7835 TITLE PAGE

NAME :- Hamza Ejaz

SUBMITTED TO :- Sir Fawad Ahmed

SUBMITTED BY :- 7835

SUBJECT :- Hydraulic ENGINEERING

SEMESTER :- 6th

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Q No 1:-

Ans:- The pressure drop Δp is expected to be depend upon the gate opening h, the overall depth d, the 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	$ML^{-1}T^{-1}$

Number of variable = $n = 6$

Number of Independent dimension $m = 3$

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

⇒ Chose $m = 3$ scaling variable : geomatric (d);

Kinamatic / Time - dependent (v) ; dynamic/mass - dependant (ρ)

Form dimensionless groups by non-dimensionalising the remaining variables : ΔP, h and μ

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

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

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

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

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

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

$$\pi_1 = \Delta P v^{-2} \rho^{-1} = \frac{\Delta P}{\rho v^2}$$

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

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

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

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

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

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

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

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

Recognition of the Reynolds number suggests that we replace π_3 by $\pi_3' = (\pi_3)^{-1} = \frac{\rho v d}{\mu}$

Hence dimensional analysis yields.

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

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

(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 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; $V_m = \frac{v_p}{0.5} = \frac{3.0}{0.5} = 6\text{m/s}$

b The ratio of the quantities of flow is

$$\frac{Q_p}{Q_m} = \frac{(\text{velocity} \times \text{area})_p}{(\text{velocity} \times \text{area})_m} = \frac{V_p}{V_m}\left(\frac{d_p}{d_m}\right)^2 = 0.5 \times 5^2 = 12.5$$

Finally, for the pressure drop,

$$\pi_1 = \left(\frac{\Delta P}{\rho V^2}\right)_p = \left(\frac{\Delta P}{\rho V^2}\right)_m \Rightarrow \frac{(\Delta P)_p}{(\Delta P)_m} = \frac{\rho_p}{\rho_m}\left(\frac{V_p}{V_m}\right)^2$$

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

Thus $\Delta P_p = 0.2 \times \Delta P_m = 0.2 \times 60$

$\Delta P_m = 12.0\ kPa.$

Q No 2:-

Sol:-

$T = 783$

$G = 2.4$

$C_u = 0$

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

$$= \frac{120 \times 783 \times 1000}{1000(2.4 - 0 + 1)} = 27635.29$$

Let H_w = 25500

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Thus $27635.29 > H_W = 25500$

So it is low gravity dam

2. Top width "a"

Free board $= 1.5\, h_{wave} = 1.5 \times 25500$

$F.B = 38250$

Height of Dam $= H_D = H_W + F.B = 25500 + 38250$

$H_D = 63750$

$a = 14\%$ of $H_D \Rightarrow 0.14 \times 63750$

$\Rightarrow a = 8925$

3. Base width "b" (without offset)

(i) For No sliding Criteria

$$b' = \frac{H_W}{\mu G} = \frac{25500}{0.7 \times 2.4} = 15178.57$$

$b' \approx 15180$ m

(ii) For no tension criteria

$$b' = \frac{H_W}{\sqrt{G}} = \frac{25500}{\sqrt{2.4}} = 16460.17$$

$b' \approx 16460$ m

4. Depth of vertical portion on u/s side

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

$h' = 2 \times 8925\sqrt{2.4 - 0}$

$h' = 27653.10$

$h' = 27653 m$

5. upstream off set $= \frac{a}{16} = \frac{8925}{16} = 557.81$

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

$= 43415.1 m.$

7. Total width of the base of the dam

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

$= 16460 + \frac{8925}{16}$

$= 17017.81$

8. $Tan\theta = \frac{b'}{H} = \frac{16460}{25500}$

$\theta = tan^{-1}\left(\frac{16460}{25500}\right)$

$\theta = 32.84$

Depth of vertical portion on D/s

$$\tan\theta = \frac{a}{d'} = \frac{8925}{d'}$$

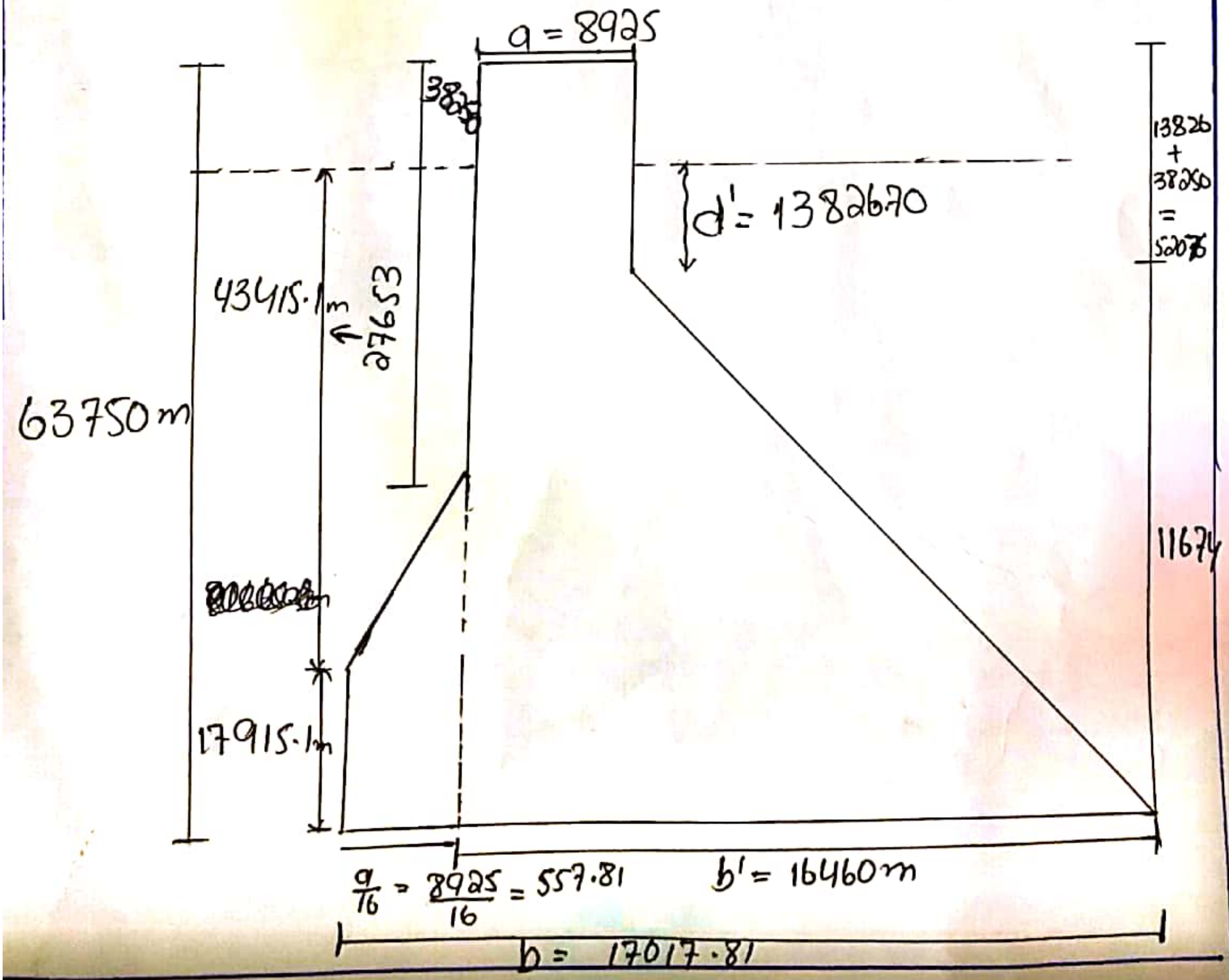
$$\left(\frac{16460}{25500}\right) d' = 8925$$

$$d' = \frac{8925 \times 25500}{16460} = 13826.70$$

depth of vertical portion

$$d = d' + F.B = 13826.70 + 38250$$

$$d = 52076.7$$



Q No 3

DIMENSIONAL ANALYSIS:-

Dimensional analysis is the concept of analysis which various physical quantities are expressed in terms of their fundamental dimensions that is often used when there is not enough information to set up precise equations.

SIMILITUDE:-

It is a concept of estimating the behavior of a prototype from model measurements. It is generally used to test engineering models. The concept of similitude is mainly used in aerospace and hydraulic applications to check the condition of fluid flow with regard to the scaled models.

Hydraulic MODEL:-

Various car suspensions contain a number of hydraulic components, such as dampers, hydraulic rubber mounts, power steering and active suspension units. Modeling and simulation of these hydraulic components are recieved and further developed on the basis of one dimensional flows represented in the time domain. which is an effective and reliable approach for the design and analysis of Automotive fluid power system.

QNo4:.

PARTICLE DIAMETER:-

The particle's diameter is directly proportional to the fall velocity because greater the size of particle so it will tend to move 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 it's weight.

2. PARTICLE DENSITY:-

Density of the partical 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.

3. "Particle Concentration:- concentration of particle size will considerably effect it's 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:-"

Particle having regular shapes tends to be effected more than irregular shapes since regular shapes particles have even surfaces which offers very little or no friction while particles with irregular shape offers more frictions, 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 see that perameter such as temperature and pressure changes the magnitude of viscosity so that 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. "Turbulance of water :-"

Turbulance 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 various at every point which is why it effect the fall velocity moreover, increase in the kinetic energy tends to effect the fall velocity compared with steady fluid.