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Semster : 6th

Section: "B"

Subject : Hydraulics Engineering.

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QNO2:.

A protable gate value which will controle the flow in pipe System conveying parraffine is to studied in a model.
list the significant drop varabile on which - - - - - -

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.

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	$ML^{-1}T^{-1}$

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7869 2)

Number of Variable $n = 6$

Number of independental dimension.

$m = 3$ (M L and T)

Number of non-dimensional group:

$n - m = 3$.

choose m (=3) Scaling variables

Geometric (d): kinematic / time-dependent (v)

dynamic / mass-dependent (p).

Foram dimension less group by non-dimensional using the remaining varaible op. n & u.

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

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

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

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

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

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

7864 3)

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

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

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

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

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

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

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

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

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

Recognition of the R Reynolds numbers suggest that we replace Π_3 by

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

Hence dimensional analysis yield.

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

from the last. we have a velocity ratio

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

$$\Rightarrow 0.5$$

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

b) the ratio of the quantities of flows.

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

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

c) Finally for the pressure drop.

$\Pi_1 = \frac{\Delta P}{\rho v^2}$

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

$= \frac{\rho_p}{\rho_m}\left(\frac{v_p}{v_m}\right)^2 = \frac{800}{1000} \times 0.5^2 = 0.2$

Hence

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

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QNo 2:

Given data

Max length depth = 78m

specific gravity = 2.4

f_{av} = 786 T/m²

High of wave = 1.2m

Solution:

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

$$= \frac{786 \times 1000}{1000 (2.4 - 0 + 1)}$$

H limiting = 231.17

2) Top width "a"

Free board = 1.5 × h a wave
= 1.5 × 1.2
= 1.8

7869 7)

Hieght of dam = HW + F.B

$= 78 + 1.8$

$H.D = 79.8$

$a = 14\%$ of HD

$= 0.14 \times 79.8$

$= 11.172m$

3) Base width:.

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

$= 46.42m$

$= 47$

4) For no tension criteria:.

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

$\Rightarrow 50.34$

7869 (a) 8)

Depth of vertical partion on u/s side.

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

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

$= 34.60$

$= 35m$

upstream offset.

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

$= 0.6$

Depth of below the water level to the end of inclined portion

$U/S = 3.14\, a\sqrt{G}$

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

$= 54.33$

Total width of the base of the dam.

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

$= 51.03$

7869 (a)
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$\tan\theta = \frac{b'}{H} = \frac{50.34}{78}$

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

$= 44.80°$

Depth of vertical portion on D/S (from WL on U/S side)

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

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

$d' = 17.30m$

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

Depth of vertical portion:.

$d = d' + F.B$

$= 17.30 + 1.8$

$= 19.1$

7869

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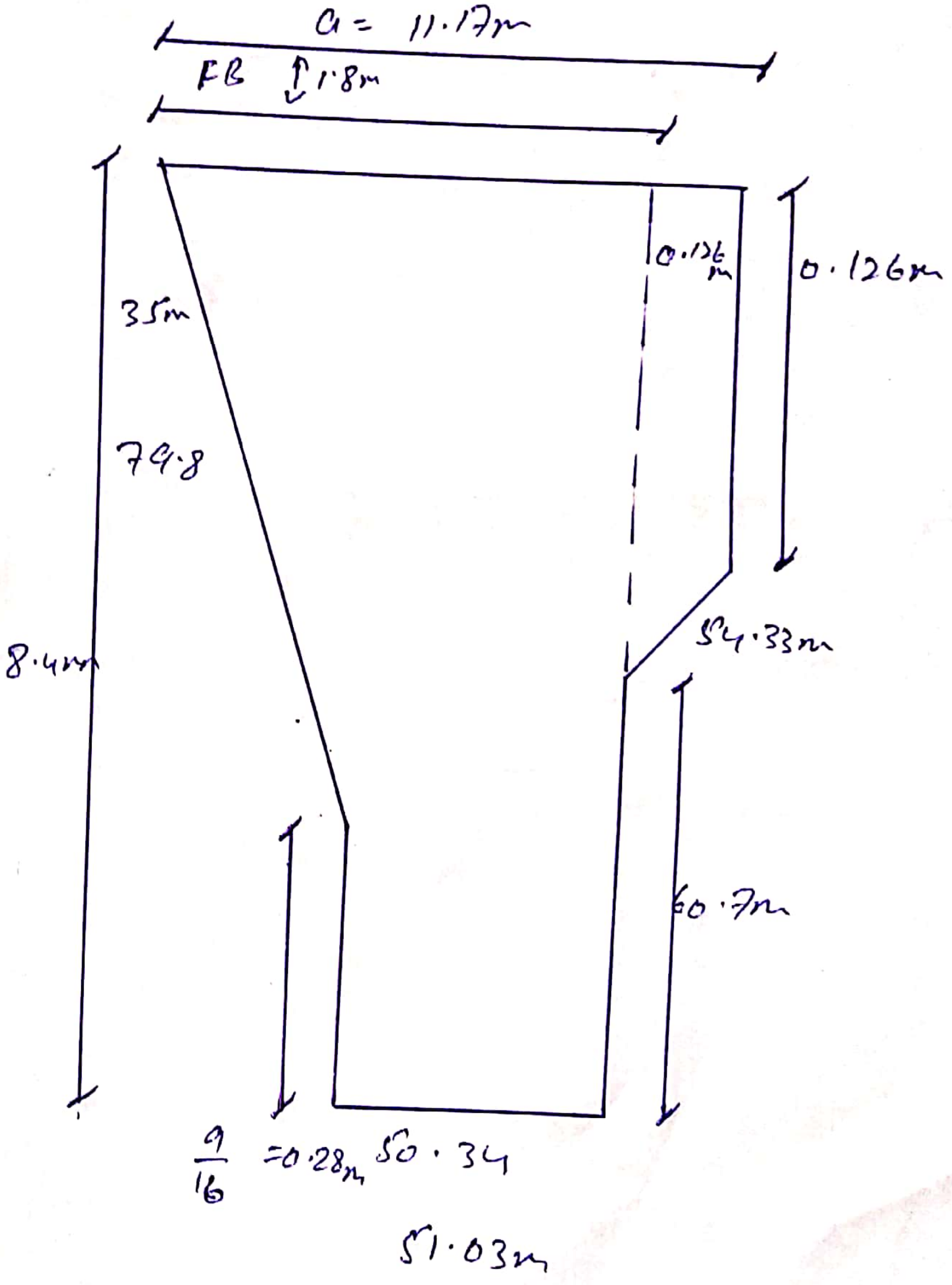

a = 11.17m
FB 1.8m
0.126 m
0.126m
35m
79.8
8.4m
54.33m
60.7m
9/16 = 0.28m
50.34
51.03m

QNo 3: model analysis and similitude. 7869 11)

Answer:

Concept of Dimensional analysis and Similitude

Back Ground:

Although many practical engineering problem involusing hydroulic enginoering can be Solved equation and analytical procedure but yet a large numbers of problems rely on experimental data for their Solution.

Similitude is used to express measurement labaratly can be used to describe the behaviour of other system outside of laboratory.

7864 12)

Dimensional Analysis.

Dimensional analysis is a mathematical technique making woc of study of dimensions.

It deal with dimension of physial Quantities involved in the phenomena.

It is helpful in experimental work b/c it provide a guide to those things that significantly influence the phenomena

this mathematical technique is used in research work for design and for conducting model test.

Types of Dimensions.

Fundamental Dimension (fundamental Quantities)

Secondary Dimension (derived Quantities)

e.g velocity = L/T

power has units of forces times velocity.

the dimension are thus

$\{P\} = \{\text{force velocity}\} = (MLT^{-2})(LT^{-1})$

$= ML^2T^{-3}$

this unit is called a watt - i.e Nm/s.

QNo4:. What will be the effect of sediment particle diameter. particles density particle concentration - — - in detail.

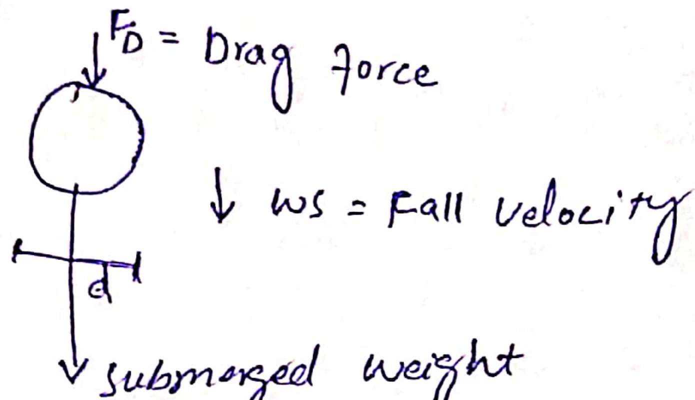
[redacted]

Fall velocity:: When a grain falls down in still water it obtains a constant velocity when the upwards fluid drag force on the grain is equal to the downwards submerged weight of the grain.

this constant velocity is defined as the fall velocity of the grain this is also called settling velocity.

Fall velocity depends on::

1) particle diameter.
2) particle density.
3) partical concentraction.
4) particle shape
5) viscosity of water (Temperature)
6) Turbulence.



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

FD = submerged weight of weight

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

$$A = \frac{\pi d^2}{4} = \text{projected Area.}$$

CD = Drag Coefficient

ws = Fall velocity of sediment $= \sqrt{\frac{4gd}{3C_D} \left(\frac{\rho_s - \rho}{\rho}\right)}$

ρ = Density of water

ρ_s = Density of sediment particles.

Particle diameter:

the diameter of the particle is directly of proportional to the fall velocity because of greater the size of particles So it will tends to more faster as compared to the particles of small size thus there will be more gravitational force on particles of greater size so it will fall quickely due to its weight.

Particle Density:- Density of particles is directly proportional to the rate of fall velocity since particles with density tends to settle down early compared with particles of low density.

Particle concentration.
concentration of particles size will considerably effect its fall velocity as the section having greater concentration will be sittled down at the place thus

causing more fald velocity comparing with section of low concentration.

Particle Shape.

particle having regular shapes tends to the be effected more than irregular shape since regular shapes particles have even surfaces which offer very little or no frication which while particles with irregular shape offer more frictions, as the resistanance.

Viscosity of water: from the experimental study we can see that parameters such as temperatures and pressures changes section of water having more temperature.

7869 18)

Turbulence of water.

Turbulence of water depends upon the different factor such as velocity It will effect the fall velocity because of it zigzag motion thus the velocity various at every point which is why it effected the fall velocity more over increase in the kinetic energy tends to effect the fluid.

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