TitLE Page. 7834

Name :— Tariq Mehmood

Submitted To :- Sir Fawad Ahmad

Submitted by :- 7834

Subject :— Hydrailic Engineering

Semester :— 6th

Data :— 25-06-2020

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, and 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 $m = 3$ (M, L & T)

number of non-dimensional groups $n - m = 3$

→ choose $m (= 3)$ scaling variable ; geomatric (d) ; Kinemtic / Time-dependent (v) ; dynamic/mass-depandant (ρ)

From dimensionless group by non-dimensionalising the remaining variable: ΔP, h, and μ

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\pi_2 = (h/d)_n = (h/d)_m \quad \text{(similar shape i.e geomatric similarity)}$$

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

From the last, we have a velocity ratio.

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

Thus; $V_m = \frac{V_P}{0.5} = \frac{3.0}{0.5} = 6\,m/s$

The ratio of the quantities of flow is

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

(c) 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

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

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

Q No 2

Sol

$T = 783$

$G = 2.4$

$C_u = 0$

(1) $H_{limiting} = \frac{6_{all}}{\gamma_w(G - C_u + 1)} = \frac{120 \times 783 \times 1000}{1000(2.4 - 0 + 1)} = 27635.29 \text{ m}$

Let $H_w = 26000$ m

Thus $27635.29 > H_w = 26000$

So it is low gravity dam.

7834

(2) Top width "a"

Free board = 1.5 h_{wave} = 1.5 x 26000

$F.B = 39000 m$

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

= 26000 + 39000

$H_D = 65000 m$

a = 14% of H_D

= 0.14 x 65000 ⇒ a = 9100

(3) Base width "b" (with out offset)

i) For No sliding criteria

$$b' = \frac{H_w}{\mu G} = \frac{26000}{0.7 \times 2.4} = 15476.19$$

$b' \simeq 15477 m$

(ii) For no tension criteria

$$b' = \frac{H_w}{\sqrt{G}} = \frac{26000}{\sqrt{2.4}} = 16782.92 m$$

$b' \simeq 16783 m$

4) Depth of vertical portion on u/s side

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

$$h' = 2 \times 9100\sqrt{2.4 - 0}$$

$$h' = 28195.31 m$$

$$\boxed{h' \approx 28195 m}$$

(5) Upstream off set $= \frac{a}{16} = \frac{9100}{16} = 568.75 m$

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

$$= 3.14 (9100)\sqrt{2.4}$$

$$= 44266.65 m$$

(7) Total width of the base of the Dam

$$b = b' + \frac{a}{16} = 16783 + \frac{9100}{16}$$

$$\boxed{b = 17351.75 m}$$

(8) $\tan\theta = \frac{b'}{H} = \frac{16783}{26000}$

$$\theta = \tan^{-1}\left(\frac{16783}{26000}\right) = 32.84^\circ$$

$$\boxed{\theta = 32.84^\circ}$$

(9) Depth of vertical portion on D/s

$$\tan\theta = \frac{a}{d'} = \frac{9100}{d'}$$

$$\left(\frac{16783}{26000}\right) d' = 9100$$

$$d' = \frac{9100 \times 26000}{16783}$$

$$\boxed{d' = 14097.59\,m}$$

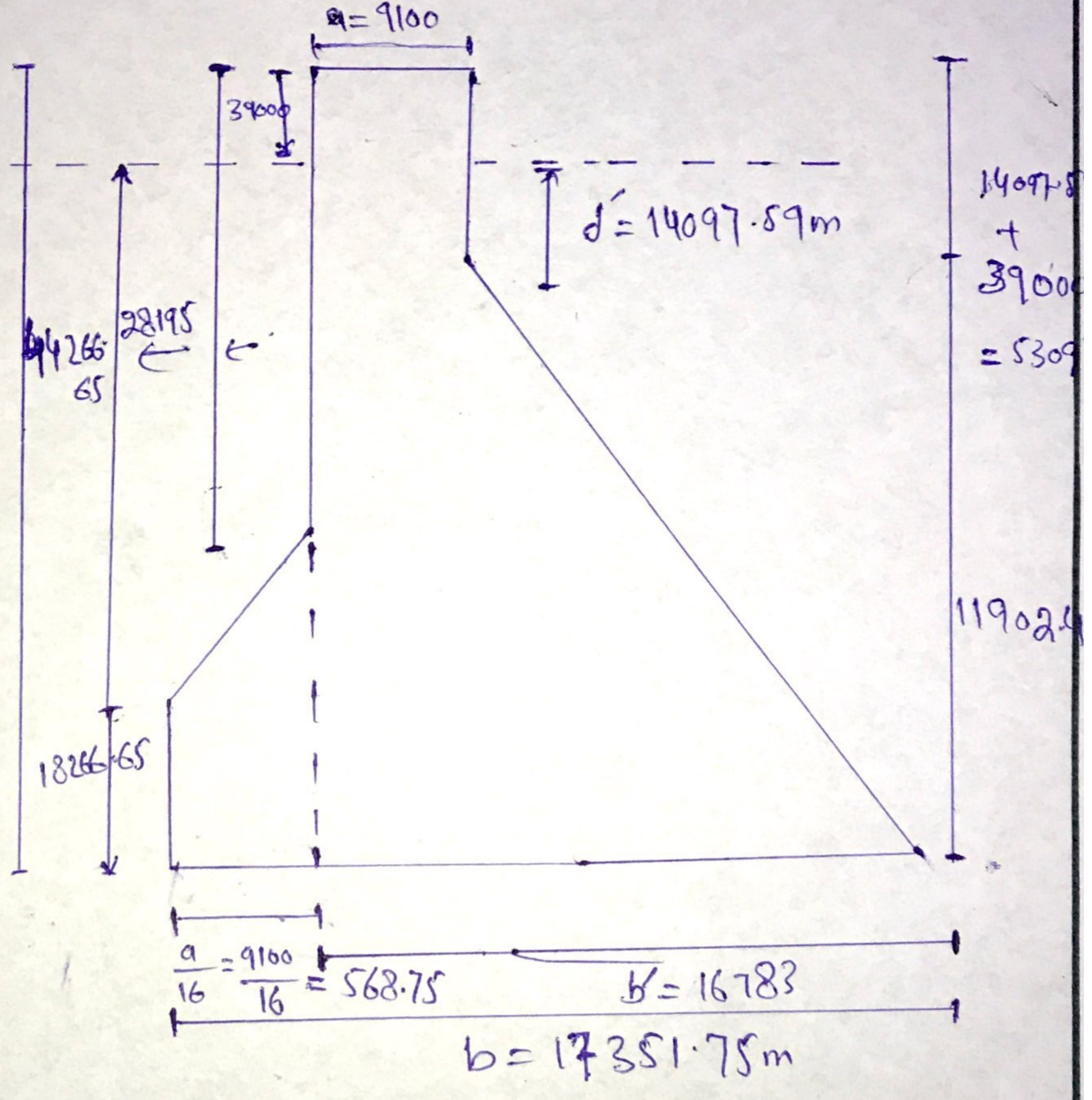
depth of vertical portion

$$d = d' + F.B = 14097.59 + 39000$$

$$\boxed{d = 53097.59\,m}$$

Diagram is on next page.

Diagram


a = 9100
3900
d' = 14097.59m
14097.5
+
39000
= 5309
28195
44266.65
65000
119024
18266.65
a/16 = 9100/16 = 568.75
b' = 16783
b = 17351.75m

Q No 3

Dimensional Analysis :-

⇒ is the analysis of the relationships between different physical quantities by Identifying their base quantities (Such as length, mass, time and electric charge) and units of measures (such as miles vs. Kilometeres, or pounds vs, kilogram) and ~~taking~~ tracking these dimensions as calculations or comparisons are performed.

⇒ Dimensional analysis or more specifically the factor-label method also known as the unit factor method

Example

How many second are in one day?

$$\frac{24\ hr}{1\ day} \times \frac{60\ min}{1\ hr} \times \frac{60\ s}{1\ min} = \frac{86,400\ s}{day}$$

Similitude

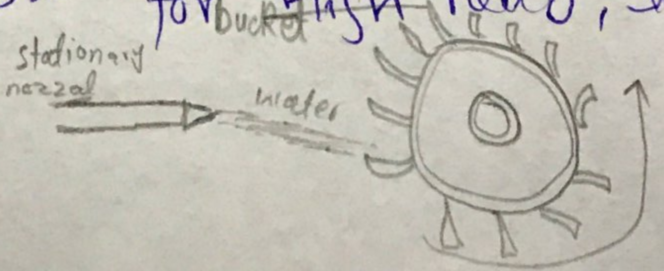
is used to express measurement on labaratory can be used to describe the behaiour of other system outside of laboratory

Hydraulic Model

Thereo are two main types of hydroturbine, impulse and reaction. The type of hydropower turbine selected for a project is based on the height of standing water - referred to as head" and the flow or volume of water at the site

⇒ Model about the Impulse Turbine

The impulse turbine generally uses the velocity of the water to move the runner and discharges to atmospheric pressure. The water stream hits each bucket on the runner. There is no suction on the down side of the turbine and the water flow out the bottom of the turbine housing after hitting the runner. An impulse turbine is generally suitable for high head, low flow application



impulse Turbine

Q No 4

(1) 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 particle of greater size so it will fall quickly due to it weight

(2) Particle density

⇒ Density of the particle is directly propertional 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 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, 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 parameter such as temperature and pressure changes the magnitude of viscosity so 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.

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 it effect the fall velocity moreover increase in the kineatic energy tends to effect the fall velocity compared with steady fluid.

The End.