HYDRAULIC STRUCTURE

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Section : A

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QNo1 => Answer: (Part A)

Reservioue:

A reservioue is a man-made lake or large freshwater body of water. Many people think of a reservioue 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 occurring bodies of water. Reservoirs are great because they provide water in case when naturally occurring bodies of water i.e lakes, rivers etc get dry.

=> There are mainly three types of reserviours;

- Valley Dammed reservioue
- Bank-Side reservioue
- Service Reservioue

In the above three reserviours "service reservioue" is most economic reservioue.

As the service reservioux are time efficient to construct compared to the other reservioux, which will be economical in term of labour cost, machinery rent and other required stuff.

Furthermore it will required less material then the other two reservioux. Additionaly it can be built on small area which can further reduced the cost.

Q No 1 ⇒ Answer:

Part (b):

The are basically two types of Embankment,

- Earth-fill Embankment
- Rock-fill Embankment

The Embankment which we suggested in hilly areas is "Rock-fill Embankment" because it is one which contains about 50% or more rock-fill materials of the total volume of materials, thus can be easily provided in hilly areas and are economical.

Similarly it is constructed on hard rock type foundation which can be easily provided in hilly areas as well as rock form best foundation material which are free form faults, seams of soft shale or clay etc.

Additionally shoulders of rock fill also provided structural Stability.

Q No 2:

Types of Spillways:

There are different types of spillways which are as following;

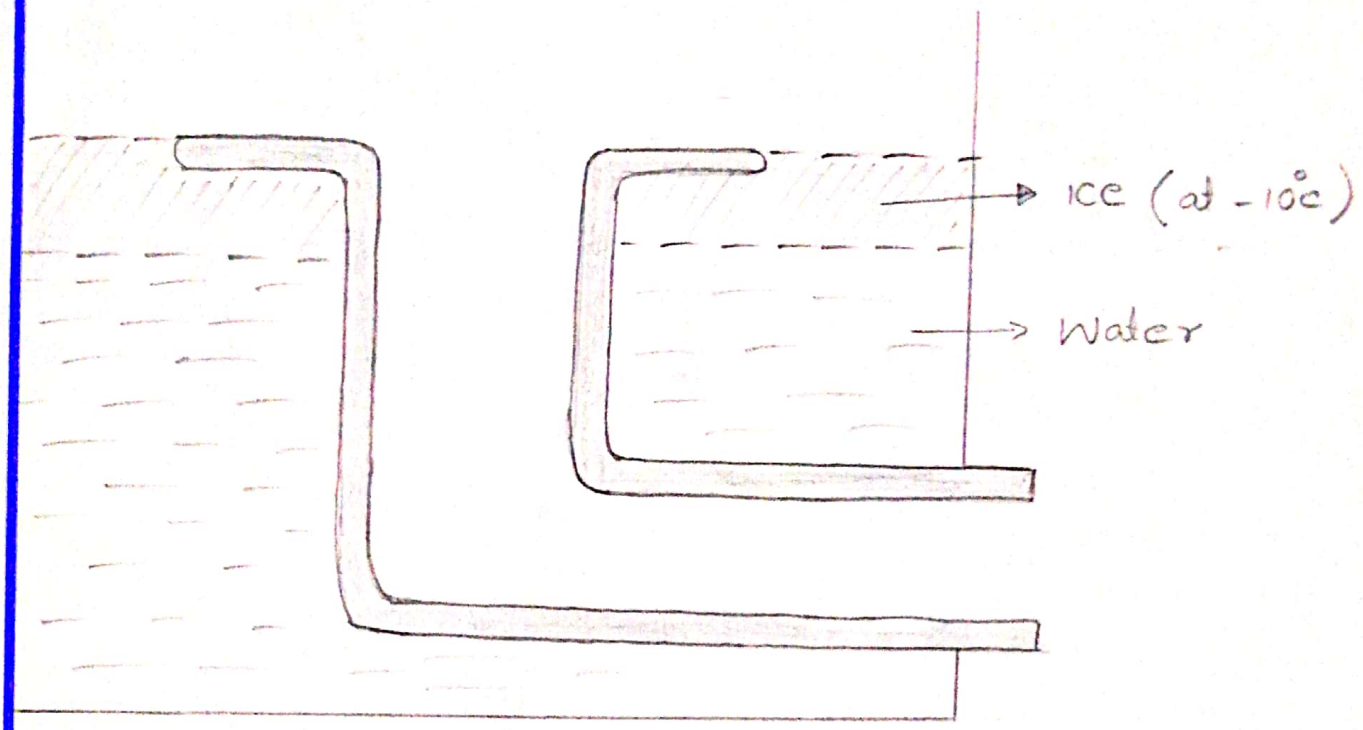
- Straight Drop Spillway
- Ogee Spillway
- Shaft Spillway
- Chute Spillway
- Side Channel Spillway
- Siphon Sipillway
- Labyrinth Spillway

⇒ Shaft spillway is the best approch then the conventional approach for water disharge from the reservoir towards down stream in case of overflow situation i.e. Flood situation. Normally when temprature reaches to -10°c the top layer of water

is converted into ice which makes hurdles for the water discharge. As it causes the blockage of conventional gates and spillways.

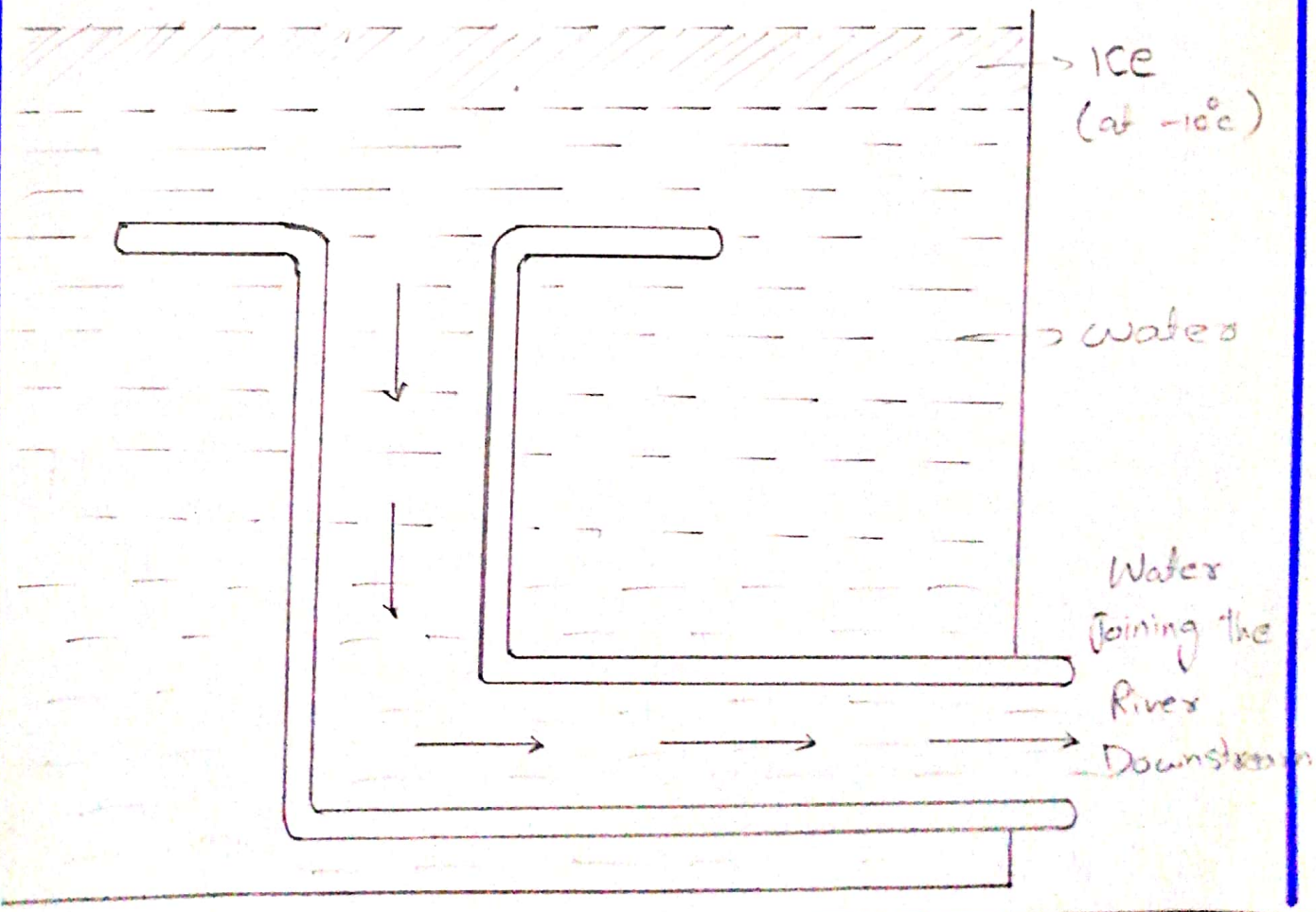
In above condition as they Whereas; the shaft spillways are advantageous in the above condition as they are constructed in such away that no water stay at the top opening as shown in figure 1. As flood occurs it rises the water level in reservoir and in such condition when the top surface of water get freezes; the shaft spillway is very helpfull in water discharge towards the downstream as shown in figure 2.

To sumup, Shaft spillway is best approuch for water discharge from the reservoir in freezing as well as in flood conditions.



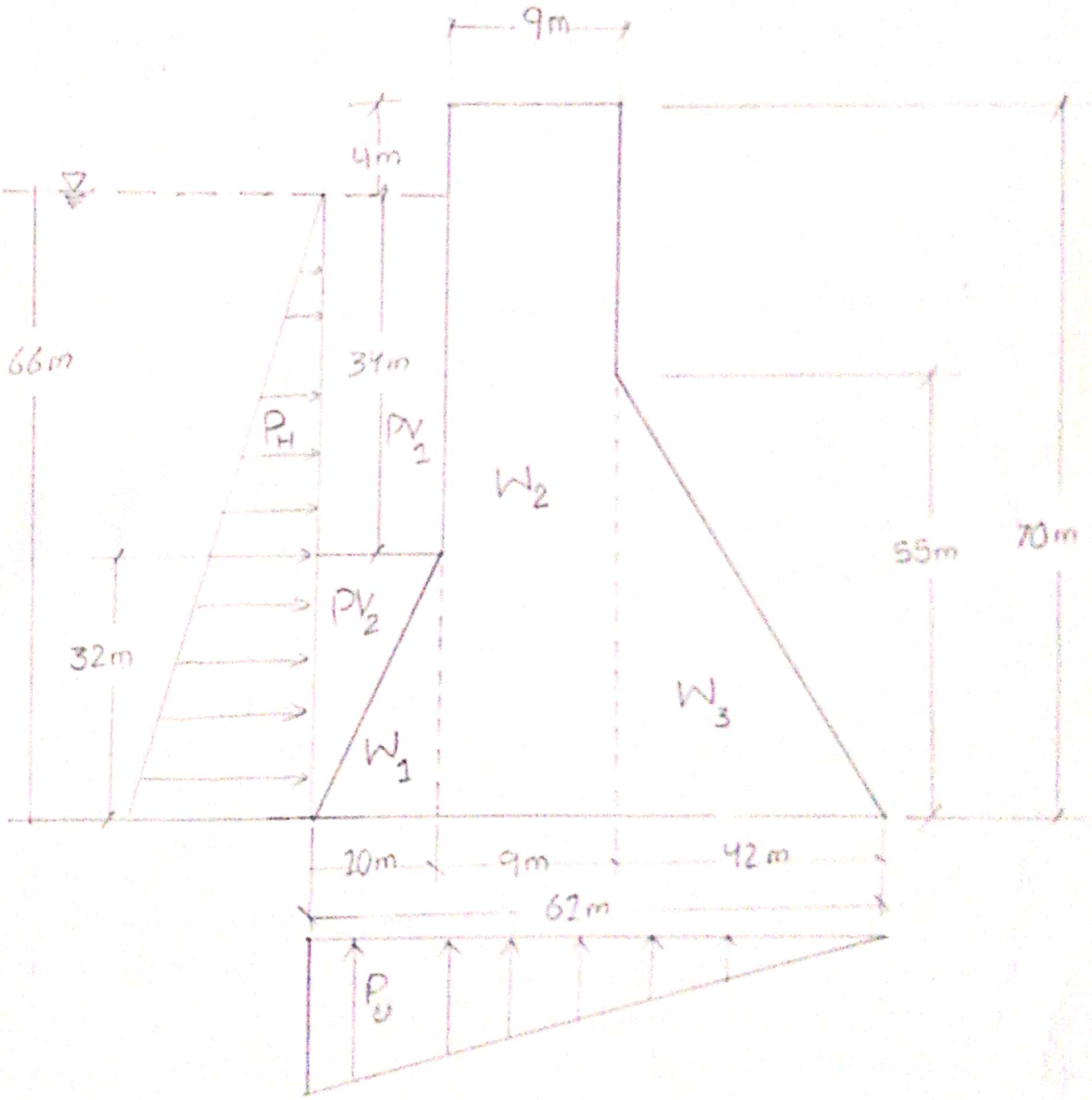
Shaft Spillway (Normal Condition) Figure 1

Shaft Spillway (Flood Condition) Figure 2



QNO3:

Solution:



Assume:

Unit weight for Concrete = 24 KN/m^3

Unit weight for water = 10 KN/m^3

Forceel and Moment Calculations

Forces	Forceel Formula	F_V (KN)	F_H (KN)	Levex Arm (m)	M_r	M_o
W_1	$\frac{1}{2} \times L \times W \times \gamma_d$	3840		54.33	208640	
W_2	$L \times W \times \gamma_d$	15120		46.50	703080	
W_3	$\frac{1}{2} \times L \times W \times \gamma_d$	27720		28.00	776160	
PV_1	$\frac{1}{2} \times L \times W \times \gamma_w$	1600		57.67	92266.67	
PV_2	$+\frac{1}{2} \times L \times W \times \gamma_w$	3400		56.00	190400.0	
P_U	$-\frac{1}{2} \times L \times W \times \gamma_w$	-20130		40.67		818620
P_h	$-\frac{1}{2} \times L \times W \times \gamma_w$		-21780	22.00		479160
	Σ	31550	-21780	Σ	1970546	1297780

• For factor of Safety against Tension:

Conclition $\rightarrow e < B/6$

$$\frac{B}{6} = \frac{61}{6} = 10.17\ m$$

Eccentricity of the Resultant force;

$$e = \left(\frac{B}{2}\right) - \bar{X} \longrightarrow (1)$$

$\bar{X}$: Location of Resultant force from Toe.

$$\bar{X} = \frac{\Sigma M_r - \Sigma M_o}{\Sigma F_v}$$

$$\bar{X} = \frac{1970546.7 - 1297780}{31550}$$

$$\bar{X} = 21.23$$

So;

eq(1) =>

$$e = \left(\frac{61}{2}\right) - 21.23$$

$$e = 9.28\ m$$

$e < B/6$

Conclition => Safe in Tension (OK)

• For factor of Safety against Stress:

Condition => $\gamma_{heel} > 0$

$$\gamma = \left(\frac{\Sigma F_v}{B}\right)\left(1 \pm \frac{6e}{B}\right)$$

For γ_{Toe};

$$\gamma_{Toe} = \left(\frac{\Sigma F_v}{B}\right)\left(1 + \frac{6e}{B}\right)$$

$$\gamma_{Toe} = \left(\frac{31550}{61}\right)\left(1 + \frac{6 \times 9.18}{61}\right)$$

$$\gamma_{Toe} = 984.0365 \ KN/m^3$$

For γ_{heel};

$$\gamma_{heel} = \left(\frac{\Sigma F_v}{B}\right)\left(1 - \frac{6e}{B}\right)$$

$$\gamma_{heel} = \left(\frac{31550}{61}\right)\left(1 - \frac{6 \times 9.18}{61}\right)$$

$$\gamma_{heel} = 50.39 \ KN/m^3 > 0$$

Condition => Safe in stress (OK)

- For factor of Safety Against Overturning:

Condition => $\Sigma M_r / \Sigma M_o > 2$

$$\frac{\Sigma M_r}{\Sigma M_o} = \frac{1970546.7}{1297780}$$

$$\frac{\Sigma M_r}{\Sigma M_o} = 1.52 \not> 2$$

Condition => Not Safe in Overturning (NOT OK)

- $\Sigma M_r > \Sigma M_o$

$\Sigma M_r = 1970546.7$

$\Sigma M_o = 1297780$

$\Sigma M_r > \Sigma M_o$

Condition => Safe (OK)

- For factor of Safety against Sliding:

Condition => $\frac{\mu \Sigma F_V + Bq}{\Sigma F_H} > 1$

Here;

$q = 1400$

$\mu = 0.7$ (0.65 to 0.75)

$$\frac{\mu \Sigma F_V + Bq}{\Sigma F_H} = \frac{0.7 \times 31550 + 61 \times 1400}{21780}$$

$$= 4.94 > 1$$

Condition => Safe in Sliding (OK)