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Question No. 1

~~Recc~~ Solution:

~~fac~~ The pressure drop Δp is expected upon the gate opening h, the overall depth d, the velocity V, density ρ & viscosity μ.

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 variables: $n = 6$

Number of independent dimensions, $m = 3$ (M, L & T)

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

Choose ($m = 3$), Scaling Variables.

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

$= \frac{[illegible]}{1000}$

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Form dimensionless groups by non-dimensionalising the remaining variables : Δp, h & μ.

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

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

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

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

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

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

$$\Rightarrow \pi_1 = \Delta p V^{-2} \rho^{-1} = \frac{\Delta p}{\rho V^2}$$

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

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

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

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

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

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

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

$$\Rightarrow \pi_3 = \mu d^{-1} V^{-1} \rho^{-1} = \frac{\mu}{\rho V d}$$

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Recognition of the Reynold's number suggests that we re-
lace π_3 by

$$\pi_3' = (\pi_3)^{-1} = \frac{\rho V d}{\mu}$$

Hence, dimensional analysis yields.

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

From the last, we have a velocity ratio.

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

$$= 0.5$$

Hence,

$$V_m = \frac{V_p}{0.5} = \frac{3.0}{0.5} = 6.0 \text{ ms}^{-1}$$

(b) 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,

$$\pi_1 = \left(\frac{\Delta p}{\rho V^2}\right)_p = \left(\frac{\Delta p}{\rho V^2}\right)_m \Rightarrow \frac{(\Delta p)_p}{(\Delta p)_m} = \frac{\rho_p}{\rho_m}\left(\frac{V_p}{V_m}\right)^2$$

$$800 \times 0.5^2 = 0.2$$

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Hence,

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

$\Delta P_p = 12.0\ kPa$

Question No. 2

Data:

Maximum depth of water in reservoir = 78 m = H

Specific gravity of Dam material = 9.3 = G

Allowable compressive strength for the Dam masonary

$\sigma_{all} = 782\ T/m^2$

Height of wave = H_w = 1.3 m

$\mu = 0.7$

No uplift pressure, so $C_u = 0$

Solution:

(1) $H_{limiting} = \dfrac{\sigma_{all}}{\gamma_w (G - C_u + 1)} = \dfrac{782 \times 1000}{1000\,(9.3 - 0 + 1)}$

$H_{limiting}$ = ~~[illegible]~~ 744.8 m > H_w = 78 m

So it flow gravity dam

② Top width "a"

Free board = 1.5 h_{wave} = 1.5 × 1.3

$$F.B = 1.95 \ m$$

height of dam = H_D = $H_W + F.B$

$= 78 + 1.95$

$$H_D = 79.95$$

a = 14% of H_D

$a = 0.14 \times 79.95$

$$a = 11.19 \ m$$

③ Base Width

(i) For no sliding criteria

$$b' = \frac{H_W}{\mu G} = \frac{78}{0.7 \times 9.3}$$

$b' = 11.98$

$$b' \cong 12 \ m$$

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(4) Depth of vertical portion on U/S side

$h' = 2a\sqrt{G - C_4}$

$= 2 \times 11.2\sqrt{9.3 - 0}$

$h' = 22.4 \times 3.05$

$h' = 68.32$ m

(5) Upstream offset

$= \frac{a}{16} = \frac{11.2}{16}$

$= 0.7$ m.

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

$= 3.14 \times 11.2\sqrt{9.3}$

$= 35.16 \times 3.05$

$= 107.23$ m

(7) Total width of the base of dam

$b = b' + \frac{a}{16} = 12 + \frac{11.2}{16}$

$b = 12.7$ m

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(8) $\tan \theta = \frac{b}{H} = \frac{12}{78}$

$\tan \theta = 0.15$

$\theta = \tan^{-1}(0.15)$

$= 0.15$

(a) Depth of vertical portion on D/S

$\tan \theta = \frac{a}{d} = \frac{11.2}{d'} \Rightarrow \tan \theta = \frac{11.2}{d'}$

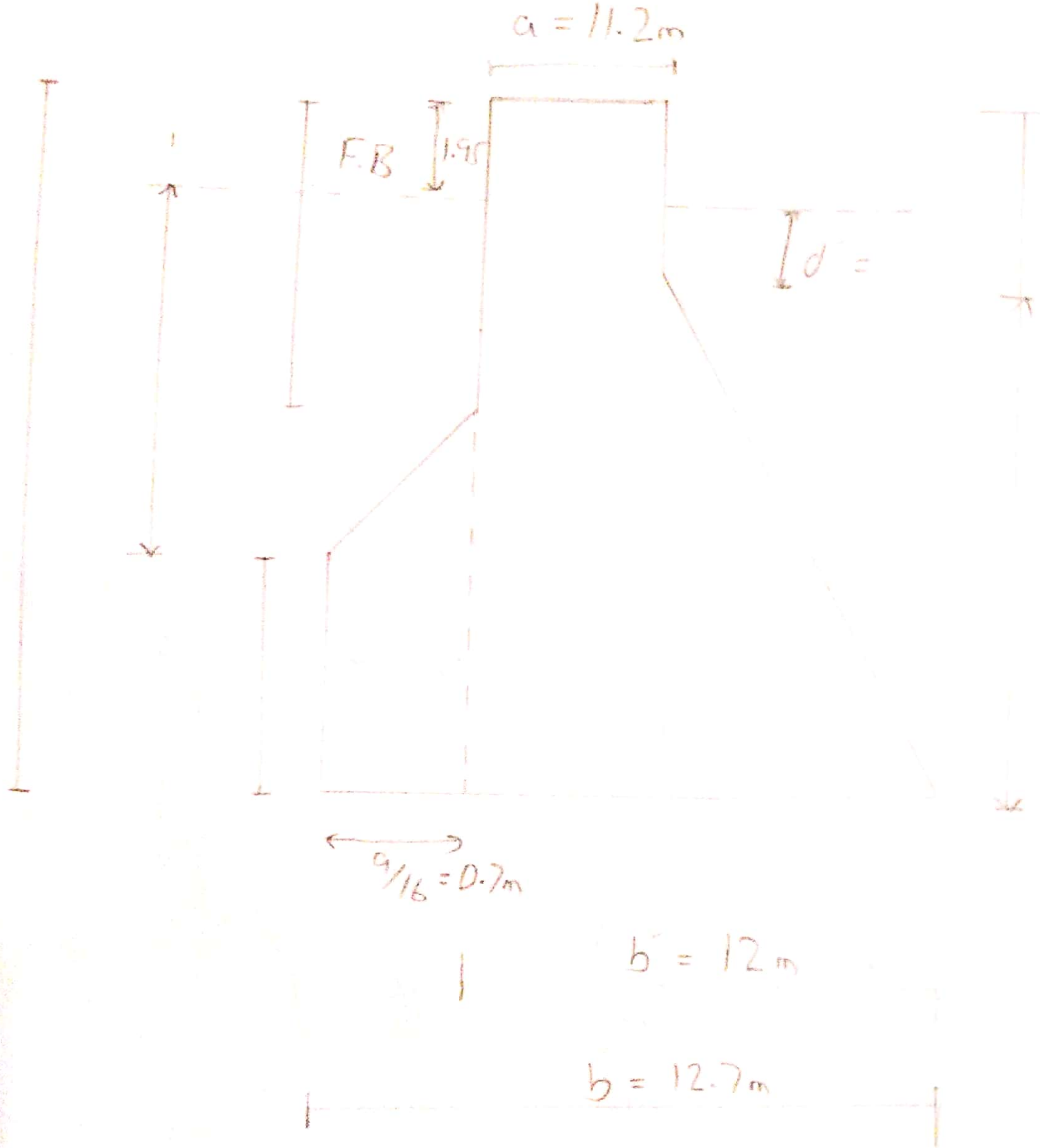
$0.15\, d' = 11.2$

$d' = \frac{11.2}{0.15}$

$d' = 74.6\,m$

P.T.O

Qu A



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Question No.3

Answer:

Dimension analysis is a mathematical technique by using making use of study of dimension.

→ Purpose of dimension analysis:

- To obtain scaling laws so that prototype performance can be predicted from model performance.
- To predict in the relationship between parameter.

→ Fundamental dimension:

These are the basic quantities.

For example.

Time T, Distance L, Mass M

Secondary Dimension:

Those quantity which possess more then one fundamental dimension.

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Question No. 4

Answer.

Particle diameter.

The diameter of a Sphere particle has Some Specific gravity and the terminal uniform velocity as the given particle in Same Seding rotation

Particle Density:

Particle density effect the settling fall velocity. As the air density increases with decreasing altitude at about 1% per 80 meter (260 ft) for every 160 meter of fall the terminal Speed decrease by 1%.

Particle Concentration:

When the Suspended ~~Contration~~ concentration of Sediment increases, the Settling velocity of each particle decreases due to the modification of the flow induced by previous particles.

Particle Shape:

Non-Spherical analogue particle fall upto

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75% slower than equivalent sphere model show 100 non spherical particles travels 44% faster than sphere vertical structure of modelled volcanic ash cloud is sensitive to particle shape.

Viscosity of Water:

Fluid velocity throughout porous med is approximated as inversely proportional to the kinematic viscosity. A decrease in viscosity therefore increase the velocity of a compound through a porous media.

Turbulance Of water:

Turbulance of water effect the fall velocity Of water in reservoir because the non-linearity & zig-zag path effect the flow Of water & cause the variation in the flow.