Name : M. Arsalan Shah.

Submitted by : *7830*

Submitted to : Engr. Fawad Khan

Section : "B"

Paper : "Hydraulic Engineering."

Date : 25-6-2020.

Semester : 6th.

DNU- Official.

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.

Δp, h, d, V, ρ & μ.

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 grop $n - m = 3$

⇒ choose ($m = 3$) Scaling variable ; geomatric (d) ; kinematic / Time - dependent (V) ; dynamic / mass - depandant (ρ).

From dimensionless group by non-dimensionalising the remaining variable : Δp, h, ρ u :

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

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

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

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

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

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

$$\Rightarrow \Pi_1 = \Delta p v^{-2} \rho^{-1} = \Delta p / \rho v^2$$

Now $\Pi_2 = h/d$ (by inspection, since h is a length).

$$\Pi_3 = u d^a v^b \rho^c$$

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

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

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

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

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

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

Recognition of the Reynolds number suggests that we have replace Π_3 by $\Pi_3' = (\Pi_3)^{-1} = \rho v d / u$

Hence dimensional analysis yields.

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

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

(A): Dynamic Similarity requires that all non-dimesional groups be the Same in model & Prototypes: i.e

$$\Rightarrow \Pi_1 = \left(\Delta p/\rho V\right)_p = \left(\Delta p/\rho V^2\right)_m$$

$$\Rightarrow \Pi_2 = (h/d)_n = (h/d)_m$$ (similar shape i.e geometric Similarity).

$$\Rightarrow \Pi 3' = \left(\frac{\rho V d}{\mu}\right)_p = \left(\rho V d/\mu\right)_m$$

From the last, we have a velocity ratio:

$$\frac{V_p}{V_m} = \frac{(\mu/\rho)_p}{(\mu/\rho)_m}\frac{d_m}{d_p} = \frac{0.002/800}{1.0\times10^{-6}} \times 1/5 = \boxed{0.5}$$

Thus;

$$V_m = V_p/0.5 = \frac{3.0}{0.5} = \boxed{6\ m/s}$$

(B): The ratio of the quantities of flow is

$$Q_p/Q_m = \frac{(\text{velocity} \times \text{area})_p}{(\text{velocity} \times \text{area})_m} = V_p/V_m \left(d_p/d_m\right)^2 = 0.5\times5^2 =$$

$\boxed{Q_p/Q_m = 12.5}$.

Finally, For the Pressure drop;

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

$$= \frac{\rho_p}{\rho_m}\left(\frac{v_p}{v_m}\right)^2.$$

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

Thus $(\Delta p)_p = 0.2 \times \Delta p_m = 0.2 \times 60$

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

xxx xxx xxx xxx xxx

Q NO # 2

Given data:

$$T = 783$$

$$G = 2.4$$

$$Cu = 0$$

Solution:

(1) : (H) Limiting $= \dfrac{\text{@ a v}}{\gamma_w (G - CV + 1)}$

Put the Value:

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

$$\boxed{\text{(H) Limiting} = 27635.29}$$

⇒ We suppose Hw:

$$Hw = 27000$$

② Top Width " a "

$$\text{Free board} = 1.5\, h_{wave} \Rightarrow 1.5 \times 27000$$

$$\boxed{F.B = 40500\ m.}$$

⇒ Height of Dam = $H_D = Hw + F.w$

= Put Value.

$$= 27000 + 40500$$

$$\boxed{H_D = 67500\ m}$$

⇒ $a = 14\%$ of H_D.

$$= 0.14 \times 67500$$

$$\boxed{a = 9450}.$$

③ Base Width " b ". [without odd set].

i) For No Sliding criteria:

$$b' = Hw/\mu q = \frac{27000}{0.7 \times 2.4} = \boxed{16071.42}$$

$$\boxed{b' = 16071.42}\ m.$$

ii) For no tension ceiteria:

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

$$\boxed{b' = 17428.42}\ m$$

(4) Depth of vertical portion on u/s side:

$$\Rightarrow \quad h' = 2q\sqrt{q - C_v}$$

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

$$\boxed{h' = 29279.7 \text{ m}}$$

(5) Upstream offset =

$$\Rightarrow \quad 9/16$$

Put Value.

$$\Rightarrow \quad 9450/16 = \boxed{590.6 \text{ m}}$$

(6) Depth below the water level to the End of inclined Portion in u/s $= 3.14\, q\sqrt{q}$

Put Value:

$$= 3.14\,(9450)\sqrt{2.4} = \boxed{45969.2 \text{ m}}$$

(7) Total width of the base of the Dam:

$$b = b' + 9/16 = 17428.42 + \frac{9450}{16}$$

$$\boxed{b = 18019.04 \text{ m}}$$

(8)

$$\tan\theta = b/H = \frac{17428.42}{27000}$$

$$\theta = \tan^{-1}\left(\frac{17428.42}{27000}\right)$$

$$\boxed{\theta = 32.82}$$

(9) Depth of Vertical Portion on D/S.

$\Rightarrow \tan\theta = 9/d' = \frac{9450}{d'}$

$\Rightarrow = \left(\frac{17428.42}{27000}\right) d' = 9450$

$\Rightarrow d' = \frac{9450 \times 27000}{17428.42}$

$\boxed{d' = 14639.88\,m}$

$\Rightarrow$ depth of Vertical Portion:

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

Put Value.

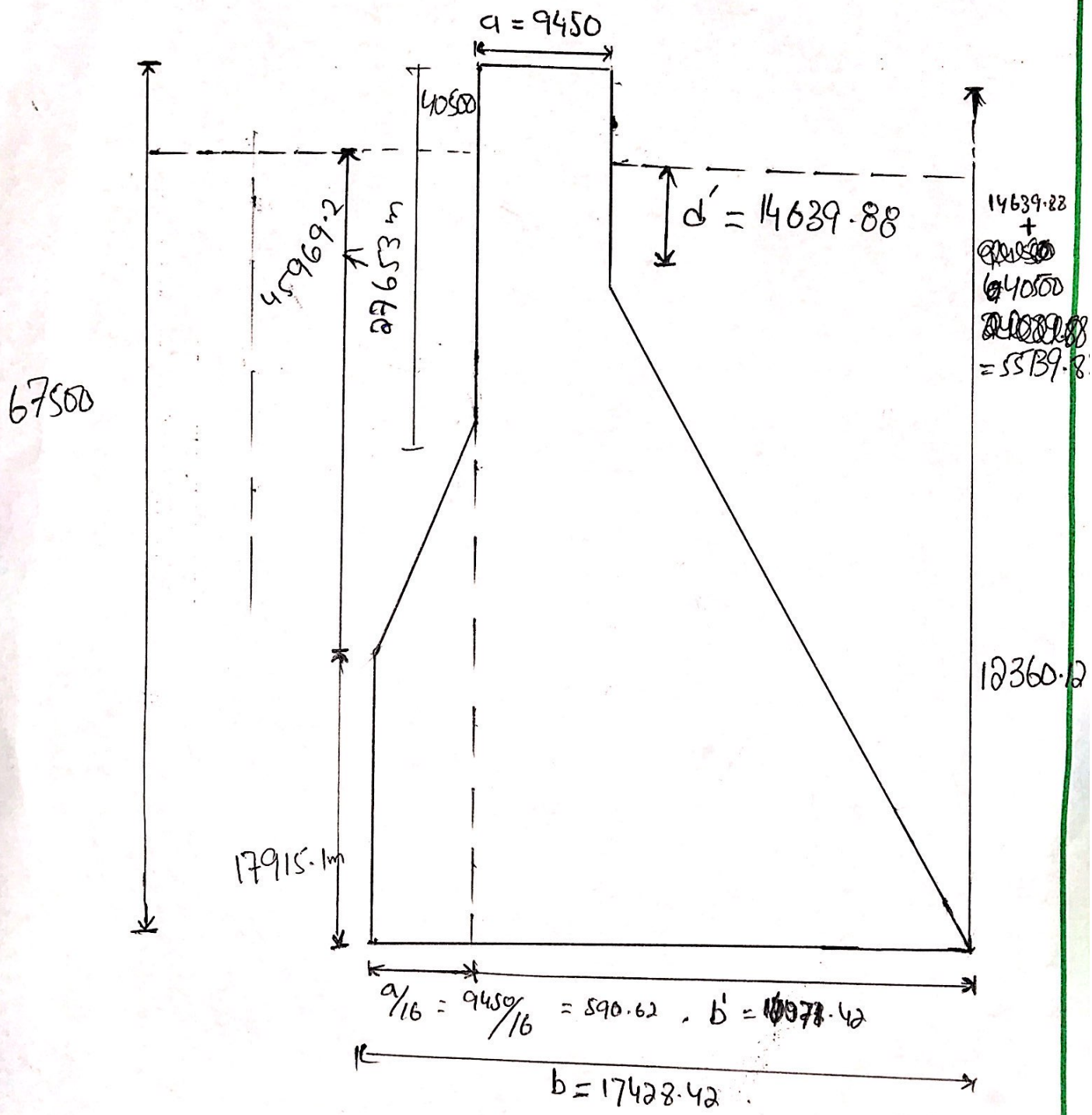
$\Rightarrow 14639.88 + 40500$

$\Rightarrow \boxed{d = 55139.88\,m}$.

Note!

Diagram on the next page ☺

P.T.O



Q NO # 3

⇒ Dimensional Analysis:

diOO Analysis of the relationship b/w different Physical quantities by Identifing their base quantities and units of measure.

⇒ In Engineering & Science, dimensional analysis is the analysis of the relationship b/w different b/w different Physical quantities by Indentifing the basic quantities & unit of measure.

Example:

⇒ More generally, dimensional analysis is used in interpreting various financial ratio, economic ratio, and accounting ratio.

⇒ Exampl:

The P/E ratio has dimensions of time; (unit of year) and can be interpreted as "year of earnings to earn the Price Paid".

⇒ Dimensional Analysis work :

⇒ In Engineering and the Science :

the dimensional analysis is actually the exercise of checking relationship b/w Physical quantities, through Identifying Their Own dimension. The dimension associated with a Physical Quantities is actually the combination of the Fundamental Physical dimensions that create it.

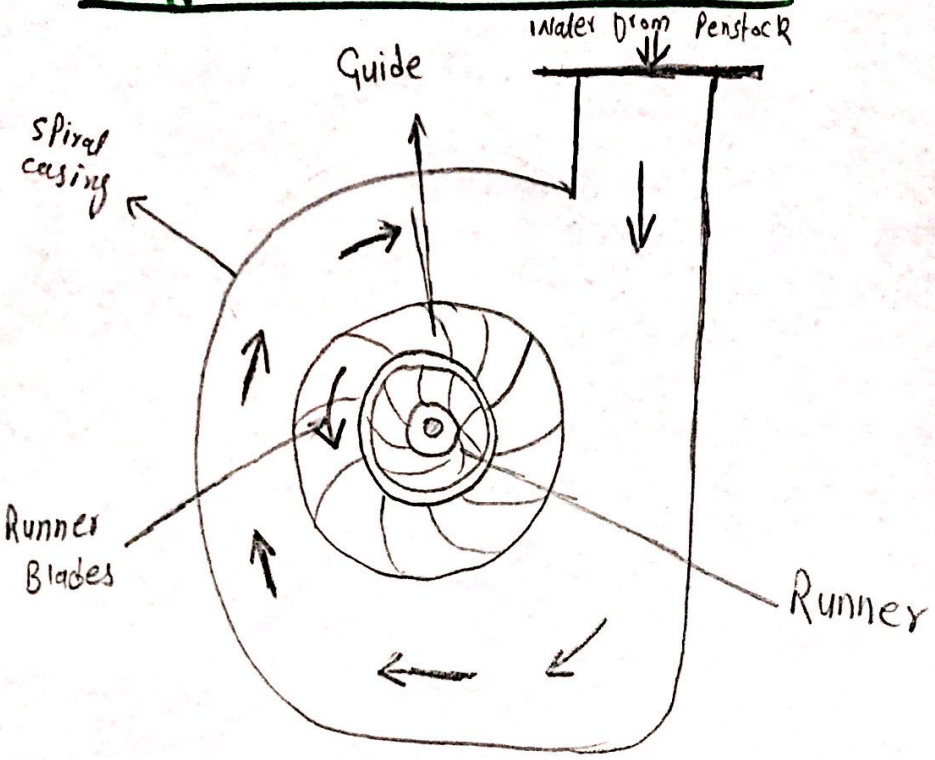
⇒ Hydraulic Model :

Reaction Turbine is the Example of Hydraulic Model which are define as:

(dd) "

⇒ A reaction turbine develops Power from the combined action of Presssure and moving blades. The runner is placed directly in the water stream flowing over the blades rather than striking each individually. Reaction turbine are generally used for sites with lower head and higher flows than compared with the impulse turbine.

⇒ diagram . Reaction Turbine :



Rection Turbine :

Q NO # 4

⇒ Particle diameter :

The diameter of the Particle is directly Proportional to the fall velocity because greater the size of Particle so it will tend to more faster as compared to the Particle of Small size thus there will be more gravitational force on Partical of greater size so it will fall quickly due to it weight

(2) Particle density:

Density of the Particle 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 Partical 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 then irregular shapes since regular shapes Particles have even surface which offers very little or no friction while Particles with Irregular shape offers more friction with as the Particle with Small Surface area are more likely to be effected due to their less resistance.

(5) **Turbulence of water:**

Turbulance of water depands upon the different factors such as velocity. It will effect the fall velocity because of its zigzag motion thus the velocity varies at every point which is why if effect the fall velocity, moreover increase in the kinetic energy tend to effect the fall velocity compared with steady fluid:

*** *** *** *** ***

The End !