Name	Jamalfaraz
ID	7832
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To	Engr Fawad Ahmad sir
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Q.NO.1

Ans:-

Solution:- the pressure drop Δp is expected to depend upon the Gate opening h, the overall depth (d) the velocity v density ρ and viscosity μ

$\Delta p, h, d, V, \rho, \mu$

Dimension:- $\Delta p = ML^{-1}T^{-2}$
$h = L$
$d = L$
$v = LT^{-1}$
$\rho = ML^{-3}$
$\mu = ML^{-1}T^{-1}$

Chose (m=3) Scaling variable, Geometric (d) Kinematic/time (v) dynamic mass dependent (ρ)

* Remaining variables:-

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

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

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

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

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

$\Pi_1 = \Delta p V^{-2} \rho^{-1} = \frac{\Delta p}{\rho V^2}$

$\Pi_2 = \frac{h}{d}$ (Since h is lenght)

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

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

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

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

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

$$\Pi_3 = \mu d^{-1} v^{-1} \rho^{-1} = \frac{\mu}{\rho v d}$$

Recognition of the Reynold no suggets that we replace Π_3 by

$$\Pi_3' = (\Pi_3)^{-1} = \frac{\rho v d}{\mu}$$

Dimensional Analysis yeild.

Solution:

The pressure drop Δp is expected to depend upon the Gate opening h, the overall depth d, the velocity V, dencity ρ, and viscosity μ.

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 varible = $n = 6$

No of Independent dimension = m = 3 (M, L and T)

No of non-dimensional = $n - m = 3$ = 3

$$\Pi_3' = \left(\frac{\rho v d}{\mu}\right)_p = \left(\frac{\rho v d}{\mu}\right)_m$$

From the last we have a velocity ratio

$$\frac{v_p}{v_m} = \frac{(\mu)(\rho)_p}{\mu/\rho_m d_p} = \frac{0.002/800}{1.0\times10^{-6}} \times \frac{1}{5} = 0.5$$

Hence $v_m = \frac{v_p}{0.5} = \frac{3.0}{0.5} = 6.0\,ms^{-1}$

(b) The ratio of the quantitys of flow is

$$\frac{Q_p}{Q_m} = \frac{(\text{velocity} \times \text{area})_p}{(\text{velocity} \times \text{area})_m} = \frac{v_p}{v_m}\left(\frac{d_p}{d_m}\right)^2 = 0.5\times5^2 = 12.5$$

(C) Finaly for the pressure drop.

$$\Pi_1 = \left(\frac{\Delta P}{\rho v^2}\right) = \left(\frac{\Delta P}{\rho v^2}\right) = \frac{(\Delta P)_p}{(\Delta P)_m} = \frac{\rho_p}{\rho_m}\left(\frac{v_p}{v_m}\right)^2$$

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

Hence $\Delta P_p = 0.2 \times \Delta P_m = 0.2 \times 60 = 12.0\,kPa.$

7832 (4)

Q.No# 2

Ans:-

Solution:-

Depth = 78 m

S.gravity = 2.4

f_{av} = 783 T/m²

Height of wave = 1.2 m.

(i) H Limiting:-

$$\frac{f_{av}}{\gamma_w (G - w + s)}$$

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

H Limiting = 230.2941

(2) Top width:-

$\Rightarrow 1.5 \times h$ wave

$\Rightarrow 1.5 \times 1.2$

$= 1.8$

Height of Dam:- $= H_w + F.B \Rightarrow 78 + 1.8$ $\boxed{\Rightarrow 79.8}$

a = 14% of HD $\Rightarrow 0.14 \times 79.8$ $\boxed{\Rightarrow 11.172 m}$

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7832 (5)

(3) Base width:-

$b' = \frac{H_w}{\mu G} = \frac{78}{0.7 \times 2.4} \Rightarrow 46.42m$

Round up

$b' = 47m$

For no Tension Criteria:-

$b' = \frac{H_w}{\sqrt{G}} = \frac{78}{\sqrt{2.4}} \Rightarrow 50.34$

$b' = 50.34$

Depth of vertical portion on u/s side:-

$h = 2a\sqrt{G \cdot w}$

$\Rightarrow 2 \times 11.172 \sqrt{2.4 - 0}$

$h = 34.60$ Round up

$h = 35m$

upstream offset:-

$\frac{a}{16} = \frac{11.172}{16}$ $= 0.6$

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

$= 3.14 \times 11.172\sqrt{2.4}$

$= 54.33$

Total width of the base of the dam.

$b = b' + \frac{a}{16} = 50.34 + \frac{11.172}{16}$ $b \Rightarrow 51.03$

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7832 (6)

$$\tan\theta = \frac{b'}{H} \Rightarrow \frac{50.34}{78}$$

$$\theta = \tan^{-1}(0.64)$$

$$\theta = 44.80^\circ$$

Depth of vertical portion on D/s (From col on U/s side)

$$\tan\theta = \frac{a}{d'} = \frac{11.172}{d'} \Rightarrow \tan\theta = \frac{11.172}{d'}$$

$$\left(\frac{839}{1300}\right) \times d' = 11.172$$

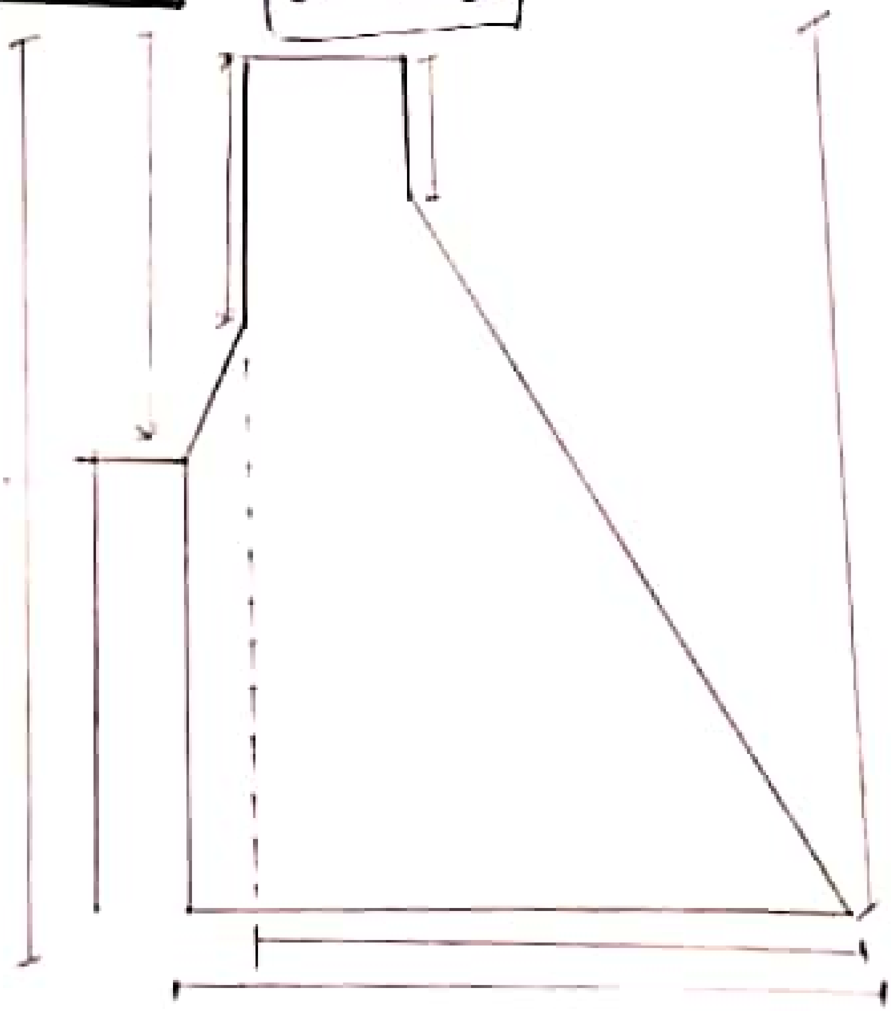
$$d' = 17.30\,m$$

Depth of vertical portion:-

$$d = d' + F.B \Rightarrow 17.30 + 1.8$$

Daigrams-

$$d = 19.1$$



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Q.NO#3

Ans:-

Dimensionae Analysis:-

Introductions.

It is a mathemathical technique making uses of the study dimension.

" In dimensional analysis one first predicts the physica parameters that will influence the flow, then by grouping these parameters in dimesional less Combination a better understand of the flow phenomena is made possible.

Types of Dimension:-

1) Fundamental Dimension:-

2) Secondry Dimension:-

Fundemental Dimension:-

Time, T   Distence, L   Mass, M   Force, F

$Force = Mass \times Acc = MLT^{-2}$

Secondry Dimension:-

These quantity posses more then one fundemental dimension.

For Example:-

velocity is denoted by distence per unit time L/T

Similtude - Type of Similarities:-

Similitude:-

is defined as similarity between the model and prototype is very respect which mean model and prototype are completely similar.

Three type

- Geometric Similarity:-
- Kinematic Similarity:
- Dynamic Similarity:-

Geometric Similarity:- It is said to exist b/w model and prototype if ration of all the corresponding linear dimension in the modale and prototype are equal

$$\frac{lp}{lm} = \frac{Bp}{Bm} = \frac{Dp}{Dm} = Lr$$

Lp, Bp, Dp are lenght and daimeter of prototype

Lm, Bm, Dm lenght Bredth and daimeter of model

Lr = Scale ratio

Kinematic Similarity: $\frac{Vp^1}{Vm} = \frac{Vp^2}{Vm^2} = V_r \therefore \frac{a_{p1}}{a_{m1}} = \frac{a_{p2}}{a_{m2}} = a_r$

Dyamic Similarity:- $\frac{(F_I)_P}{(F_I)_m} = \frac{(F_V)_P}{(F_V)_m} = \frac{(F_g)_P}{(F_g)_m} = F$

7832 (9)

Methods of Dimensional Analysis:-

If the no. of variable involed in a physical phenamena are known, then the relation among the varibles can be determined by the following two methods.

- Rayleigh's method:-
- Buckingham's theorm:-

(7832) (10) Ans-

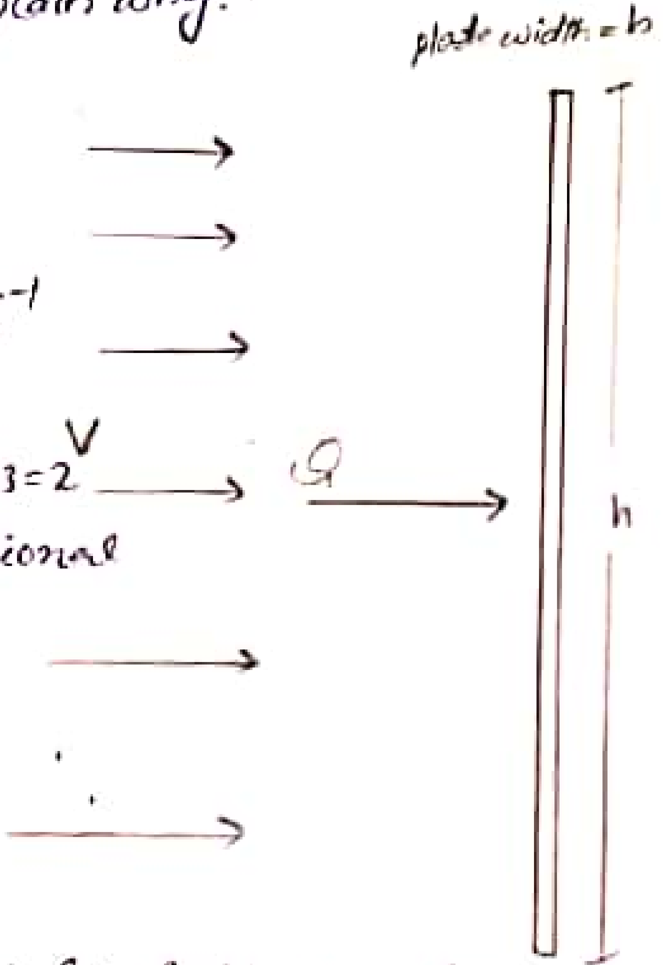
Sample for Module Analysis and Dimensional

A very viscous fluid flows slowly in submerged rectangular plate, plat height, h, width (b) velocity V viscosity μ, ($\mu_m = 0.03$) (width $h_m = 1$ in) ($b_m = 3$ in)

$h = 4$ $b = 12$ velocity of glycerin 2ft/s

It is not possible, explain why?

Dimensional Analysis:-



$Q = f(h, b, V, \mu)$

$Q = F$ $h = L$ $b = L$ $V = LT^{-1}$

$\mu = FL^{-2}T$

From the pi-theorm, $5 - 3 = 2$

Pi term require and dimensional Analysis yields

$$\frac{Q}{h V \mu} = \phi\left(\frac{b}{h}\right)$$

Model Analysis:-

The required similarity condition

$$\Rightarrow \frac{b}{h} = \frac{b_m}{h_m} \quad \text{From Given Data}$$

$$\Rightarrow \frac{12\,\text{inch}}{4\,\text{inch}} = \frac{3\,\text{in}}{1\,\text{in}} = 3$$

Condition Satisfied

Prediction Equation:- 7832 (11)

$$\frac{Q}{h v \mu} = \frac{Q_m}{h_m V_m \mu_m}$$

$$Q = \frac{h}{h_m} \frac{V}{V_m} \frac{\mu}{\mu_m} Q_m$$

$$Q = \left(\frac{4\,inch}{1\,inch}\right)\left(\frac{2\,\frac{ft}{s}}{0.5\,\frac{ft}{s}}\right)(1)(0.2\,lb) = 3.20\,lb$$

7832 (12)

Q.NO#4

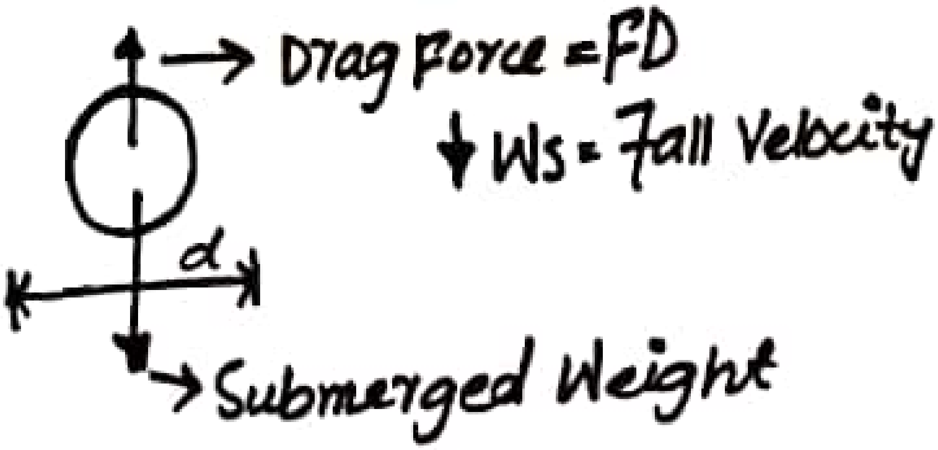
Ans:-

Back Ground:-

Setting Velocity:- The downward velocity in a flow dense fluid at equilibrium in which the sum of the gravity force, buoyancy force and fluid drag force are equal to zero.
When a given falls down in still water it obtain a constant velocity when the upward fluid drag force on the given is equal to the downward submerged weight of the grain. This is called setting velocity.

Fall velocity effected factors:-

a) Particle diameter
b) partical density
c) Particle Concentration
d) Partical Shape
e) Viscosity of water
f) Turbulance



★. The balance force b/w the drag force and the Submerged weight gives.

$$F_D = \text{Submerged weight}$$

$$\frac{1}{2}\rho C_D \frac{\pi}{4} d^2 w_s^2 = (\rho_s - \rho) g \frac{\pi d^3}{6}$$

$A = \frac{\pi d^2}{4}$. Projected area

C_D = Drag Coefficient

W_s = Fall Velocity of Sediment

$$= \sqrt{\frac{4gd}{3C_D}\left(\frac{\rho_s - \rho}{\rho}\right)}$$

ρ = Density of the water

ρ_s = Density of the Sediment Particle.

Sediment Measurements:- The measurment of Sediment transport requires that many simplifying asumtion are made. This is largley because Sediment transport is the dynamic phenomena and measurment techniques cannot register the ever changing condition that exists in water body.

Particle Size classification by the wentworth Grade Scale

Particle	Particle Size (mm)	Cohesive property
Cobble	256-64 (mm)	Non-cohesive
Gravel	64-2	
Very course Sand	2-1	Non-cohesive Sediment
Coarse Sand	1-0.5	
Medium Sand	0.5-0.25	
Fine Sand	0.125-0.063	
Silt	0.063-0.004	Cohesive Sedime
Clay	0.004-0.00024	