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Question # 1 (a)

Define Reservoir also explain which type of Reservoir will be more economical and why?

Answer;

Reservoir is a French word which means a 'tank'.

The word Reservoir refers to a place where large amount of water get stored.

A Reservoir is a man made lake or large fresh water body of water.

Many people think of Reservoir as a lake and might even use the

Word interchangeably. However the main difference is that Reservoirs are artificial and made by humans, while lakes are naturally occurring bodies of water. Reservoirs are great because they provide a supply of water for naturally occurring bodies of water, like lakes or rivers.

Types of Reservoirs.

- (1) Valley dammed Reservoir.
- (2) Bank side Reservoir
- (3) Service Reservoir.

In these types of reservoirs, Service reservoirs are more economical, the reasons are given below.

(1) Service reservoirs perform several functions including ensuring sufficient head of water in the distribution system of water.

(2) Service reservoirs provide water capacity to even out of peak demand from consumers.

(3) Service reservoirs also reduce the cost of pumping because service reservoirs constructed at high location/elevation.

Question # 1 (b)

Which type of embankment dam you will suggest in a hilly area and why?

Answer ;

An embankment dam is a large artificial dam. It is typically created by placement and compaction of a complex semi-plastic mound of various composition of soil, sand, clay or rocks.

I will suggest Rockfill embankment dam because they are economical in hilly areas.

Reasons;

Rockfill dam are appropriate for construction at location where suitable rock can be quarried at or near the dam site, and where the foundation will not be subjected to material settlement due to loading or to erosion from any seepage through or under the dam.

One of the most important aspects of a rockfill dam is that, it can be very cheap and economical since material can be sourced from near the dam location.

This type of dam can also

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be suitable in areas that don't present the best condition for deep foundation.

The section of compacted granular soil helps to slow the flow of water while the impervious zone provides strength and stability during heavy rainfall and flood.

Another key benefit is that it can withstand to cold conditions, hot and humid climate, as well.

Question # 2

List down different types of spillways also mention which type of spillway will be more efficient in a condition where freezing point of water is less than -10 degree centigrade in winter and why?

Answer ;

Types of spillways ;

i) Straight drop spillway

ii) Ogee spillway

iii) Shaft spillway

iv) Chute spillway

v) Side channel spillway

vi) Siphon spillway

viii) Labyrinth Spillway.

In a condition where freezing point of water is less than -10 degree centegrade in winters the most

efficient spillway is chute spillway.

Because chute spillway disposed water from upstream to downstream through steeply sloped open channel so that the flow will be very fast. The flowing water pressure will be high and will be in supercritical condition that will dissipate energy from the falling water, energy dissipates are also provided in this type of spillway. Thus the temperature

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of water go high and it will not allow water to freeze and stop so the water will move freely in this cold area.

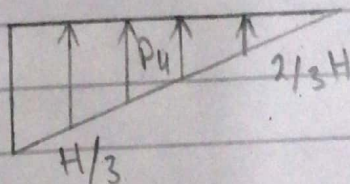
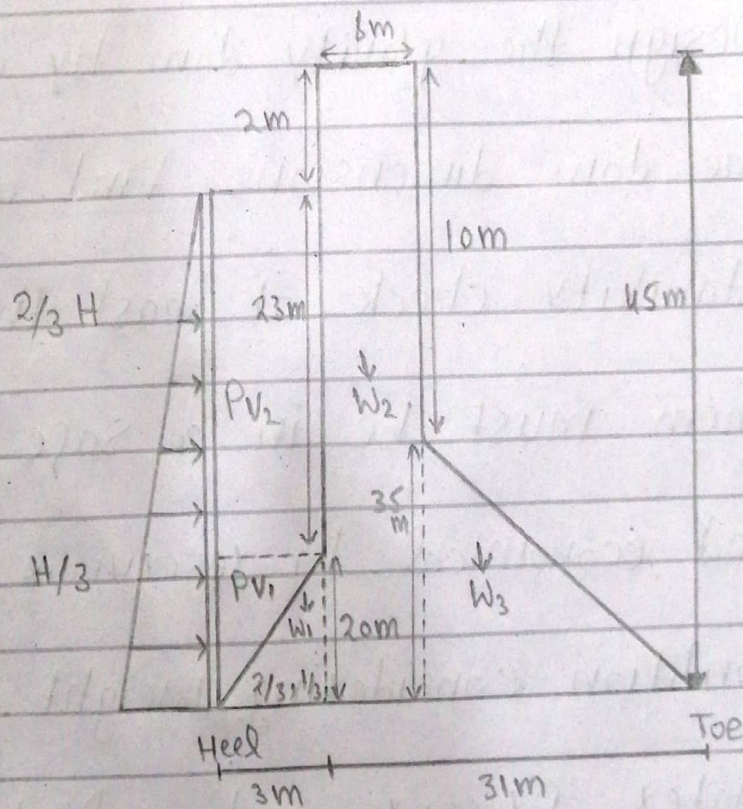
Question # 3

Design the gravity dam by assuming the dam dimensions, find all the stability check at least three of them must be in a safe condition and economical. In reservoir full condition considering weight of dam, water pressure and uplift pressure.

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Graph dam ;

For the graph, Dam as shown in figure, We will check the stability in reservoir condition considering weight of dam, water pressure & weight pressure.



Moment calculation, Assume $\gamma_d = 24 \text{ kN/m}^3$
 $\gamma_w = 10 \text{ kN/m}^3$

Forces	Forces Calculation	FV (KN)	FH	Level axm (L.A)	M _x	M _o
W ₁	$\frac{1}{2} \times 3 \times 20 \times 24$	720		$31 + 3 \times \frac{1}{3}$ = 32	23040	
W ₂	$6 \times 4.5 \times 24$	6480		$25 + 6 \times \frac{1}{2}$ = 28	181440	
W ₃	$\frac{1}{2} \times 25 \times 35 \times 24$	10500		$31 + 2 \times \frac{1}{3}$ = 31	220500	
PV ₁	$\frac{1}{2} \times 3 \times 20 \times 10$	300		$31 + 3 \times \frac{2}{3}$ = 33	9900	
PV ₂	$3 \times 23 \times 10$	690		$31 + 3 \times \frac{1}{2}$ = 32.5	22425	157080
P _u	$-\frac{1}{2} \times 3 \times 10 \times 10$	-7140		$33 \times \frac{2}{3}$ = 22		157080 151000 58000 58000
P _H	$-\frac{4 \times 3}{2} \times 10$		-9245	$43 \times \frac{1}{3}$ = 14.33		157080 58000 58000
		ΣF_V 11550	ΣF_H -9245		ΣM_x 457305	ΣM_o 289560

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Essentiality;

$$\text{Given as; } e = B/2 - \bar{x} \rightarrow (A)$$

$$\bar{x} = \frac{\sum Mx - \sum M_0}{\sum Fy} = \frac{457305 - 289560.85}{11550}$$

$$\bar{x} = \underline{14.52}$$

Putting values in (A)

$$e = 34/2 - 14.52 = 17 - 14.52$$

$$e = \underline{2.48}$$

(1) Factor of Safety for Tension;

$$e = L B/6$$

$$2.48 < 34/6$$

$$\underline{2.48} < 5.67 \text{ — OK}$$

(2) Stress;

$$y_{\text{heel}} > 0$$

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$$y = \sum Fv/B (1 \pm be/B)$$

$$y_{Toe} = \sum Fv/B (1 \pm be/B)$$

$$= \frac{11550}{34} \left(1 + \frac{6(2.48)}{34} \right)$$

$$= (339.71) (1 + 0.48)$$

$$= (339.71) (1.48)$$

$$y_{Toe} = \underline{502.778}$$

$$y_{heel} = \sum Fv/B (1 - be/B)$$

$$= \frac{11550}{34} \left(1 - \frac{6(2.48)}{34} \right)$$

$$= 339.71 (1 - 0.44)$$

$$y_{heel} = \underline{190.24} > 0 \quad \text{OK}$$

(3) Factor of Safety Against
"Overturning".

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Given as; $\frac{\sum M_y}{\sum M_o} > 2$

($\sum M_y > \sum M_o$)

$$\frac{457305}{289560.85} > 2$$

1.58 > 2

457305 > 289560.85

(4) Factors Against Sliding

$$\frac{\sum FV + Bq}{\sum FH} > 1$$

$$\frac{(0.7)(11550) + (34)(1400)}{9245} > 1$$

$$\frac{8085 + 47600}{9245} > 1$$

6.02 > 1 - OK

"Thus our design is safe".