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Section ⇒ 'B'.

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Subject Name ⇒ Hydraulic Engr.

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QNO# 01 :-

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 group $n - m = 3$

⇒ Choose (m=3) sealing variable; geomatric (d); Kinematic / Time-dependent (V); dynamic / mass-depandant (ρ).

From dimenionalees group by non-dimensimalising the remaing variable :

$\Delta P , h , v , \rho$

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

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

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

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

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

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

Now

$\pi_2 = h/d$ (by inspection, since h is a length).

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

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

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

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

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

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

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

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Recognition of Reynolds Number suggests that we have replace π_3 by $\pi_3' = (\pi_3)^{-1} = \rho v d / \mu$.

Hence dimension analysis yields.

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

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

(A): Dynamic similarity requires that all non-dimensional groups be the same in model & prototypes: i-e

$\Rightarrow \pi_1 = (\Delta p / \rho v)_p = (\Delta p / \rho v^2)_m$

$\Rightarrow \pi_2 = (h/d)_n = (h/d)_n$ (similar shape ie geometric similarity)

$\Rightarrow \pi_3 = \left(\frac{\rho v d}{\mu}\right)_p = \left(\frac{\rho v d}{\mu}\right)_m$

From the last, we have a velocity ratio;

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

$$= 0.5$$

Thus;

$$V_m = v_p / 0.5 = \frac{3.0}{0.5} = 6 \, m/s$$

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(B):- The ratio of the quantities of flow is $Q_P/Q_m = \frac{(\text{velocity} \times \text{area})_P}{(\text{velocity} \times \text{area})_m} = V_P/V_m$

$$(d_P/d_m)^2 = 0.5 \times 5^2 =$$

Finally, For the pressure drop;

$$\pi_1 = (\Delta P/\rho V^2)_P = (\Delta P/\rho V^2)_m \Rightarrow \left(\frac{(\Delta P)_P}{(\Delta P)_m}\right)$$

$$= \rho_P/\rho_m \, (V_P/V_m)^2.$$

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

Thus $(\Delta P)_P = 0.2 \times \Delta P_m = 0.2 \times 60$

$$\Delta P_m = 12.0 \text{ KPa.}$$

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Given Data:

$T = 767$

$C_1 = 2.4$

$C_4 = 0$.

Sol:-

① : $(H)\ \text{Limiting} = \dfrac{6aV}{\gamma w(C_1 - C(C+1))}$

put the value:

$$= \frac{120 \times 767 \times 1000}{1000 \times (2.4 - 0 + 1)}$$

$$(H)\ \text{Limiting} = 27070.58$$

② Top width "a"

Free board $= 1.5\ h_{wave} = 1.5 \times 27070$

$$F.B = 40605$$

Height of Dam $= H_D = H_w + F.B$

$= 27070 + 40605$

$$H_D = 64675\ m$$

$a = 14\%$ of H_D

$= 0.14 \times 64675$

$$a = 9054.5$$

Base width "b" (without offset).

(i) For No sliding Criteria,

$$b' = \frac{H\!\!\!\!\;W}{\mu G} = \frac{27070}{0.7\times2.4} = 16113.09$$

$$b' \simeq 16114\ m$$

(ii) For No tension Criteria.

$$b' = \frac{HW}{\sqrt{a}} = \frac{27070}{\sqrt{2.4}} = 17473.60$$

$$b' = 17474\ m$$

(4) Depth of verticle portion on U/S Side.

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

$$h' = 2\times9054.5\sqrt{2.4-0}$$

$$h' = 28052.79\ m$$

(5) Upstream offset:-

$\Rightarrow a/16$ put value

$\Rightarrow 9054.5/16$

$\Rightarrow 565.90\ m$

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(8) Depth below the water level to the u/s of inclined portion in V/s

$= 3.14\ a\sqrt{a}$ put value.

$= 3.14(9054.5)\sqrt{2.4}$

$= 44045.317\ m$

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

$b = b' + a/16 = 17474 + \frac{9054.5}{16}$

$b = 18039.90\ m$

(8) $\tan\theta = b'/H = \frac{17474}{27070.58}$

$\theta = \tan^{-1}\left(\frac{17474}{27070.58}\right)$

$\theta = 32.84.$

(9) Depth of verticle portion on D/s.

$\Rightarrow \tan\theta = a/d' = \left(\frac{9054.5}{27070.58}\right) d' =$

2.98.

$d' = \frac{9054.5 \times 27070.58}{17474}$

$d' = 14022.51$

⇒ depth of vertical portion.

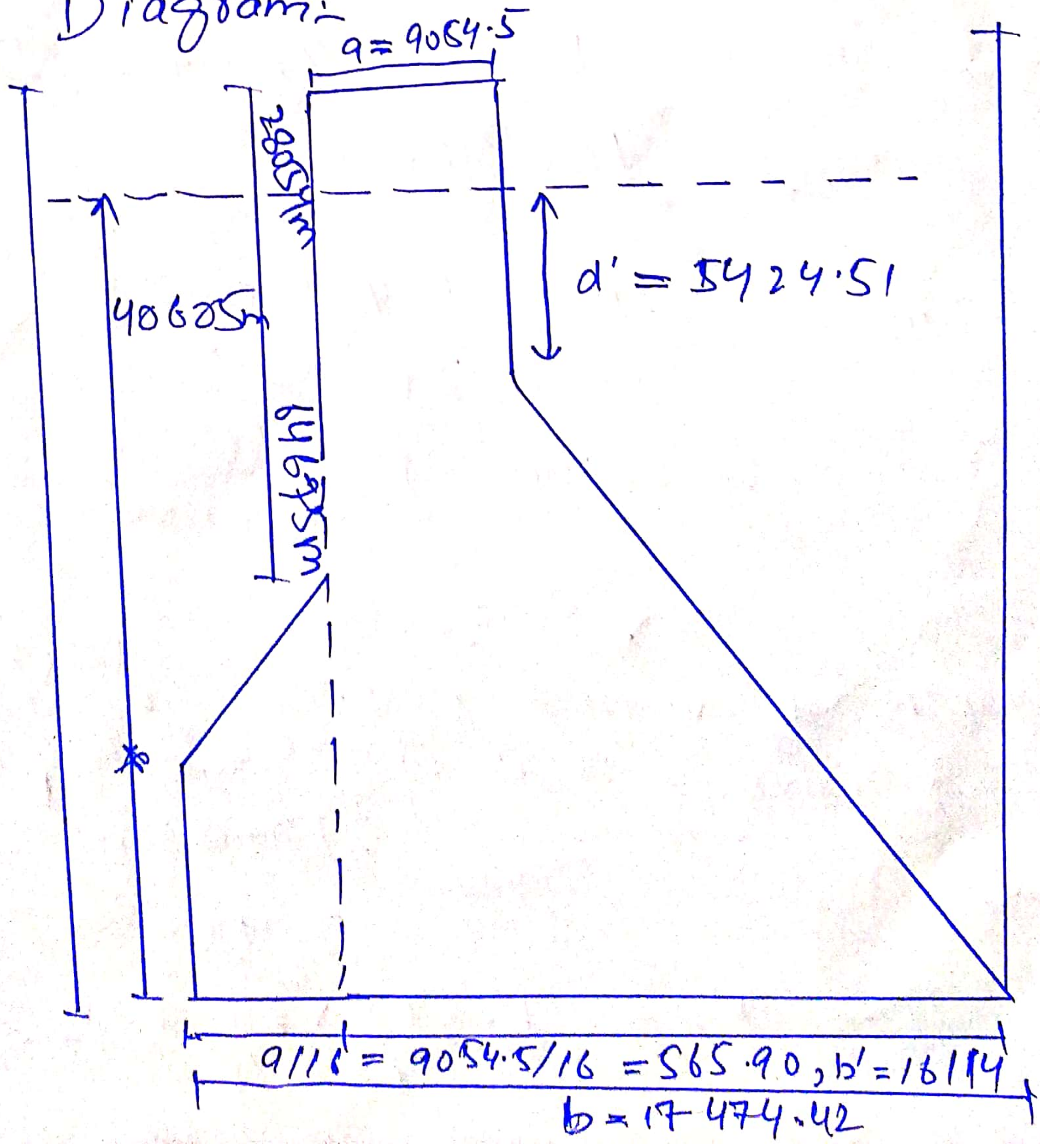
⇒ $d' = d' + F.B$

put value.

⇒ $14022.51 + 40605.$

⇒ $d = 54624.51$ Ans

Diagram:-



Q NO # 03 ?

⇒ Dimensional Analysis :-

Analysis of the relationship b/w different physical quantities by identifing their base quantities & units of measure:

⇒ In engineering & Science dimensional analysis in the analysis of the relationship b/w different b/w different physical quantities by identifing the basic quantities & unit of measure.

Example:-

⇒ More generally, dimensional analysis is used in interpreting various Financial ratio, economic ratio, & accounting ratio.

⇒ Example:-

The P/E ratio has dimensions of time; (unit of year) & Can be interpreted as "year of earnings to earn the price paid".

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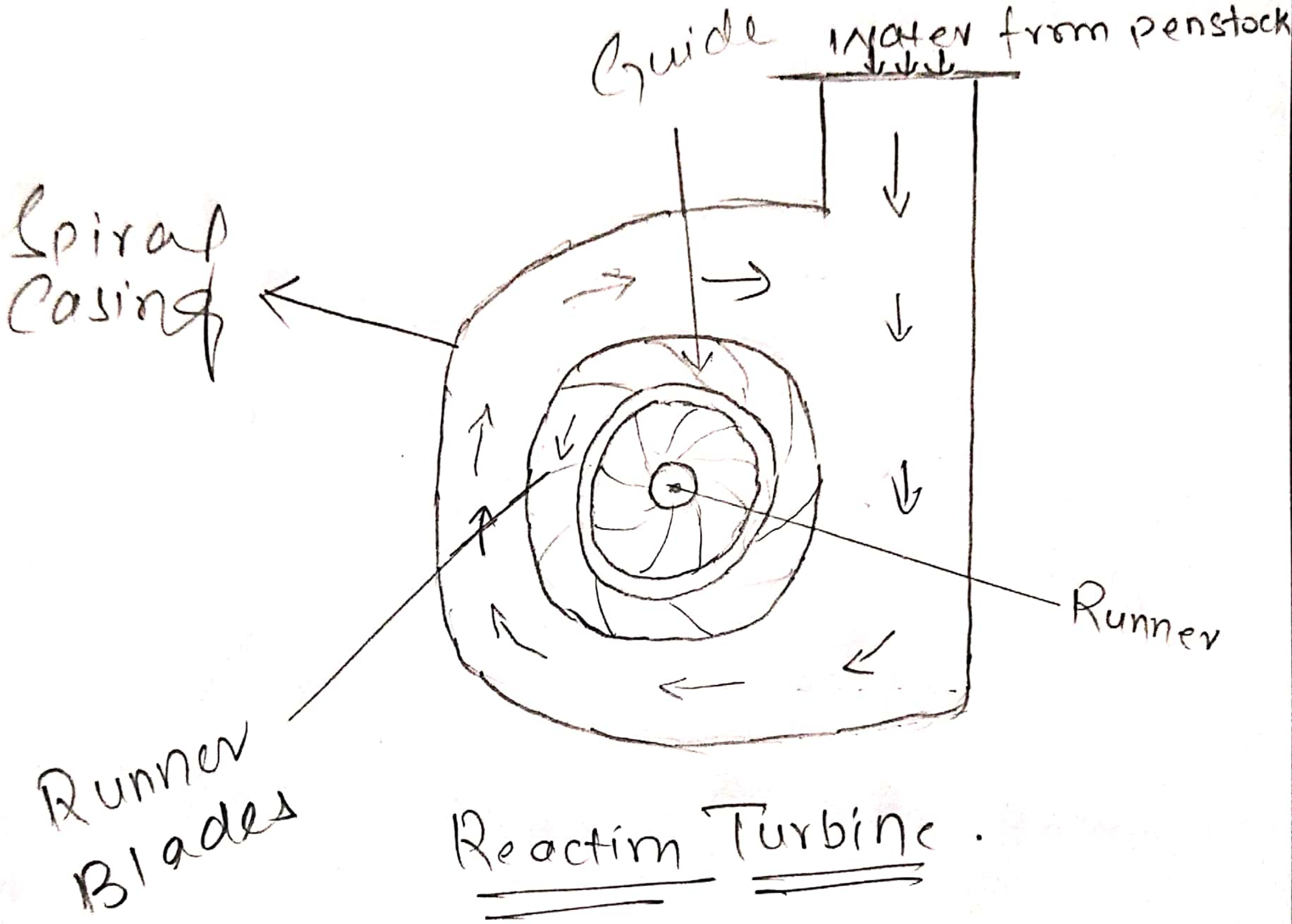
⇒ Dimensimal Analysis work :-

⇒ In engineering & The Science, the dimensimal 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 fondamental Physical dimensions that create it.

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

(diDD)
⇒ " A reaction turbine develops power from the combined action of pressure and moving water. The runner is placed directly in the water stream flowing over the blades rather than striking each induidually Reaction turbine are generlly used for sides with lower head and higher flows than compared with the impulse turbine.

Diagram Reaction Turbine :-



Reaction Turbine.

Q NO# 04:-

Ans: **Particle diameter:-**

the diameter of the particles is directly proportional to the rate of fall velocity particles because greater the size of the particles so it will tend to move faster compared with particles of small size, thus there will be more gravitational force on particle of greater size so it will fall quickly due to its weight.

Practicle Density:-

Density of the particles its directly proportional to the rate of fall velocity since particles with high density tends to settle down early compared with particle of low density.

Particle Concentration:- Concentration of the particle size will considerably affect its fall velocity as the section having greater concentration will be settled down at the place

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Thus Causing more fall velocity Comparing with section of lower Concentration & vice versa.

Particle Shape:-

Particles having regular shapes to be effected more than irregular shapes since regular shaped particles have even surfaces which offers very little are no friction, as the particles which smaller surface area are more likely to be effected due to their less resistance.

Viscosity of water:-

From the experimental study we can see that parameters such as temperature & pressure changes the magnitude of viscosity; so the section of water having more temperature & pressure will fall objectively & they more due to increase in the kinetic energy so fall velocity will be more & voice versa.

Turbulance of Water:- Turbulence of water depends upon the different factors such as velocity. It will effect the fall velocity because of its zig-zag motion thus the velocity varies at every point which is why it effects the fall velocity, moreover increas in the kintic energy tends to effect the fall velocity compound with steady fluid.