905}$$

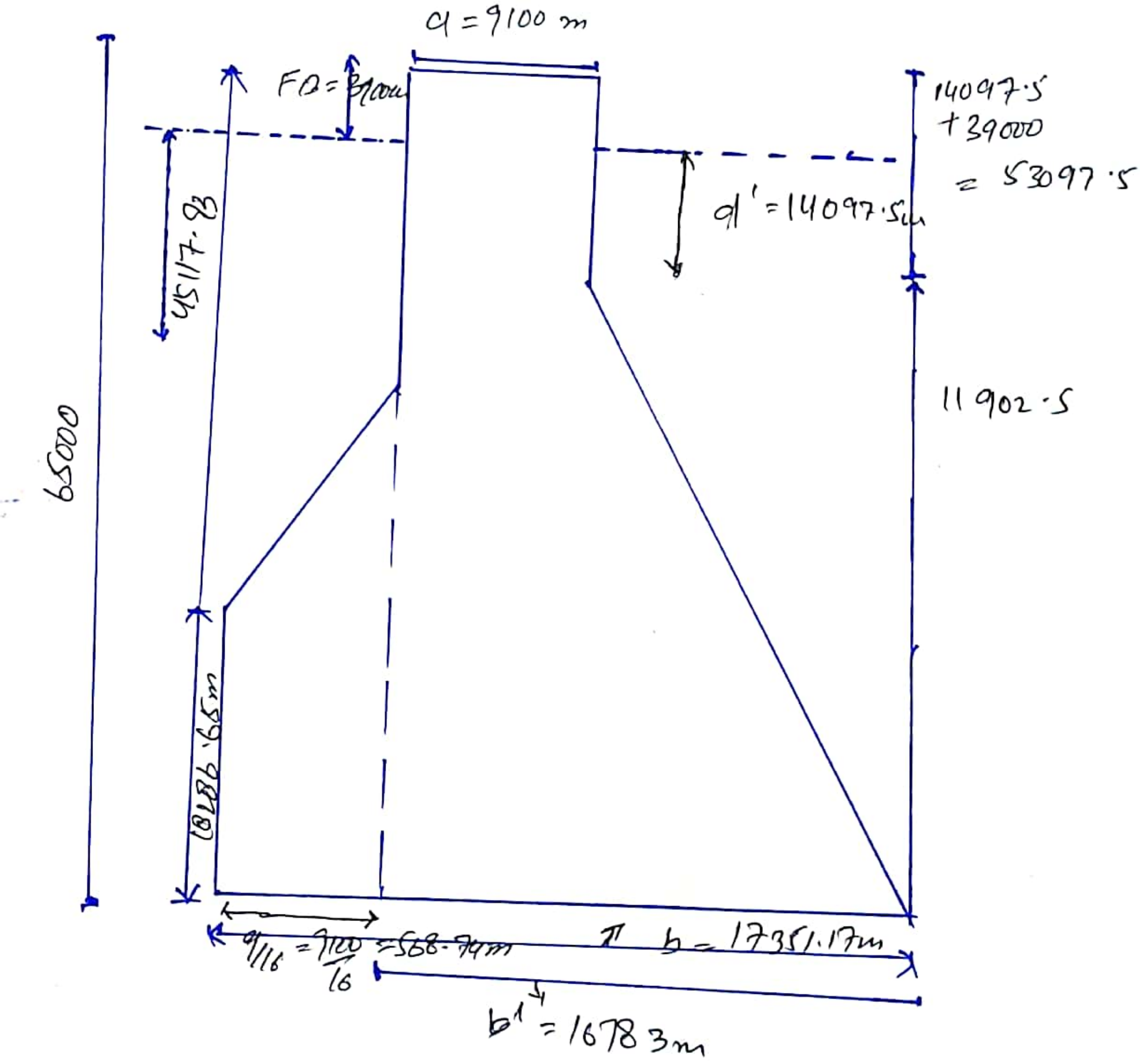
$$d' = 14369.33$$

⇒ Depth of vertical portion,

$$d = d' + F.B = 14369 + 39750$$

$$d = 54119.$$

⇒ **Daigram:-**



Q No. 3

(7)

⇒ Using Any Hydraulic model and explain the concept of Dimensional analysis and similitude - Each student should have separat model analysis.

Ans//

DIMENSIONAL Analysis :-

→ Dimensional Analysis is a mathematicle technique making use of study of dimension

→ It deals with the dimensions of physical quantities involved in the phenomenon.

→ In dimensional analysis, one first predicts the physical parameters that will influence the flow, and then by grouping these paramotors in Dimensionless combination a better understandings of flow phenomina is made possible".

It is helpful particularly in experimental work because it provides a guides to Those things that significantly influence the Phenomena.

⇒ TYPES OF DIMENSIONS:-

① → Fundamental Dimensions:-

These are Basic quantitie. For Example.

Time, T → Time, T
Distance, L → Distance, L
Mass, M → Force, F

Force = mass × Acceleration

$F = mass \times M/s^2$

$F = Mass \times MS^{-2}$ meter = distance, sec = Time

$F = M \times LT^{-2}$

$F = MLT^{-2}$

② → Secondary DIMENSION:-

These are those quantities which passes more than one fundamental Dimension.

⇒ For example:-

→ velocity denoted by distance per unit time L/T

→ Acceleration denote by distance per unit time sec L/T^2

→ Density denoted by mass per unit volume M/L^3

⇒ Since velocity, Acceleration, Density involve more than one fundamental quantities.

(01)

⇒ Similitude:-

It is defined as the Similarity between the mode and prototype in every report which mean model and prototype have similar properties or model or prototype or completly Similar. (Conditions).

⇒ Types of Similarties:-

→ There are Three types of Similarties must exists b/w model and prototypes.

i - Geometric Similarity.
ii - Kinematic Similarity.
iii - Dynamic Similarity.

Q4:-

What will be the effect of sediment Sediment particle diameter, particle density, particle concentration, particle shap, viscosity of water, turbulance of water flowing in reservoir on fall velocity? Explain in detail.

Ans/ ① ⇒ PARTICLE DIAMETER:- The diameter of the particle is directly proportional to the fall velocity because the greater of size of the particle so it will tends to move faster as compared to particles of small size thus there will be more gravitational force on particle of greater size so it will fall quickly due to it's weight.

② ⇒ 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.

③ ⇒ 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 the more fall velocity comparing with section of low concentration.

4=> PARTICLE SHAPE :-

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

5=> VESCOSITY OF WATER :-

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

(b) ⇒ TURBULENT OF WATER:

Turbulence of water depends upon the different factors such as velocity. It will effect the fall velocity because of it's zigzag motion thus the velocity varries at every point which is why it effect the fall velocity moreover increase in the kinetic energy tends to effect the fall velocity compare with steady fluid.

"THE END"