Name	ShohAB malook
id	7878
Section	A
Semester	6th
Subject	hydraulic engineering

Scanned with CamScanner

page 1 ① Name ShohAB malook
id 7878
Section A

QNo1

Solution

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

The relevant variables.

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

write down dimensions

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 and T)

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

choose $m(=3)$ Scalling variables:

Scanned with CamScanner

ye 2

(2) Name ShohAB malik
Id 7878
Section A

geometric d: kinematic/time dependent (V) dynamic/mass-dependent (ρ)

Form dimensionless group by non-dimensionalising The remaining variables Δp h and μ

$$\Pi = \Delta p d^a V^b \rho^c$$

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

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

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

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

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

$\Pi_2 = \frac{h}{d}$ (by inspection since h is a length)

$\Pi_3 = \mu d^a V^b \rho^c$ (probably obvious by now but here goes anyway)

$\Pi_3 = \mu^a b^b \rho^c$ (Probably obvious by now but here goes anyway)

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

Scanned with CamScanner

page 3 ③ Name ShohAB malush
id 7878
Section A

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

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

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

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

Recognition of the Reynold number Suggest that we replace Π_3 by

$$\Pi_3 = (\Pi_3)^{-3} = \frac{\rho v d}{\mu}$$

Hence dimensional analysis yields.

$$\Pi_1 = f(\Pi_2, \Pi_3)$$

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

(a) Dynamic Similarity requires that all non dimensional group be the Same in model and prototype.

$$\Pi_1 = \left(\frac{\Delta p}{\rho v^2}\right)_p = \left(\frac{\Delta p}{\rho v^2}\right)_m$$

$$\Pi_2 = \left(\frac{h}{d}\right)_a = \left(\frac{h}{d}\right)_m$$

"automatic if Similar shap geometric Similarity"

Scanned with CamScanner

page 4

(4) Name SHOUAB malook
id 7878
Section 1A

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

From the last we have a velocity ratio:

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

Hence

$$V_m = \frac{V_p}{0.5} = \frac{3.0}{0.5} = 6.0\ m s^{-1}$$

(b) The ratio of the quantities of flow is

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

$$= 0.5 \times 5^{2} = 12.5$$

(c) Finally for the pressures drop

$$\Pi_1 = \left(\frac{\Delta p}{\rho v^2}\right)_p = \left(\frac{\Delta p}{\rho v^2}\right)_m \Rightarrow$$

$$\frac{(\Delta p)_p}{(\Delta p)_m} = \frac{\rho_p}{\rho_m}\left(\frac{V_p}{V_m}\right)^2 = \frac{800}{1000} \times 0.5^2 = 0.2$$

Hence

$$\Delta p_p = 0.2 \times \Delta p_m = 0.2 \times 60$$

$$= \boxed{12.0\ kPa}$$

Scanned with CamScanner

page 5 | Q2 Name Shohab maloon
id 7878
Section A

QNo2:- Given Data

max depth water in Reservoir = 78m

Specific Gravity of Dam matrial = 2.40

Allowable Compress Stree for the σ_{all} = 787

No uplift pressure = $C_u = 0$

Height of wave = 1.40 m

$\mu = 0.7$

Solution.

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

$= \dfrac{787 \times 1000}{1000(2.40 - 0 + 1)}$

H limiting = 231.47058

231.470 > Hw = 78

it is Low gratuity Dam

2) Top with "a"

Free board = 1.5 wave

= 1.5 × 1.40

F B = 2.1

Scanned with CamScanner

page 6 | Q2

Name ShoAIB mahroh
id 7878
section A

high of Dam : $HD = Hw + FB$

$78 + 2.1$

$HD = 80.1$

$a = 14\%$ of HD

0.14×80.1

$a = 11.214$

3) Base with = b' (with out offset)

1) for no Slidiy Criteria

$b' = \frac{Hw}{\mu G} = \frac{78}{0.7 \times 2.40}$

$b' = 46.42$

for no tension Criteris

$b = \frac{Hw}{\sqrt{G}} = \frac{78}{\sqrt{2.40}}$

$b' = 50.6$

b) Depth of vertical portion on U/s Side

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

$h' = 2 \times 11.24 \sqrt{2.40 - 1}$

$h' = 34.52$

Scanned with CamScanner

page 7 ②3

Name shohAB mecloor
id 7878
Section A

(5) up strem off set

$\frac{a}{16} = \frac{11.214}{16}$

0.70m

6) Depth below the mater level to the end of inclind. portion is $D/s = 3.4a\sqrt{G}$

$3.14a\sqrt{G}$

$3.14 \times 11.214\sqrt{2.35}$

$3.14 \times 11.214 \times 1.54$

54.22m

Total width

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

$50.6 + \frac{11.214}{16}$

$b = 51.30$

$\tan \theta = \frac{b'}{H} = \frac{50.6}{78}$

$\theta = 32.97$

Scanned with CamScanner

page 8

Name ShohAB malouh
id 7878
Q4 Section A

9) Depth of vertical postion on D/s from WL on U/s Side.

$$\tan \alpha = 9/d_1 = \frac{11.214}{d_1}$$

$$\tan \alpha = \frac{11.214}{d}$$

$$d' = \frac{50.6 \times 11.214}{78}$$

$$\boxed{d_1 = 7.274}$$

Depth on vertical protion

$$d = d' + FB$$

$$d = 7.274 + 2.1$$

$$\boxed{d = 9.374}$$

Scanned with CamScanner

page 9 (3)! Name ShohAB malooh
id 7878
Section A

Q No 03: pressure in soap Bubble.

Some children are playing with soap bubbles and you become curious as to the relation between soap bubble radius and the pressure inside the soap bubble you Reason that the pressure inside the soap bubble must be greater than atmospheric pressure and that the shell of the soap bubble is under tension much be important in this problem No knowing any the physics you decide to approach the problem using dimensional analysis establish a relationship between pressure difference $\Delta P = P_{inside} - P_{outside}$ soap bubble radius R; and the surface tension σ_s of the soap film.

Solution.

The pressure difference between the inside of a soap buble and the outside air is to b analyzed by the method of repeating variable.

Assumptions:- 1 The soap bubble is neutrally buoyant in the air and gravity is not reverant. (2) No other variables or constants are important in this problem.

page 10 | Q3 Name ShohAB malooh
id 7878
Section A

Analysis:- The step by step method of repeating variable is employed

Step1:- There are three variable and constant in this in this problem $n=3$ function of the independent variable and constant.
List of relevent parameter

$$\Delta p = f(R\ \sigma_s\quad n=3$$

Step 2:- The primary dimension of each parameter are listed the dimesion of Surface tension and those of pressure are obtained from

$$\begin{matrix} \Delta P & R & \sigma_s \\ (m^1 L^{-1} t^{-2}) & (L^1) & (m^1 t^{-2}) \end{matrix}$$

~~Spt~~ Step3:- As a first guess j is set equal to 3 the number of primary dimensions represented the problem (ML and t)

(Reduction first guess)

if this value of j is correct the expected number of Π's is $k=n-J=3$ $3=0$ But how can we have zero Π's? Something is obviously not right we are no At times like the we need to first go back and mack sure that we are not neglecting some important variable or constant in the problem Since we are conifident that the pressure difference should depend only on soap bubles radius and surface tension we reduce the value of j by on.

Scanned with CamScanner

Pg 11

Name ShoHAB maloch
id 7878
Section A

QNO3 Dimensional Analysis and Similitude simple and qualitive technique applicable to many fields of Science and engineering.

Dimensional Analysis.

if certain plsical phenomenon is governed by.

$f(x_1, x_2 \cdots x_n) = 0$ where some all the variables (n) are dimensional

Then the above phenomen can be represented as

$\psi(\pi_1, \pi_2 \cdots \pi_m = 0$ where all the veriable (π) are non dimensional

The nature of f and ψ may be obtain from experment

page 12 Name ShowAB malowh
id 7878
Section A

9Nov4

particle diameter:- The diameter of a Sphere particle has Same Specific gravity and the terminal uniform Settling velocity as the given particle in the Same Sedimentation

particle density:- Particale density effect the Settling fall velocity effect the Settling fall velocity As Air density increases with decreasing altitude at ~~at~~ about 1% per 80 meter (260ft) for every 160 meter of fall the terminal Speed decreasel 1%.

Particle Concentration:-
Suspended concentration of Sedminent increases the Setting velocity of each particle decreases due to the modification of the flow induced by prevent particles

Particle Shap:-
NON-spherical andlayer partical fall up to 75% Slower Than equilant ~~Sti~~ Sphere model Show 100 um non Spherical particles travals 44% farther than Sphere vertical Structure of modelled volcanicash cloud is Sensitive to particle Shap.

Scanned with CamScanner

page 13

Name ShohAB malook
Id 7878
Section A

viscosity of water:- fluid velocity through porous media is approximated as inversely propertional to the kinematic viscosity A decrease in viscosity therefore increase the velocity of a compaid throuf porous.

Turbulance of water:- Turbulence of water effect the fall velocity of water in reservoir because the non linearity and Zig zag path effect the flow of water & cause the variation in the flow.

Scanned with CamScanner