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Q No 1:

Part (1); Ans:-

Reservoir:- A reservoir is a man-made lake or large freshwater body of water. Many People Think of a reservoir as a lake and might even use the words interchangeably. However, the key difference is that reservoirs are artifical and made by humans, while lakes are naturally occuring bodies of water. Reservoirs are great because they Provide a supply of water for when naturally occuring bodies of water, like lakes or rivers. run dry.

Economical Reservoir:- Service Reservoir are most economical reservoir. Because service reservoir are entirely man made. They are usually stored in concrete basins above or below ground. You might be familiar with the large water towers in the country side.

in some areas, people dig cisterns, or service reservoirs that are underground. cisterns must be in a place of higher elevation to allow the water to flow where it needs to go, whereas water towers are already at a higher location than the surrounding land.

Q 1 :- Part (2)

Ans: Rock fill Embankment dam is suitable for hilly area.

In this type of embankment dam which uses various sizes of materials to Provide stability. It also has impervious membrane on upstream face to Provide water tightness impervious membrane is usually made of concrete. Rock fill dam is Preferred when Plenty of rocks are available from nearby quarry.

Rock fill dams require foundation which will result in a minimum settlement. The foundation should be free from all foregin materials like silt, clay, saud e.t.c. The upstream and downstream slopes of a rock fill dams depend on The type of Impervious membrane and its location. They are cheaper Than concrete dam and can be built rapidly because Proper rock materials are available in hilly area.

Q No 2:-

Types of Spillways:

1. Straight Drop Spillway.
2. Ogee Spillway.
3. Shaft Spillway.
4. Chute Spillway.
5. Side channel Spillway.
6. Siphon Spillway.
7. Labyrinth Spillway.

① Straight Drop Spillway:-

A straight Drop spillway consists of low height weir wall having its downstream face roughly or perfectly vertical. when the water level in the reservoir rises above the normal pod level, the surplus water falls freely from the crest of the weir and hence it is know as straight drop spillway or free overfall spillway.

② ogee - shaped Spillway:-

An ogee shaped spill way is the most commonly used spillway. It is widely used with gravity dams, arch dams & buttress dams. several earth & Rock fill dams also Provided with this type of spillway as a super structure. An ogee shaped spillway has a control weir of ogee shaped, which is like the elongated English letter "S". The upper part of the spillway surface matches closely to the profile of the lower nappe of a ventilated sheet of water falling freely from a sharp crested weir.

③ Shaft Spillway :-

A shaft spill way consists of a horizontal crest & vertical shaft, with its top surface at the crest level of the spillway and its lower end connected to a vertical shaft. The other end of the vertical shaft is connected to a horizontal conduit or tunnel which extends through or around the dam and carries the water to the river downstream.

④ Chute Spillway :-

Chute spillway is a type of spillway in which surplus water from upstream is disposed to the downstream through a steeply sloped open channel. It is generally constructed at one end the dam or separately away from the dam in a natural saddle in a bank of the river.

⑤ Side channel spillway:-

Side channel spillway is similar to chute spillway but the only difference is the crest of side channel spillway is located on one of its side whereas crest of chute spillway is located b/w the side walls. In other words, the water spillway from the crest is turned to 90 degress and flows parallel to the crest of side channel spillway unlike in chute spillway.

⑥ Siphon Spillway:-

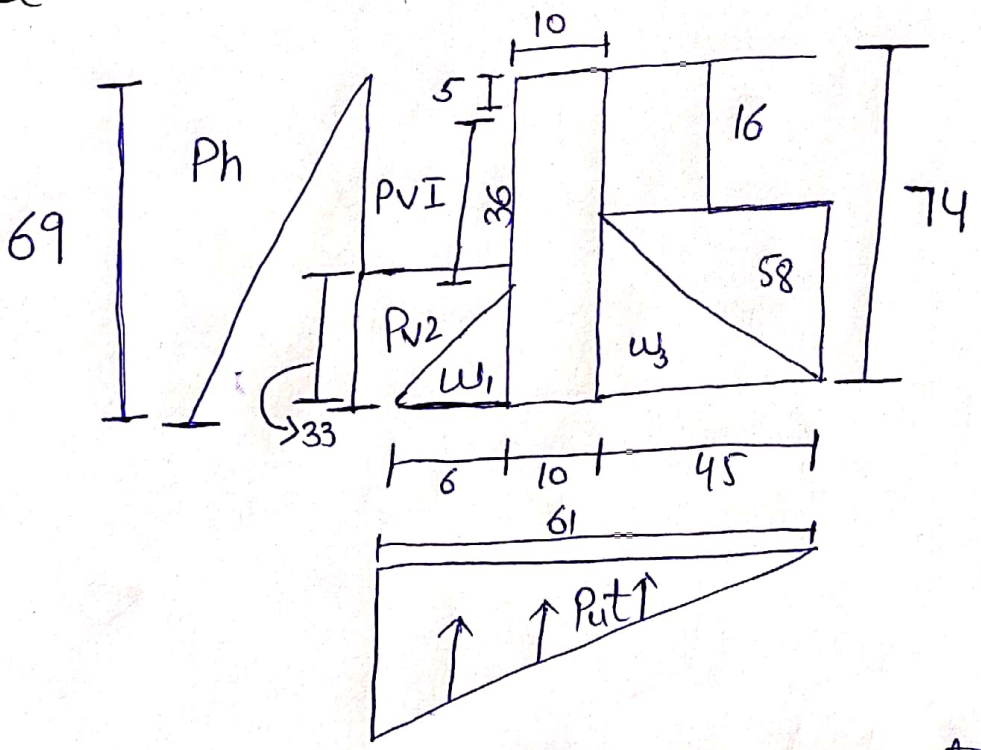
A siphon spillway is a type of spillway in which surplus water is disposed to downstream through an inverted U shaped conduit. It is generally arranged inside the body or over the crest of the dam. whenever the level raises above normal pool level, water enters into the conduit and is discharged to the downstream of the channel by siphonic action.

7. Labyrinth Spillway:-

A labyrinth spillway is a type of spillway in which the weir wall is constructed in a zigzag manner in order to increase the effective length of the weir crest with respect to the channel width. This increase in effective length raises the discharge capacity of the weir and hence higher water flow at small heads can be conveyed to the downstream easily.

x ——— x ——— x ——— x

Q No 3:



Assume unit weight for concrete = 24 KN/m³

Assume unit weight for water = 10 KN/m³

Forced and moment calculation

Forces	Force Formula	Fv	Fx	Lever Arm	Mr	Mo
W_1	$(1/2)\times L\times w\times \gamma_d$	2376	0	57.00	135432.0	0
W_2	$L\times w\times \gamma_d$	17760	0	50.00	888000.0	0
W_3	$(1/2)\times L\times w\times \gamma_d$	31320	0	30.00	939600.0	0
Pv_1	$(1/2)\times L\times w\times \gamma_d$	990	0	59.00	58410	0
Pv_2	$L\times w\times \gamma_w$	2160	0	58.00	58410	0
Px	$(-(1/2)\times L\times w\times \gamma_w)$	-21045	0	40.67	0	853850
Ph	$(-(1/2)\times L\times w\times \gamma_w$	0	-23805	23.00	0	547515
		Σ 33561	-23805		Σ 2146722.0	1403345

→ For Factor of Safety Against Tension Condition.

$e < B/6$

$B/6 = 10.17\,m$

eccentricity of the Resultant Force.

$e = (B/2) - \bar{x}$

$\bar{n}$ = Location of Resultant Force From Toe.

$\bar{x} = (\Sigma Mr - \Sigma Mo)/\Sigma Fv$

$\bar{x} = 22.15$

So $e = 8.35m$

Condition → Safe in Tension (OK)

→ For Factor of Safety Against Stress.

Condition → $\gamma_{heel} > 0$

$\gamma_{Toe} = (\Sigma Fv/B)(1 \pm (6e/B))$

$\gamma_{Toe} = 1002.0484\ KN/m^3$

$\gamma_{heel} = (\Sigma Fv/B)(1-(6e/B))$

$\gamma_{heel} = 98.31\ KN/m^3$

→ Condition → Safe in stress (OK).

→ For Factor of Safety Against Overtaking.

Condition → $(\Sigma Mr/\Sigma Mo) > 2$

$= (\Sigma Mr/\Sigma Mo) = 1.53$

Condition → Not safe in overturning (Not OK)

$(\Sigma Mr > \Sigma Mo)$

$\Sigma Mr = 2146722.0$

$\Sigma Mo = 1403345$

Condition → Safe (OK)

→ For Factor of Safety Against sliding

Condition = $((\mu \Sigma Fv + BqV)/\Sigma FH) > 1$

$q = 1400$

$\mu = 0.87$ (0.65 to 0.75)

$((\mu \Sigma Fv + BqV)/\Sigma FH) = 4.57$

Condition → Safe in sliding (OK)

END-Paper