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Section # B.

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Subject # Hydroulic Eng.

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Question No 01

A prototyle gate value which will controle the flow in pipe system conveying parraffine is to studied in a model.

list the significand drop variable on which......

⇒ Solution :->

The pressure drop ΔP is expected to depend upon the gate opening h, the overall depth d, the velocity v. density "ρ" and viscousity μ.

List the relevent variables.

$\Delta P, h, d, v, \mu$.

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 independal dimension:

$m = 3$ (M.L and T)

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

Choose m $(=3)$ Scaling variables.

Geometric (d) : Kimematic/time - dependand (V)

dynamic/mass - dependent (ρ).

Form dimensionless group by non-dimensional -ising the remaining variable ΔP. h μ ll.

$$\Pi_1 = \Delta P d^a V^b \rho^c$$

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\Rightarrow \Pi_1 = \mu d^{-1} V^{-1} \rho^{-1} = \frac{\mu}{\rho V d}$$

Recognition of the Reynolds number suggest that we replace Π_3 by

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

Hence dimensional analysis yield:

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

from the last, we have a velocity ratio.

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

$$\Rightarrow 0.5$$

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 flows.

$$\frac{Q_p}{Q_m} = \frac{(\text{velocity} \times \text{area})_p}{(\text{velocity} \times \text{area})_m}$$

$$= \frac{v_p}{v_m}\left(\frac{d_p}{d_m}\right)^2 = 0.5 \times 5^2$$

$$= 12.5$$

c) Finally for the pressur 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

$$\Delta P_p = 0.2 \times 60 = 12.0 \text{ kPa.}$$

Q No.2 Given

(a) Max ~~length~~ depth = 78 m

Spacific Gravity = 2.4

f_{av} = 784 T/m^2

Hight of wave = 1.2 m.

Solution :->

1) $H_{limiting} = \frac{f_{av}}{\gamma_w (G - w + 1)}$

$= \frac{784 \times 1000}{1000 (24 - 0 + 1)}$

$H_{limiting} = 230.58$

2) Top width. "a"

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

$= 1.5 \times 1.2$

$= 1.8$

Hieght of Dam = Hw + F.B

= 78 + 1.8

HD = 79.8

a = 14% of HD

= 0.14 × 79.8

= 11.172 m

3) Base width :->

$$b' = \frac{Hw}{\mu G} = \frac{78}{0.7 \times 2.4}$$

= 46.42 m

= 47

4) For no tension criteria :->

$$b' = \frac{Hw}{\sqrt{G}} = \frac{78}{\sqrt{2.4}}$$

⇒ 50.34

→ Depth of vertical portion on u/s side

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

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

$= 34.60$

$= 35\,m$

→ 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.

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

$= 51.03$

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

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

$$= 44.80°$$

Depth of vertical portion on D/s (from WL on U/s sid).

$$\tan Q = \frac{a}{d'} = \frac{11.172}{d'}$$

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

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

$$d' = 17.30\text{ m}$$

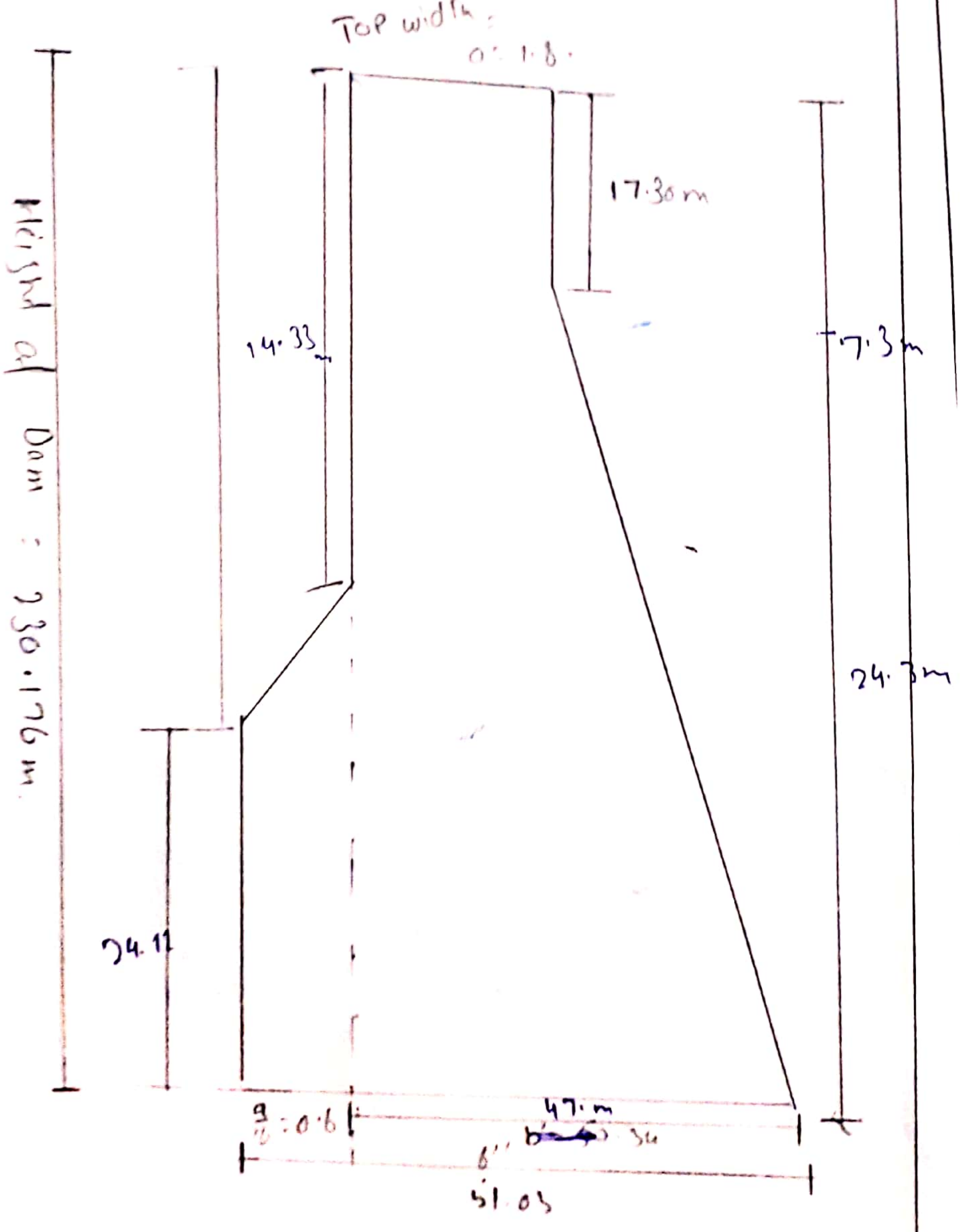
Depth of vertical portion:

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

$$= 17.30 + 1.8$$

$$= 19.1$$

Diagram.



Top width = 0: 1.8.
17.30 m
14.33 m
7.3 m
Height of Dam = 230.176 m.
24.3 m
24.11
47. m
51.03

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Q. Dimensional analysis of Power.

Sol
(i) head (H)
(ii) discharge (Q)
(iii) sp weight (w).

OR $P = f[H, Q, w]$.

$\Rightarrow P = K H^a \cdot Q^b \cdot w^c \rightarrow (1)$.

where K. = const.

a, b, c arbitary power.

Now:

L.H.S.
i.e Power = $[ML^2T^{-3}]$

dimension on RHS

i.e $H = [L]$
$Q = [L^3T^{-1}]$
$w = [ML^{-2}T^{-2}]$.

Putting eq.

~~$[ML^2T^{-3}] = K[L]^a [L^3T^{-1}]$~~

$$[ML^2T^{-3}] = K[L]^a [L^3T^{-1}]^b [ML^{-2}T^{-2}]^c.$$

power of M: $1 = c$ $\because c = 1.$

power of L : $2 = a + 3b - 2c$

Power of T: $3 = -b - 2c$

$\Rightarrow b = 1$ F

Thus putting values of b & c in power of L we get. $a = 1$

Thus. $a = b = c = 1$

$(1) \Rightarrow P = KHQ\omega$

Q NO: 04

what will be the effect of Sediments particles daimeter, particles density, particle concentration, particle shap, viscousity of water, turbulence of water flowing in reservior on fall velocity? explain in details.

Fall velocity :>

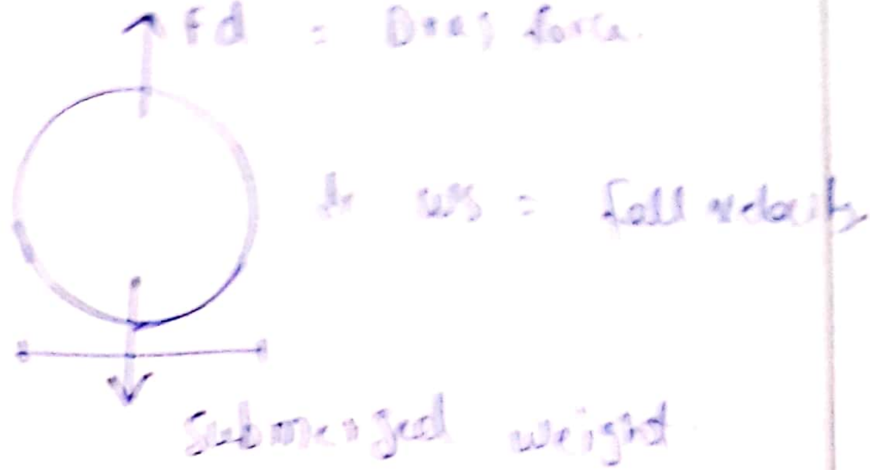
When a grain falls down in still water it obtains a constant velocity when the upword fluid drag force on the grain is equal to the downword submerged weight of the grain. This constant velocity is defined as the fall velocity of the grain
this is also called setling velocity

Fall velocity depends on.

1) Particle diameter.
2) particle density
3) Particle concentration
4) particle shap.

5) Viscousity shape of water (temperature)

6) Turbulence.



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

FD = Submerged weight.

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

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

C_D = Drag coefficient

w_s = Fall velocity of sediment

ρ = Density of water.

ρ_s = Density of sediment particle.

⇒ Particle diameter :->

The diameter of the Particle is directly proportional to the fall velocity b/c of greater the size of particle so it will tends to move op faster as compared to the particles of small size Thus There will be more gravitational force on particle of greater six so it will be more gravitional force on particle of greater size so it will fall quickly due to its weight.

Particle Density :->

Density of particle is directly proportional to the rate of fall velocity since particle with ~~velocity~~ density tends to settle down early ~~compound~~ compared with particle of low density.

⇒ Particle Concentration:→

Concentration of Particle size will considerably effect its fall velocity as The section having greater concentration will be sittled down at The place Thus causing more fall velocity comparing with section of low concentration

Particle shape:

Particles having regular shape tends to be effected more Than irregular shape since regular shape particles have even surfaces which offer very little or no friction. Which while particles with irregular shape offer more friction as The particles with smaller surface area are more likely to be effected due to Their resistance.

⇒ Viscosity of water:→

from the experimental studies we can see that parameters such as temperature and pressure changes section of water having more ~~temperation~~ temprature and pressure will fall objectively more due to increase in the kinetic energy so fall velocity will be more

⇒ turbulance of water:→

turbulance of water depends upon the different factor such as velocity it will effect the fall velocity b/c of it zigzage motion. thus the velocity ~~of it~~ varies at every point which is why it effect the fall velocity moreover increase in the kinetic energy tends to effect the fall velocity compared with steady fluid.